South Fork Kent Creek Watershed

Watershed Plan

This report was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

Olson Ecological Solutions: 2221 Hammond Drive, Schaumburg, IL 60173 t) 815.985.2689 rebecca@olsonecosolutions.com

Section 2
Acknowledgements

The South Fork Kent Creek Watershed Plan was initiated by efforts of the Rockford Park District (RPD). RPD has been working to maintain and improve the recreational water quality of Levings Lake for many years. In 2016, they enlisted Olson Ecological Solutions (OES), and JadEco Natural Resource Consultation and Management to create a report, entitled *A Cleaner Levings Lake: Putting Nature to Work*, identifying water quality issues and solutions to improve Levings Lake water quality (OES, 2017). RPD has implemented the following recommendations from this report: 20 BioHaven® floating islands, vegetated filter strips, a 0.64-acre constructed stormwater wetland, and native plantings.

A scope limitation acknowledged in this report is that projects for water quality improvement could only be made on Rockford Park District owned property. For a more sustainable and comprehensive solution, RPD needed to consider the entire watershed, especially areas upstream of the lake. With this in mind, RPD decided to move forward with developing a more comprehensive watershed wide plan.

RPD applied for and received funding from the Illinois Environmental Protection Agency through the Section 319 Nonpoint Source Pollution Control Financial Assistance Program. This program provides financial assistance for projects that prevent, eliminate, or reduce water quality impairments caused by nonpoint source pollution. The Park District has hired Olson Ecological Solutions to facilitate the project and prepare the plan.

Consulting, compiling, and writing of this report was conducted by Olson Ecological Solutions with contributions from Tallgrass Restoration. The following consultants were instrumental in compiling this watershed plan:

Written and Edited by: Alyssa Robinson and Rebecca Olson, Olson Ecological Solutions
Maps by: Kristin Adams, Tallgrass Restoration
Modeling by: Kristin Adams, Tallgrass Restoration, and Rebecca Olson
Rockford Park District Contact and Support: Tom Lind, Rockford Park District
Rockford Park District Grant Administration: Jean Olivencia, Rockford Park District
Stakeholder Development: Alyssa Robinson, Rebecca Olson, and Tom Lind
Site-Specific Project Development: Alyssa Robinson; Rebecca Olson; Tom Lind; Sean Von Bergen, Winnebago County Highway Department; Tom Okite, Chastain Engineers; and Joni Denker, Rockford Park District

Stakeholders are those who live, work, and play in the watershed. They have first-hand experience with the concerns and opportunities for improvement. The following stakeholders provided participation and feedback that was vital in the creation of this plan:

Charles Abramson
Diane Abramson
Shane Anderson
Christopher Baer
Dennis Bragelman
Curtis Countryman
Kathleen Countryman
Guy Cunningham
Richard Ellena
Dave Gonitzke
Joanne Gonitzke
Leonard Humpal
Dan Jarrett
Tina Johnson
Lou Ann Johnson
Harlan Johnson
Darryl Jones
Russ Kaney
Dustin Kapp
Heather Kapp
WM Kindrachuk
Karen Leick
Michael Leick
Joyce Lillie
John Lillie
Todd Marshall
Matt Martin
Robert Martin
John Martin
John Mershon
Roger Peters
Tony Redmond
Dawn Redmond
Dick Rundall
Randy Schultz
Mark Smith
Scott Suma
Jeffrey Vettore
Kimberly Vettore

Technical Advisors are local experts and professionals in the fields of agriculture, natural resources, water quality, engineering, and planning. Technical advisors analyzed natural resources and stakeholder concerns to help make recommendations about potential causes of water quality impairments and prospective solutions. The following technical advisors provided their volunteered time and technical expertise that was vital in the creation of this plan:

Sean Von Bergen, *Engineer,* Winnebago County Highway Department
Ann Marie Cain, *Manager,* Winnebago-Boone Farm Bureau
Dennis Anthony, *Executive Director*, Winnebago County Soil and Water Conservation District
Katie Walsh, *Resource Conservationist*, Winnebago County Soil and Water Conservation District
Josh Franks, *District Conservationist,* Natural Resources and Conservation Service
Larry McFall, *Plant Operations Manager,* Rock River Water Reclamation District
Allen Mills, *Land Use Planner*, Region 1 Planning Council
Kaylin Janicke, *Project Assistant,* Region 1 Planning Council
Brad Holcomb, *Stormwater Manager*, City of Rockford
Mike Groves, *Natural Resource Manager,* Forest Preserves of Winnebago County

Anytime all three parties of contributors, e.g. consultants, stakeholders, and technical advisors, worked together or provided input for the creation of this plan, the group effort of all parties is henceforth referred to as “the group”.

Section 2

Table of Contents Page

Figures Page

Chapter 7

Tables Page

Introduction

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

Chapter 7

Section 2
Introduction

Section 1 of this document details the Watershed Resource Inventory. This section, Section 2, details the Watershed Plan. Creating a watershed-based plan is an important first step in improving water quality in South Fork Kent Creek Watershed. Clean water has positive impacts on the local economy, property values, and recreational opportunities. Moreover, it preserves the local heritage for future generations. Watershed-based plans are valuable tools because they identify the most probable causes and sources of water quality impairments and develop a course of action to address the impairments.

What is a Watershed?

A watershed is a geologic area within the boundary of a drainage divide. In the image below, everything within the black dotted line represents that particular watershed. As seen in the image, precipitation that falls within the watershed boundary eventually drains to the same stream, lake, or river. Any precipitation that falls outside of this watershed boundary drains to a different area. Precipitation usually comes in the form of rain, sleet or snow that drops on or flows over the land as snowmelt, surface runoff, tributaries, and groundwater. The water quality within a watershed is a reflection of the land use and land management within the watershed. In other words, precipitation picks up nutrients, sediment, and other pollutants from the ground as it travels over the land and deposits them into the stream, lake, or river. The different ways that local stakeholders use the land contributes varying amounts of these pollutants, which can positively or negatively affect the water quality, with the greatest impact to those downstream.

The black dotted line represents the watershed divide in this illustration. All precipitation that falls within the watershed divide eventually runs to the same stream.

What is a Watershed-Based Plan?

The South Fork Kent Creek watershed-based plan contains the nine minimum elements consistent with the United States Environmental Protection Agency (USEPA) watershed-based plan guidance.

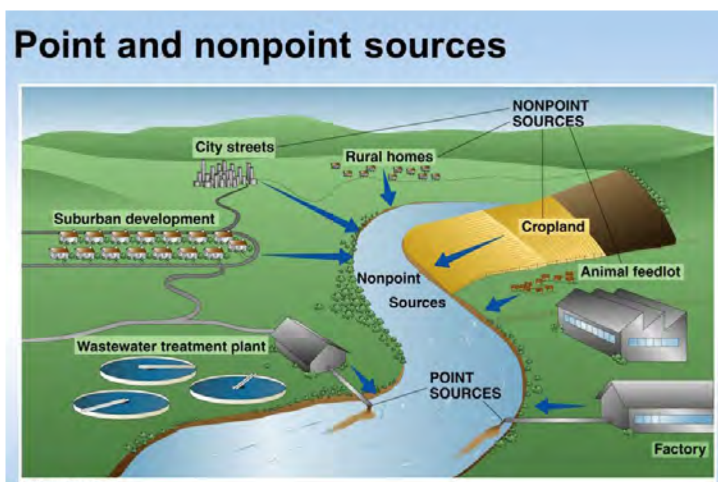
EPA's 9 Minimum Elements of a Watershed-Based Plan:

1. Identify causes and sources of pollution.
2. Estimate expected load reductions.
3. Detail management measures and targeted critical areas.
4. Estimate needed technical and financial assistance.
5. Create an information and education component.
6. Develop a project schedule.
7. Describe interim, measurable milestones.
8. Identify indicators to measure progress.
9. Develop a monitoring component (USEPA Introduction to Watershed Planning).

This plan addresses surface water quality impairments by identifying causes and sources of pollution, crafting a problem statement and vision, setting target pollution reductions, creating goals and measurable objectives, involving stakeholder participation, detailing management measures by recommending best management practices to improve water quality in the watershed, estimating the pollutant load reductions once recommended practices are implemented, targeting critical areas, creating a landowner engagement component, identifying local technical and financial assistance opportunities, and establishing a schedule and monitoring strategy for measuring progress during plan implementation.

Purpose and Funding

The Rockford Park District (RPD) initiated the watershed planning process with their desire to improve water quality. They requested planning assistance and facilitation from Olson Ecological Solutions (OES). The Illinois Environmental Protection Agency (Illinois EPA) provided partial funding through Section 319 of the Clean Water Act. RPD provided the remainder of the funding and administered the grant.



(Pearson Education. 2011)

The objective of the EPA Section 319 program is to manage nonpoint source pollution. Nonpoint source pollution develops as rainfall or snowmelt flows over land, picks up natural and man-made pollutants, and carries them to surface water. The image to the right depicts the difference between nonpoint and point source pollution. Nonpoint source pollution comes from runoff from city streets, suburban development, rural homes, cropland, and animal feedlots, to name a few. It is difficult to pinpoint where nonpoint source pollution comes from because it is a combination of runoff from all the land uses within a watershed. Point source pollution has a definitive source, such as pipes or discharge from industrial factories or wastewater treatment plants. Point source pollution is heavily regulated by the EPA.

Through the EPA Section 319 program, EPA provides funding to communities with waterways impaired by nonpoint source pollution to aid in creating solutions and improving water quality in and downstream of that community. Nationally, USEPA has funded $165.4 million in voluntary projects and programs through Section 319 grants to reduce nonpoint source pollution from entering our streams and lakes in the year 2019 alone. This number is somewhat typical for the average national annual funding (USEPA 2020). The Illinois EPA estimates that approximately $3.5 million in grant dollars are available to fund projects through the Section 319 program in Illinois on an average year (Illinois EPA, FAQs). Funds are intended for watershed planning and implementation of projects and programs focused on best management practices that improve water quality and address nonpoint source pollution. The South Fork Kent Creek Watershed Plan and future implementation of the plan will be strictly voluntary and appropriate for grant funding assistance; this is not a regulatory program.

Scope

Geography Scope

The South Fork Kent Creek Watershed is approximately 7,400 acres near the western edge of Winnebago County, Illinois, between the Village of Winnebago and the City of Rockford and west of the Rock River. Levings Lake is at the bottom (southwest portion) of the watershed. Section 1 of this document describes natural resources and characteristics of the watershed.

Content Scope

The South Fork Kent Creek Watershed Plan proposes how to prevent nonpoint source pollution from entering local streams and lakes. It is formed with information from an inventory of the watershed, stakeholder involvement through participation in planning, and guidance from technical advisers and consultants. In the following pages, the plan provides a vision statement, goals, pollutant reduction targets, proposed projects and programs plus education and outreach efforts needed to reach goals, schedules and priorities for projects and education, cost estimates and guidance for financial and technical support, and a monitoring strategy to evaluate the success of the plan. The plan is broad in scope and conceptual in nature, appropriate for watershed-scale planning. Detail may be added to specific projects and programs as they are more fully developed during plan implementation.

Scope Limitations

This plan does not address retroactive measures to remove pollutants from waterbodies or flood mitigation. Retroactive measures include dredging of sediment and mechanical removal of algae. Although these activities are useful where applicable, they do not prevent pollution from entering streams, ponds, and lakes. Therefore, they are not within the interests of this watershed plan, nor would they be likely candidates for financial and technical assistance by environmental organizations.

Flooding is a major concern for the stakeholders in the watershed. Many residents who have lived in the area for over 20 years have never experienced so much flooding as they have in more recent years. For some stakeholders, flooding is one of the biggest reasons they initially became involved in the watershed planning effort. Because flooding is a major concern for stakeholders, it is important to acknowledge that flood mitigation is not within the scope of this plan. For instance, this plan does not study water volume, velocity, flood storage capacity, or any other aspects related to flood mitigation. However, there is a link between water quality and flooding issues and some of the recommendations in this plan will mitigate flooding while addressing water quality. A 2009 publication from the New York Department of Environmental Conservation and New York Federation of Lake Associations further depicts the link between nonpoint source pollution and flooding:

> "Increased volume and intensity of stormwater contributes to an increase in the magnitude and frequency of floods, increased erosion and degraded stream and lake systems. Equally important, however, are the large quantities of contaminants which are transported along the way, including suspended sediments and attached or dissolved nutrients such as phosphorus, trace metals, petroleum hydrocarbons and deicers from roadways" (p. 229).

The land surfaces in a watershed intercept rainfall and other forms of precipitation. When these land surfaces are permeable (e.g. planting bed, gravel, permeable pavers), precipitation can infiltrate into the ground. When these surfaces are impermeable (e.g. roadways, sidewalks, parking lots, buildings), precipitation travels across surfaces as runoff. The image to the right depicts how stormwater runoff increases as areas are urbanized, i.e. when areas have more impermeable surfaces. Increased stormwater runoff not only degrades water quality of surface water, but also increases the likelihood of flooding. Therefore, flooding and water quality are linked. Recommendations for practices and projects in this plan target water quality improvement; however, many practices have more than one benefit and can potentially address flood mitigation as well.

(FEMA, 2005)

Planning

The watershed planning process involves the compilation of natural resource data throughout the watershed, including inventory of streams, wetlands, forest, waterbodies, land uses, and more. The Natural Resource Inventory can be found on the Rockford Park District Levings Lake webpage: https://rockfordparkdistrict.org/levings-park. OES will utilize the Inventory as well as knowledge from local technical experts and input and participation from local stakeholders to create a watershed-based plan that satisfies the nine requirements of a watershed plan set forth by the US Environmental Protection Agency.

OES facilitated the watershed planning process, assembled the inventory of the watershed's existing conditions, provided the stakeholder participants with factual information on which to base decisions, and wrote the watershed plan according to decisions and direction of the stakeholders and technical advisory panel. The planning effort was facilitated by Rebecca Olson and Alyssa Robinson of OES. Tom Lind of the RPD provided support and resources from the RPD.

Planning participants were made up of interested stakeholders who live, work, play, and control the land management in the watershed. Letters, emails, newsletters, posters, advertisements around the watershed, and the RPD website invited stakeholders to participate in meetings. The community came together six times between July 2019 and March 2020, after which time participation continued through email and phone calls due to gathering restrictions associated with the Covid-19 pandemic. Meeting minutes are posted on RPD website at https://rockfordparkdistrict.org/levings-park. At these meetings, stakeholders determined the vision and direction of the watershed and provided input for all aspects of the watershed plan. Stakeholders who participated in these meetings are listed in the Acknowledgments section of this plan.

A technical advisory panel consisted of local experts in natural resources, water management, and agriculture. They provided expert review of the plan and recommendations. The technical advisors came together four times between May 2019 and March 2020 and were encouraged to also attend and participate in stakeholder meetings. Technical advisors provided constructive feedback for drafts of the Natural Resource Inventory and Watershed Plan. They are listed in the Acknowledgments section of this plan.

Table i.1 lists the past and future planning meetings along with an agenda of each meeting. Completed meetings are shaded in grey, whereas future meetings are shaded in blue. A stakeholder meeting scheduled for March 31, 2020 was canceled due to Covid-19 restrictions and is shaded in pink.

Table i.1 Schedule of Planning Meetings

Date	Agenda
May 28, 2019	Technical Advisory Meeting: Gather local knowledge and information.
Jul 11, 2019	Stakeholder Meeting: Provide overview of watershed-based plan and process. Determine stakeholder concerns.
Aug 28, 2019	Stakeholder Meeting: Create preliminary vision statement and determine stakeholder concerns.
Oct 16, 2019	Stakeholder Meeting: Set preliminary goals and determine stakeholder concerns.
Dec 12, 2019	Stakeholder Meeting: Review and confirm vision statement and goals. Review Draft of Natural Resource Inventory and present BMP opportunities for rural and residential areas.
Dec 2019	Technical Advisory Meeting: Review and provide feedback for the Natural Resource Inventory.
Jan 30, 2020	Stakeholder Meeting: Consider pollutant reduction targets and watershed-wide best management projects. Create objectives for each goal.
Feb 18, 2020	Technical Advisory Meeting: Review progress of plan, including vision, goals, and proposed pollutant reduction targets. Decide upon priority BMPs, education topics, and the process of creating objectives.

Feb 27, 2020	Stakeholder Meeting: Choose rural and residential education/outreach opportunities.
Mar 11, 2020	Technical Advisory Meeting: Review BMP cost estimates, BMP cost to benefit ratio, and proposed objectives.
~~Mar 31, 2020~~ **Canceled due to Covid-19**	Stakeholder Meeting: Determine monitoring/evaluation strategies for watershed plan.
Apr 8, 2020	Remote Technical Advisor Involvement: Review watershed plan progress and provide input for updated pollutant reduction targets, objectives, and implementation schedule.
July 2020	Remote Stakeholder Involvement: Review watershed plan draft and provide input.
Fall 2020 & Beyond	The Region 1 Planning Council (RPC) maintains an Environmental Planning Committee (EPC) that meets bi-monthly. The RPC may coordinate with or delegate to stakeholders and other interested organizations in tracking, evaluating, and enacting these implementation efforts. Participation in this implementation effort through the RPC is strictly voluntary; this is not mandatory or regulatory in nature.

Watershed planning efforts offered stakeholders and technical advisors the opportunity to be proactive in improving water quality on a voluntary basis. The following plan is a result of this community effort to care for South Fork Kent Creek, Levings Lake, and other natural resources throughout the watershed. As part of the ongoing planning process, the Region 1 Planning Council (RPC) may coordinate with partners to further the implementation of this plan; however, this coordination is strictly voluntary. Some examples of the RPC's involvement may include facilitating coordination with agency partners and landowners within the watershed, especially those within identified priority areas; facilitating land conservation efforts; and the implementation of best management conservation practices. However, this process is dependent on funding assistance, voluntary involvement from stakeholder and landowners, and other factors.

Section 2, Chapter 1
Concerns, Vision, and Goals

Introduction
Chapter 1 details the process of stakeholders and technical advisors identifying their concerns for the watershed, creating goals and a vision for the watershed, establishing pollutant reduction targets and tangible objectives for reaching stated goals, and prioritizing areas in which to implement best management practices to achieve maximum benefit. The following chapters in Section 2 provide guidance for meeting these goals and objectives.

Enjoyments and Concerns
Stakeholder and technical advisory meetings gave local participants a chance to come together to share their enjoyments and concerns and consider how they could collaborate toward solutions to common issues. At any given stakeholder meeting, participants ranged from agricultural producers, residents, industrial and commercial representatives, and technical advisors. Producers and homeowners had a similar list of enjoyments within the watershed, including walking and biking the Pecatonica Prairie Path trail, fishing, clear water, presence of wildlife, forested land, wildflowers, and agriculture. The stakeholders also acknowledged the economic value of industry, particularly to Rockford, and the value of agricultural production. They wanted to protect these enjoyments and values while protecting Levings Lake and addressing concerns for the watershed.

The stakeholders recognized that Levings Lake is a great part of the county and hoped that the lake would be improved and highlighted as a positive amenity for current and future generations. They valued water clarity, recreational value, and the overall health of the lake. Prior to this plan, consultants, the Rockford Park District, and West Rock Wake Park also recognized the importance of good water quality in the lake and have been working toward improvement. In recent years, they have focused on implementing best management practices within Levings Park and the lake itself with help from the Perks Family Foundation and Patagonia. This interest in improving the lake's water quality led to the formation of this watershed plan, recognizing the connection between a healthy watershed and a high-quality lake.

Stakeholders expressed concerns for the watershed as well. The biggest concern that was touched upon at multiple meetings was the seemingly increased volume of water and the watershed's inability to slow runoff down, which results in erosion, flooding, and sedimentation. Other major concerns were future land use development and changes, grassed waterways not being wide enough to handle increased rainfall, litter and debris blockages along the stream especially along Cunningham Road, illegal dumping on private land especially in woodlands, and faulty septic systems. Beavers and beaver dams also came up as concerns since some areas have a lot; however, meeting attendees now understand that the beavers help with water quality by detaining water and slowing velocity during storm surges.

Another main concern for the watershed is the presence of elevated fecal coliform levels. South Fork Kent Creek is listed by the Illinois EPA as a 303d impaired stream caused by fecal coliform from unknown sources (Illinois EPA, et al., Resource Management Mapping Service). The South Fork Kent Creek does not support primary contact (Illinois EPA, 2018 Appendix B-2). Primary contact activities, like swimming, involve submersion of the body. This is different than secondary contact activities, like canoeing, sailing, or fishing, when only arms and legs are in contact with the water. Since fecal coliform is listed as the reason South

Fork Kent Creek is considered impaired for primary contact by the EPA, the group recognized the significance of identifying where the fecal coliform is coming from.
Potential sources of fecal coliform include crop fields utilizing sludge application, livestock, geese, other concentrations of wildlife, faulty septic systems, and wastewater treatment plants. Within this watershed, consultants found the first two potential sources to be unlikely contributors of fecal coliform. The Inventory identified no croplands utilizing sludge application and no stockyards with a concentrated pollutant load to nearby waterways. The only presence of livestock was on 37 acres of small pastures scattered throughout the watershed. The Inventory process identified congregations of geese and faulty septic systems to be the most likely sources of the problem and did not rule out wastewater treatment as a potential source.

Geese and other concentrated populations of wildlife likely exist in open water areas scattered throughout the watershed as residential ponds and Levings Lake. Implementing best management practices downstream of the open water could be effective and are discussed in later chapters of this plan, including wetland restoration or enhancement and vegetated swales and treatment areas normally designed for manure digestion.

Faulty septic systems could also cause elevated fecal coliform levels. The USEPA recognizes that septic systems that are poorly designed, installed, or maintained can result in water contamination by disease-causing pathogens and nitrates (USEPA, Septic Systems). The exact number of households in the watershed serviced by septic systems is unknown. OES reached out to the Winnebago County Health Department to retrieve access to records of faulty septic systems in the watershed; however, the Health Department did not have an easily accessible database or completely updated records. Instead OES infers that any residential neighborhoods that do not connect to the local sewer line are most likely serviced by septic systems. Given this inference, approximately 488.3 acres of residential land are serviced by septic systems. Stakeholders are concerned that septic systems in these residential neighborhoods are not maintained properly. Some stakeholders who live in these neighborhoods acknowledge that they have not seen homeowners take measures to empty their septic fields. Outreach and community involvement promoting proper septic system maintenance could lead to voluntary compliance with best management of septic systems, as discussed in later chapters of this plan.

Another potential source of fecal coliform is wastewater treatment plants via illegal or leaky sewer line connections or poorly functioning wastewater treatment plant effluent. The Rock River Water Reclamation District (RRWRD) is the only wastewater treatment plant in the watershed. It is headquartered at 3501 Kishwaukee Street, in Rockford, IL, which is outside the watershed boundary southeast of Rockford. The RRWRD has a pumping station located southeast of the intersection of Cunningham Road and Centerville Road. They have installed sewer lines scattered throughout the watershed following the main stem of the creek and throughout some of the residential neighborhoods. The probability of sewer line failure greatly varies depending on different factors including but not limited to pipe material, pipe wall thickness, installation date, structural soundness, tree roots, and rust. Any recently installed RRWRD sewer lines are made of PVC (polyvinyl chloride) pipe. In the last 35 to 40 years, no VCP (vitrified clay pipe) has been installed (RRWRD, 2020). According to the Michigan Water Environment Association, a vitrified clay pipe (VCP) installed in 1930 has an average lifespan of 90 years (Anderson and Hyer). Plastic or PVC piping is the preferred piping in most new construction as of the 1980s because they do not corrode, do not leak water as long as there are good connections, and can last virtually a lifetime (Clark and Thurnau, 2011). The probability of a pipeline break increases as the age of the pipe increases. On the other hand, the probability of a break decreases as the pipe diameter increases. The RRWRD installed sewer lines in phases over the last 35 years. The gravity sewer line ranges in small and large diameter with the largest diameter being 6 feet. Residential neighborhoods contain lateral sewer lines ranging from eight to ten-inch diameter pipes.

The RRWRD cleans sanitary sewer lateral lines and trunk lines on a routine basis and in the event of a back-up. RRWRD maintains the sewer mains that run along the streets. Individual property owners are responsible for cleaning and maintaining the lines running from houses to the sewer mains, and they are responsible for damage to these sewer lines caused by blockages. RRWRD is responsible for issues in its main sewer lines only when the issue is due to the District's negligence (RRWRD, 2020). For more information about how to prevent sewer lines back-ups and other household tips regarding sewer lines, please visit the RRWRD website at http://www.rrwrd.dst.il.us/. For more information about the spatial location and amount of sewer lines through the watershed, please see Part 3 of the South Fork Kent Creek Watershed Resource Inventory.

Stakeholders were also concerned about overall water quality of the streams and waterbodies. Beyond bacteria levels (e.g. elevated levels of fecal coliform), the project team and stakeholders focused on four other pollutants that lower water quality: nitrogen, phosphorus, total suspended solids (TSS), and sediment. Nitrogen and phosphorus naturally occur as nutrients in aquatic systems; however, all human activities, such as commercial, industrial, residential, and agricultural, have greatly increased the amounts that occur. Too much of these nutrients causes significant jumps in algae growth, which negatively impacts water quality, reduces or eliminates oxygen within the water, harms food resources, degrades aquatic habitats, and can eventually cause algal blooms. Some algal blooms produce toxins and promote bacteria growth, which can harm humans who encounter the water (USEPA, Nutrient Pollution). Sediment and other total suspended solids in the water not only bring excess phosphorous and potentially harmful bacteria into waterways, but they also block sunlight for photosynthesis, clog fish gills, clog drainage pipes and ditches, reduce flood storage capacity, and accumulate in calm waters like lakes and ponds decreasing depth and storing nutrients. When this silty bottom is disturbed by fish, boats, swimmers, or other movement, the nutrients and sediment are released back into the water, becoming a significant contributor to water quality problems. Best management practices and programs discussed throughout this plan aim to improve these conditions. For a watershed experiencing a lot of flooding, flood storage is a capacity that should be increased through smart implementation of best management practices that store and filter water.

Considering these concerns, the stakeholders and consultants brainstormed practices that could improve the quality of the lake, ponds, and streams. They considered slowing water runoff rate; installing areas for runoff to be stored to reduce flooding and settle out and filter pollutants; and lining streambanks, shorelines, and roadways with vegetated filter strips. Other ideas for improvement included installing native plants, creating aeration in the lakes, improving grassed waterways, considering best management practice implementation within sensitive areas like highly erodible land (HEL) and frequently flooded soils, septic system maintenance education, and working with policy makers to protect current and future water quality.

Problem Statement

Overall, the watershed's biggest concerns, discussed in depth above, include erosion, sedimentation, flooding, future land use development, protection of wildlife and agricultural land, nonpoint source pollution degrading the quality of waterbodies, and elevated levels of fecal coliform. The creation of this watershed plan is a step towards addressing these concerns. A vision statement and specific goals will help guide the stakeholders in addressing these concerns and aid in measuring success.

Vision

Stakeholders envision a watershed that preserves water quality and the watershed's natural resources for future generations, safeguards the recreational value of Levings Lake and other waterways/natural areas, considers the value of wildlife and their habitat, works to reduce levels of fecal coliform, and protects the agricultural land use within the watershed. Stakeholders worked together to combine their individual visions to form one united vision for the watershed. The resulting vision statement captures these desires:

We envision improving the water quality in South Fork Kent Creek Watershed by reducing and preventing nonpoint source pollution in order to preserve and enhance the natural beauty, wildlife habitat, recreational attractions, and agricultural use of this natural resource for future generations to come.

Goals

After stakeholders created the vision statement, they brainstormed specific goals for the watershed that could lead to the fulfillment of the vision statement. They wanted to address the volume and velocity of water in the watershed that not only causes flooding issues but also erodes streambanks and carries the

The resulting eight goals captured the most important elements needed to achieve the vision:

1. **Decrease contaminants in the water, including fecal coliform bacteria.**
2. **Minimize erosion, sediment, and nutrient loading into surface waters.**
3. **Address water volume and velocity to improve water quality and prevent flooding.**
4. **Protect, enhance, and manage wildlife habitat.**
5. **Sustain and enhance the recreational opportunities of the watershed.**
6. **Educate the community about water quality and this plan.**
7. **Work with governing and policy-making bodies to protect water quality currently and in future land use planning.**
8. **Preserve prime farmland during future land use changes.**

resulting sediment into waterways. They saw the need to minimize erosion and sedimentation and to reduce the amount of pollutants, especially fecal coliform, entering surface waters. They acknowledged the importance of educating the community about water quality issues and the creation of this plan. Along with educating the community, they also saw the value in coordinating with local governing bodies to develop policy that protects water quality and considers water quality in future land use planning, specifically considering the projected land use changes in the *2030 Land Resource Management Plan* and how they will affect water quality. They also wanted to protect the recreational values, agricultural land, and wildlife in the watershed. These overarching goals encompass the concerns for the watershed, facilitate enhancement of South Fork Kent Creek water quality, and compliment the goals of the Illinois Nutrient Loss Reduction Strategy.

Pollutant Reduction Targets

Beyond establishing a vision and goals for the South Fork Kent Creek Watershed, stakeholders, technical advisors, and consultants also selected specific pollutant reduction targets for nitrogen, phosphorous, total suspended solids, sediment, and bacteria. By selecting pollutant reduction targets, OES could recommend correlating best management practices. When applicable, these targets are congruent with the Illinois Nutrient Loss Reduction Strategy (Illinois NLRS) and Illinois Environmental Protection Agency General Use Water Quality Standards (IEPA, 2018).

This plan identifies pollutant reduction targets specific to nutrients (phosphorous and nitrogen), total suspended solids, sediment, and bacteria as described below.

Nutrient Load Reduction Targets

Although nitrogen and phosphorous are essential components of the aquatic food web, humans have greatly increased the amount of nitrogen and phosphorous input into water systems through development, agriculture, and lawn care. Excess nitrogen and phosphorous cause depletions of oxygen in freshwater sources which can eventually lead to dead zones. In fresh waters and in the right conditions, even a miniscule jump in phosphorous can cause a negative ripple effect on many other factors, including algae blooms, decreased levels in dissolved oxygen, and the death of certain fish, invertebrates, and other aquatic animals (USEPA, 2012). Surplus sources of nitrogen and phosphorus can come from agricultural sources (e.g. fertilizer and livestock waste) and urban sources (e.g. lawn fertilizer, pet waste, sewage and wastewater treatment plants). Limiting nitrogen and phosphorus from reaching waterways will improve the overall health of the streams and waterbodies. To

NUTRIENT LOSS
REDUCTION STRATEGY
Improving our water resources with

The Illinois Nutrient Loss Reduction Strategy calls on Illinois to address the concerns associated with algal blooms and other negative water quality issues resulting from excess nutrients within the Mississippi River Basin, of which Illinois is a part.

Illinois is one of 12 states in the Mississippi River Basin included in the U.S. EPA's 2008 Gulf Hypoxia Action Plan. This plan calls on the 12 states to develop a strategy to reduce the amount of nitrogen and phosphorus carried to the Gulf of Mexico. Excess nutrients from these states have led to an aquatic life "dead zone" that stretches for thousands of miles. The goals of the Gulf Hypoxia Action Plan are to reduce the amount of total phosphorus and nitrogen by 45%, reduce nutrient loading to the Gulf of Mexico, and reduce the Gulf of Mexico hypoxic zone to 1,930 square miles. Illinois is one of the primary contributors of nitrogen and phosphorous to the Gulf of Mexico by contributing a 10-17% share (see *Figure 1.1)*.

determine watershed-wide targets for nitrogen and phosphorus reduction, consultants referenced the Illinois NLRS (see side tabs on pages 1-7 and 1-8 for more information about the Illinois NLRS).

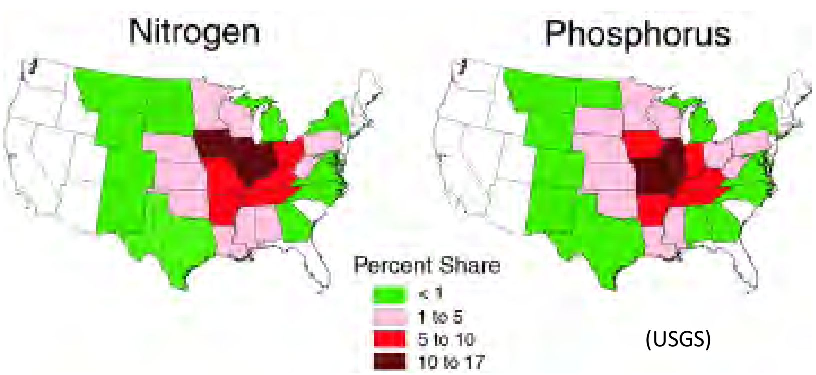
Nitrogen Reduction Targets

To determine targets for nitrogen reduction for streams and waterbodies in the watershed, consultants referenced the Illinois NLRS. The Illinois NLRS set an interim 10-year standard to reduce total nitrogen loads by 15%. Since this watershed plan addresses the next five years, consultants and stakeholders agreed to cut the NLRS 10-year nitrogen reduction standard of 15% in half to reflect a 5-year nitrogen reduction target of 7.5% for the watershed, or 3,730 pounds per year.

Phosphorus Reduction Targets

Similar to nitrogen, consultants and stakeholders adopted to reduce total phosphorus by 12.5%, which is half of the interim phosphorus reduction target of the Illinois NLRS. This reduction target represents what can reasonably be expected by this community's effort within the next five years and equals 1,321 pounds per year.

Figure 1.1 State Percentage Share of Nitrogen and Phosphorous Contribution to Gulf of Mexico



(USGS)

Total Suspended Solids and Sediment Reduction Targets

Sedimentation and total suspended solids (TSS) are impairments to the watershed. TSS are any type of sediment or material suspended in stormwater runoff such as gravel, sand, silt, clay, or even algae and grass clippings. Sediment can become suspended in water, but it sloughs off at the source from erosion directly into stream and lakes rather than being suspended in runoff. These materials can block sunlight for photosynthesis, clog fish gills, reduce flood storage capacity, fluctuate water temperatures, and clog drainage pipes and ditches, all of which negatively impact aquatic life and water quality (Murphy 2007). In addition, harmful bacteria and excess nutrients attach themselves to the sediment accumulated in water. One goal of

ILLINOIS NUTRIENT LOSS REDUCTION STRATEGY
Improving our water resources with collaboration and innovation

The NLRS outlines best management practices to reduce nutrient losses from point sources, urban stormwater, and agricultural nonpoint sources. It uses scientific assessments to target the most critical watersheds and to build upon existing state and industry programs. The goal is to reduce the amount of total phosphorus and nitrate-nitrogen reaching Illinois waters by 45% while also considering land uses and cost-efficiency.

A NLRS Report was adopted and publicly released on July 21, 2015, and **established 2025 interim milestone goals of reducing phosphorous loads by 25% and nitrogen loads by 15%.** The 2015-2017 Biennial Report documents NLRS progress (*Nutrient Loss Reduction Strategy-NLRS: past, present, and future)*. In comparing numbers from eight major Illinois rivers from 1980-1996 to data from 2011-2015, Illinois has reduced nitrate-nitrogen by 10% and increased phosphorous by 17%.

this plan is to minimize TSS and sediment loading into surface waters. There are no General Use Water Quality Standards for total suspended solids or sediment (IEPA, 2018) and no sediment-related targets in the Illinois NLRS. Consultants anticipate that reasonable efforts taken within the next five years aimed to meet the nutrient targets will reduce TSS loading into surface water by 7%, or 99,701 pounds per year and reduce sediment loading by 4%, or 295 tons per year.

Bacteria Reduction Target

Fecal coliform is a type of bacteria found in the intestines and waste of warm-blooded mammals. It is typically not pathogenic unless it is found in high concentrations. High concentrations of fecal coliform in drinking or surface waters can cause fever, nausea, stomach cramps, ear infections, Dysentery, Typhoid, and Hepatitis A (Oram, 2014). Potential sources of fecal coliform are concentrations of wildlife, livestock, and faulty septic systems. Fecal coliform is a known cause of impairment to South Fork Kent Creek; the 0.5-mile-long section of Kent Creek just downstream of South Fork Kent Creek; and North Fork Kent Creek, a 12.13-mile-long creek that also feeds into Kent Creek just north of South Fork (RMMS). The Illinois General Use Standard for fecal coliform states that the mean of five samples taken within 30 days must not exceed 200 counts per 100 ml (IEPA, 2018). Between 2003 and 2010 the Illinois EPA, in partnership with local organizations, conducted water sampling in South Fork Kent Creek just downstream of Levings Lake at the intersection of Tay Street and Corbin Street in Rockford, Illinois. Each sampling result did not meet the Illinois EPA General Use Standard for fecal coliform with geometric means ranging from 581 to 1577 colony forming units/100 ml. *Table 1.1* outlines fecal coliform levels from water sampling (Nicole Vidales, Illinois EPA, personal communication). Stakeholders are interested in learning what specific levels of fecal coliform resulted in South Fork Kent Creek being on the Illinois EPA impaired streams list. They wonder if it is feasible to reduce fecal coliform levels enough to remove South Fork Kent Creek from the impaired streams list. Using the 2012 data from the most recently reported amount of fecal coliform (581 cfu/100ml), consultants calculated how much it would take to get the levels below 200 cfu/100ml. The difference between the current geometric mean of 581 cfu/100ml and the general use standard of 200 cfu/100ml is 381 cfu/100ml, or a 65% reduction in fecal coliform. Although this is a simplification of calculations, it provides a baseline estimate of what it would take to remove South Fork Kent Creek from the impaired stream list due to fecal coliform. A 65% reduction in fecal coliform loading seems like an appropriate long-term goal but unlikely to be accomplished within the five-year life of this plan. OES ran several scenarios using their pollutant reduction model to see possible bacteria reduction targets that seemed realistic for this watershed within five years. Stakeholders and consultants agreed to create a fecal coliform reduction target of 20%, or 55,610 billion counts per year, within a five-year timeframe.

Table 1.1 Fecal Coliform Levels in South Fork Kent Creek

Year Reported	Years Retrieved	Location of Samples	Number of Samples	Fecal Coliform Geometric Mean (cfu/100ml)	% of samples > 400 cfu/100ml	Retrieved by:
2006	5/2003-10/2004	Tay & Corbin St.	7	1577	28%	Rock River Water Reclamation District
2008	1/2005-7/2007	Tay & Corbin St.	13	703	62%	Sinissippi Colation for Resoring the Environment (SCORE)
2010	1/2006-11/2009	Station Trib 2	17	802	65%	Sinissippi Colation for Resoring the Environment (SCORE)
2012	2008-2010	Tay & Corbin St.	5	581	60%	Rock River Study Group

Table 1.2 outlines the chosen pollutant load reduction targets for South Fork Kent Creek Watershed in both percentages and units.

Table 1.2 Pollutant Load Reduction Targets

Pollutant Load Parameter	Pollutant Load Reduction Target (%)	Pollutant Load Reduction Target (units)	Units
Total Nitrogen (TN)	7.50%	3,730	lbs/year
Total Phosphorus (TP)	12.50%	1,321	lbs/year
Total Suspended Solids	7%	99,701	lbs/year
Sediment	4%	295	tons/year
Bacteria	20%	55,610	billion counts/year

After creating pollutant reduction targets, technical advisors and consultants worked together to establish specific, measurable objectives that correlate to the goals and pollutant reduction targets for the watershed. Objectives for each goal are described below.

Objectives

OES consultants, stakeholders, and technical advisors discussed how to create specific, action-oriented objectives for each of the eight goals for South Fork Kent Creek Watershed. Objectives answer the question of how stakeholders tangibly accomplish each goal in a designated timeframe. These objectives will answer which best management practices (BMPs) and the specific amount of each BMP is recommended for implementation along with tangible action items for each goal. Since Goals 1, 2, and 3 have much overlap and can for the most part be accomplished together by implementing BMPs that improve water quality, the objectives for these first three goals are combined. In other words, a BMP than addresses Goal 1 by decreasing fecal coliform in surface waters is also likely to minimize erosion and may provide some flooding relief. Objectives for the first three goals only consider the top six BMPs prioritized by the technical advisors and stakeholders due to their ability to most efficiently remove pollutants from stormwater and prevent erosion within the specific conditions of this watershed. Consultants include other BMP options in the plan (via BMPs with high applicability in the watershed and BMPs with low applicability in the watershed), but these other BMP options do not have any tangible, measurable objectives associated with them. They can be utilized in addition to or instead of the top six prioritized BMPs when preferred, working toward the overall pollution reduction targets. The objectives for Goals 1, 2, and 3 align with the pollutant reduction targets, so if each objective is met within this plan, then the pollutant reduction targets will also be met. Goal 4 through Goal 8 have objectives listed separately per goal.

Goal 1: Decrease pollutants in the water, including fecal coliform bacteria.
Goal 2: Minimize erosion, sediment, and nutrient loading into surface waters.
Goal 3: Address water volume and velocity to improve water quality and prevent flooding.

Objectives for goals 1-3:

- Install 41.3 acres of grassed waterways.
- Install 21.9 acres vegetated swales into existing ditches.
- Install 286.4 acres of herbaceous filter strips.
- Install 18.3 acres of constructed stormwater wetlands on existing hydric soils.
- Convert 328 acres of land into natural areas.
- Stabilize 13.3%, or 5,145 feet, of very severely eroded and severely eroded streambank.

Goal 4: Protect, enhance, and manage wildlife habitat.

Objectives for goal 4:

- Whenever applicable, utilize a diversified mix of native plant species when installing any recommended BMP.
- Protect and enhance wildlife and wildlife habitat whenever implementing BMPs.
- Protect, expand, and enhance existing forests, wetlands, and grasslands using BMPs such as forest stand improvement, wetland and prairie restoration, and conversion to natural areas.

Goal 5: Sustain and enhance the recreational opportunities of the watershed.

Objectives for goal 5:

- Consider leaving up to 25% of the shoreline exposed to provide recreational access when installing riparian filter strips or other naturalized BMPs.
- Consider paths through riparian filter strips or other naturalized BMPs to access the water's edge or enjoy a walk, birdwatching, and other nature-based activities. Mow zig zag paths that geese will not follow when appropriate.

Goal 6: Educate the community about water quality and this plan.

Objectives for goal 6:

- Reach 500 homeowners that utilize septic systems to increase awareness of septic system maintenance and its relationship to the fecal coliform impairment of the stream.
- Reach 500 homeowners to increase awareness of lawn care practices and native plantings and their relationship to water quality of the stream.
- Increase awareness of this plan, the importance of implementing BMPs, potential for funding assistance, and educational topics by:
    - posting the plan on websites of planning partners,
    - making 100 copies of the plan's executive summary available through the facilities of planning partners, and
    - holding five annual community events.
- Appoint a leadership group to educate community about water quality and this plan.
- Promote partnerships with community groups that can assist in creating public awareness (adopted from EPA's "Developing an Outreach Strategy" website).
- Invite local municipalities and developers to educational events and meetings and provide them with educational publications and materials.

Goal 7: Work with governing and policy-making bodies to protect water quality currently and in future land use planning.

Objectives for goal 7:

- Present the findings and recommendations of this plan to the Executive Committee of the Region 1 Planning Council (RPC).

- Create relationships with the Village of Winnebago, City of Rockford, Winnebago County, and other local organizations to promote cooperation in land and water conservation efforts and to assist stakeholders in addressing current concerns for water quality and concerns with future development.
- Implore developers and governing bodies to create and approve development plans that incorporate BMPs that address water quality and mitigate the effects that intensive land use has on water quality.
- Urge governing bodies to advocate for the stakeholders' desire to improve water quality by allowing water conservation practices in ordinances and by-laws.

Goal 8: Preserve prime farmland during future land use changes.

Objectives for goal 8:

- Implement proper BMPs not only to improve water quality on-site and downstream but also to preserve the soil necessary to farming.
- Encourage interested agricultural families farming for generations to continue farming their lands, with or without the use of agricultural easements or deed restrictions.
- Collaborate with developers and land use planners to ensure that they consider the value of prime farmland and allow agricultural producers' voices to be heard in land use planning decisions.

Priority Locations

Where is it best to focus efforts to implement BMPs to get the greatest reduction in pollutant loading to the streams and water bodies? There are several variables that come into play in making these decisions that consider geographic placement, land use, and willingness of landowners.

Prioritized geographic placement for BMPs include:

- in the headwaters of the watershed, then work downstream,
- as close to the origin of nonpoint source pollution as possible,
- within environmentally sensitive areas, and
- within subbasins with highest pollutant loading.

Priority land uses needing BMPs include:

- within land uses that have the highest pollutant loading rates per acre, and
- within land uses that have the highest total pollutant loading for the watershed, which is a factor of total acreage and pollutant loading rate per acre.

Priority for providing time and resources to BMP projects are given:

- on lands with willing landowners.

Priority locations for best management practices should start in the headwaters and be placed as close to the origin of nonpoint source pollution as possible, such as management practices within crop fields and lawns and projects adjacent to impervious surfaces, lawns, and crop fields. Consultants recognize the next best opportunity for improvement is to move down the watershed, working within and next to impervious surfaces, drainageways, wetlands, and streams. Keeping this pattern in mind, a given project may be more effective if it is placed in an environmentally sensitive area, in a prioritized subbasin, within a prioritized land use, or a combination of those. Stakeholders can make the greatest impact in reducing water quality impairments by implementing recommended BMPs at locations where these factors overlap. No matter where the BMP is located, the best use of limited time and resources will focus on projects that will likely happen with willing landowners. Each of these factors are discussed in greater detail below.

Environmentally Sensitive Areas

Areas with substantial opportunity for pollutant reduction are those that are most sensitive to water quality impairments. If choosing where to best locate a project, the same project will be more effective within the priority areas than any other area of the watershed. These sensitive areas include:

- areas with frequent flooding,
- areas in flood zones,
- areas with hydric soils,
- areas with high runoff potential,
- land near open water and wetlands, and
- areas with highly erodible land.

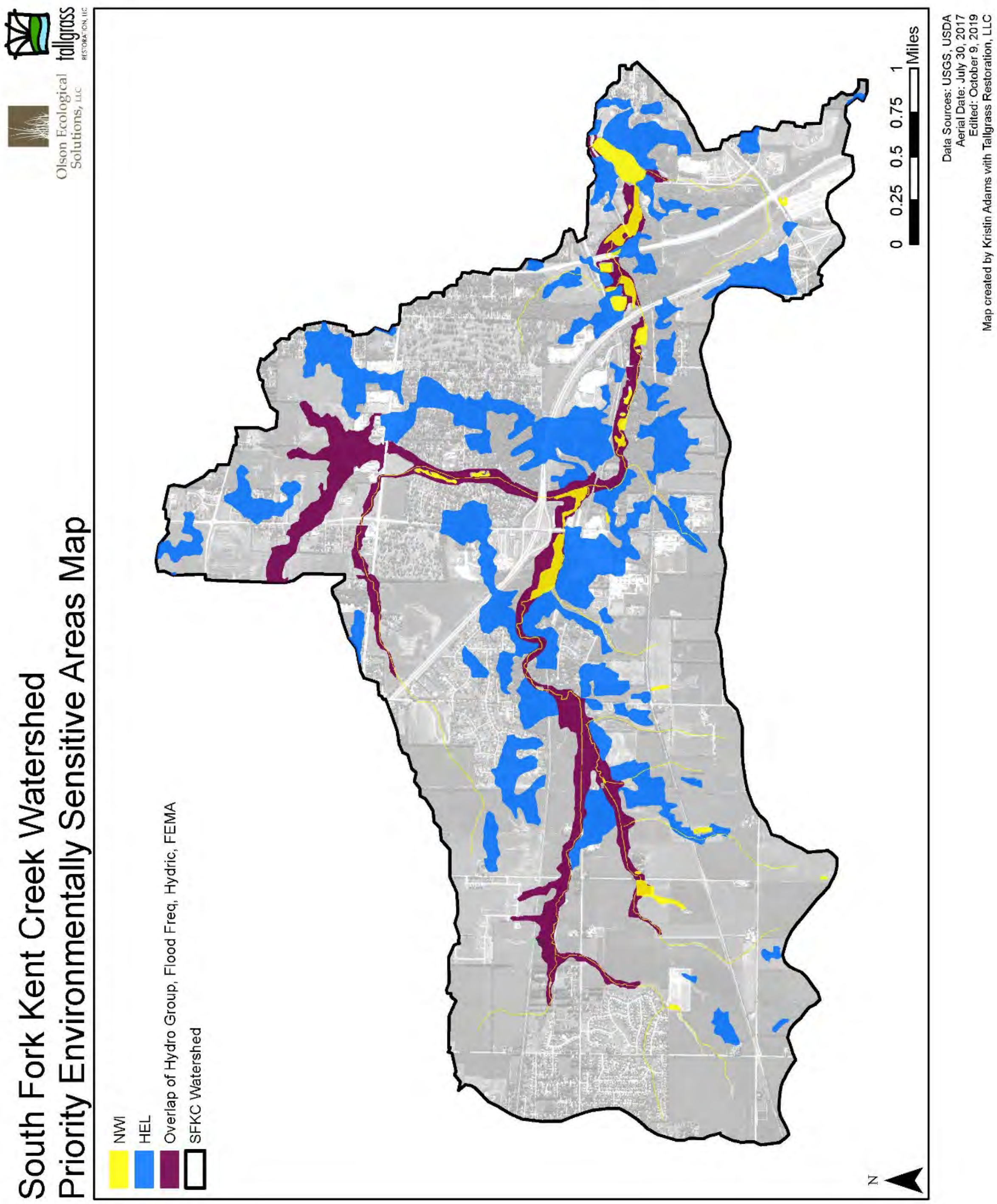
These areas that are more sensitive to erosion and water quality impairments pose great opportunity for implementation of BMPs. *Figure 1.2* depicts these various parameters that are more likely to be sensitive to water quality impairments. These land features are discussed below in relation to the priority criteria above.

The NWI, or National Wetland Inventory, layer is shown in yellow and depicts the abundance of wetlands. BMPs near wetlands or open water will protect these sensitive areas. Wetlands represent some of the areas that have hydric soils, and some wetlands, especially near the stream, can have high runoff potential and frequent flooding and can be located within flood zones.

The blue layer shows HEL, which stands for highly erodible land. For land to be categorized as highly erodible land, factors like wind erosion and water erosion are considered to determine the land's erodibility potential. HEL is more sensitive to erosion and runoff carrying pollutants. BMPs located in areas of HEL can treat more runoff than a BMP of the same size located on flatter, non-HEL areas.

The maroon layer shows the overlap of sensitive areas due to their high runoff potential, hydric soils, flooding frequency, and flood zones. The area's runoff potential is labeled by their hydrologic group. Hydrologic groups with high runoff potential, shaded maroon, include Hydrologic Groups D, B/D, and C/D. Consultants elected to only show the overlap of these four parameters since they had a lot of naturally occurring overlap. Areas of frequent flooding, flood hazard zones, and areas with hydric soils are more likely to have ponding or flooding and are usually in proximity to wetlands and open water. When these lands are utilized for crops, livestock, mowed lawns, or other unnatural states, they are more apt to have sediment, nutrients, and bacteria carried into the stream by the flood waters than if they are fully vegetated with deep-rooted, native plants that hold soil in place. Furthermore, hydric soils are also more likely to be areas with high runoff potential, as their soils are so fine and tight that water does not infiltrate into the ground as quickly. These areas can increase flashy hydrology during storm events if not properly vegetated and otherwise treated. They also indicate areas where wetlands have been drained or otherwise hydrologically altered and have high restoration potential.

Figure 1.2 Priority Environmentally Sensitive Areas



Sensitive Flood Zones

The Priority Environmentally Sensitive Areas map summarizes all environmentally sensitive parameters in one image. However, consultants also looked more closely at some of these parameters by considering the land uses within them. For instance, there are approximately 539.9 acres within the 100-year flood zone in the watershed that are within the flood zone and more prone to flooding. They would benefit from BMP implementation to stabilize soil and keep pollutants from washing into waterbodies and streams during storm events.

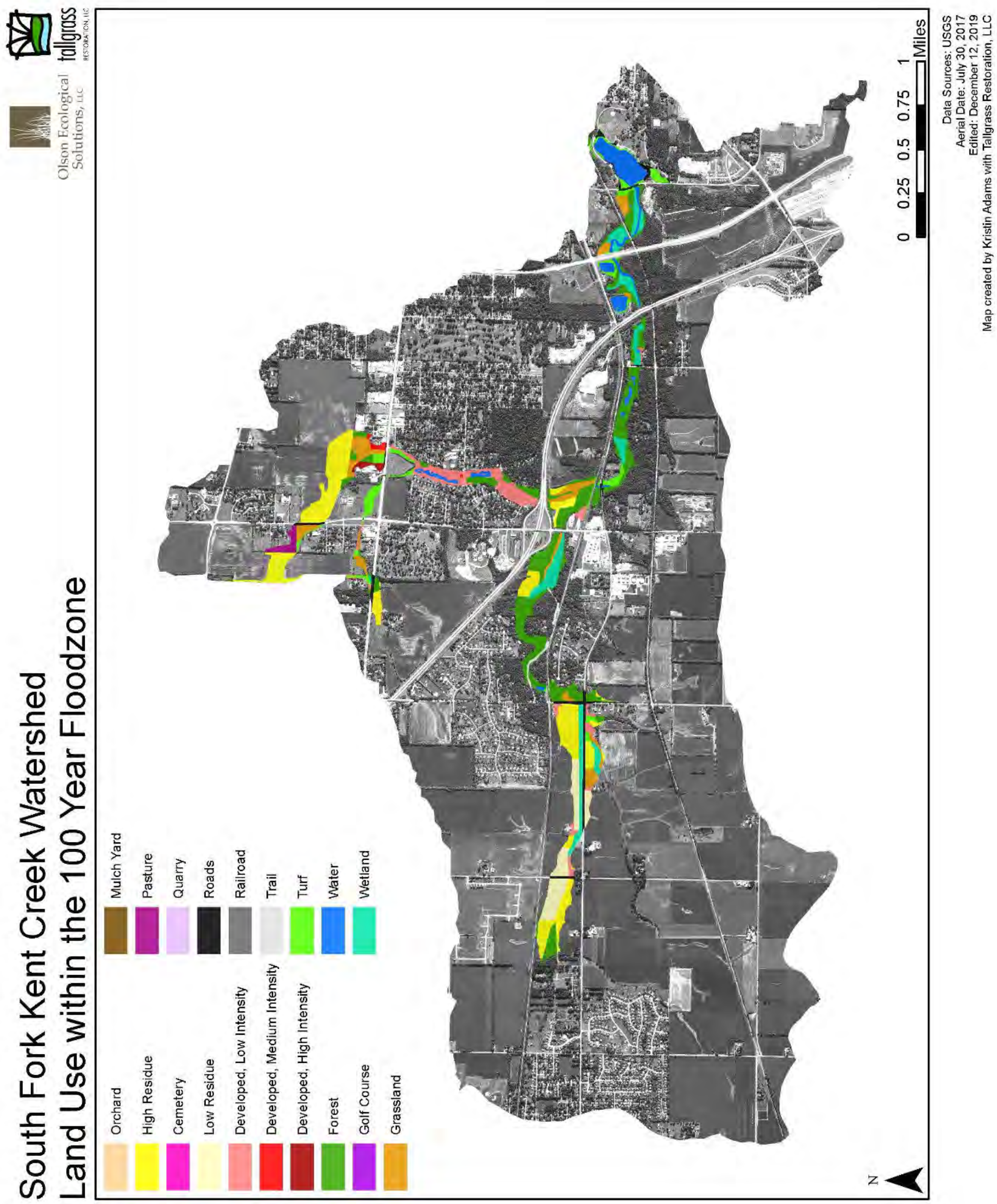
Table 1.3 depicts each land use type within the 100-year flood zone along with their corresponding acreages. Land uses that are the highest polluting per acre located within the flood zone are highlighted. *Figure 1.3* maps each land use type within the 100-year flood zone.

Table 1.3 Land Use within the 100-Year Floodzone

Land Use Type	Acreage of Land Use in Flood Zone	Highest Polluting Land Uses per Acre in Flood Zone			
		TN	TP	TSS	Bacteria
High Intensity Developed	3.2	X	X	X	X
Medium Intensity Developed	2.6	X	X	X	X
Low Intensity Developed	42.1	X	X	X	X
Roads	20.1	X	X	X	X
Railroad	0.2	X	X	X	X
Trail	2.5	X	X	X	X
Turf	32.9				
High Residue Till	119.2			X	
Low Residue Till	34.8			X	
Pasture	6.8				X
Forest	134.5				
Grassland	42.9				
Wetland	53				
Water	45.1				
Total	**539.9**				

Majority of flood zone acres are on forest (24.91%, or 134.5 acres) and high residue till cropland (22.08%, or 119.2 acres). Lands located within flood zones have their polluting capabilities increased even further by flood water runoff. If BMPs are implemented within the flood zone, those treating land uses with the highest polluting capabilities per acre will be more effective than placement on a different type of land use that is less polluting per acre. These land uses are discussed in greater detail later in this chapter.

Figure 1.3 Land Use within the 100-Year Floodzone



Sensitive Highly Erodible Land (HEL)

The consultants took a closer look at the land uses on HEL (highly erodible land). In the watershed, there are approximately 1,148 acres of HEL. HEL have their polluting capabilities increased even further by greater slopes and other forces increasing the potential for erosion when compared to flatter, non-HEL lands.

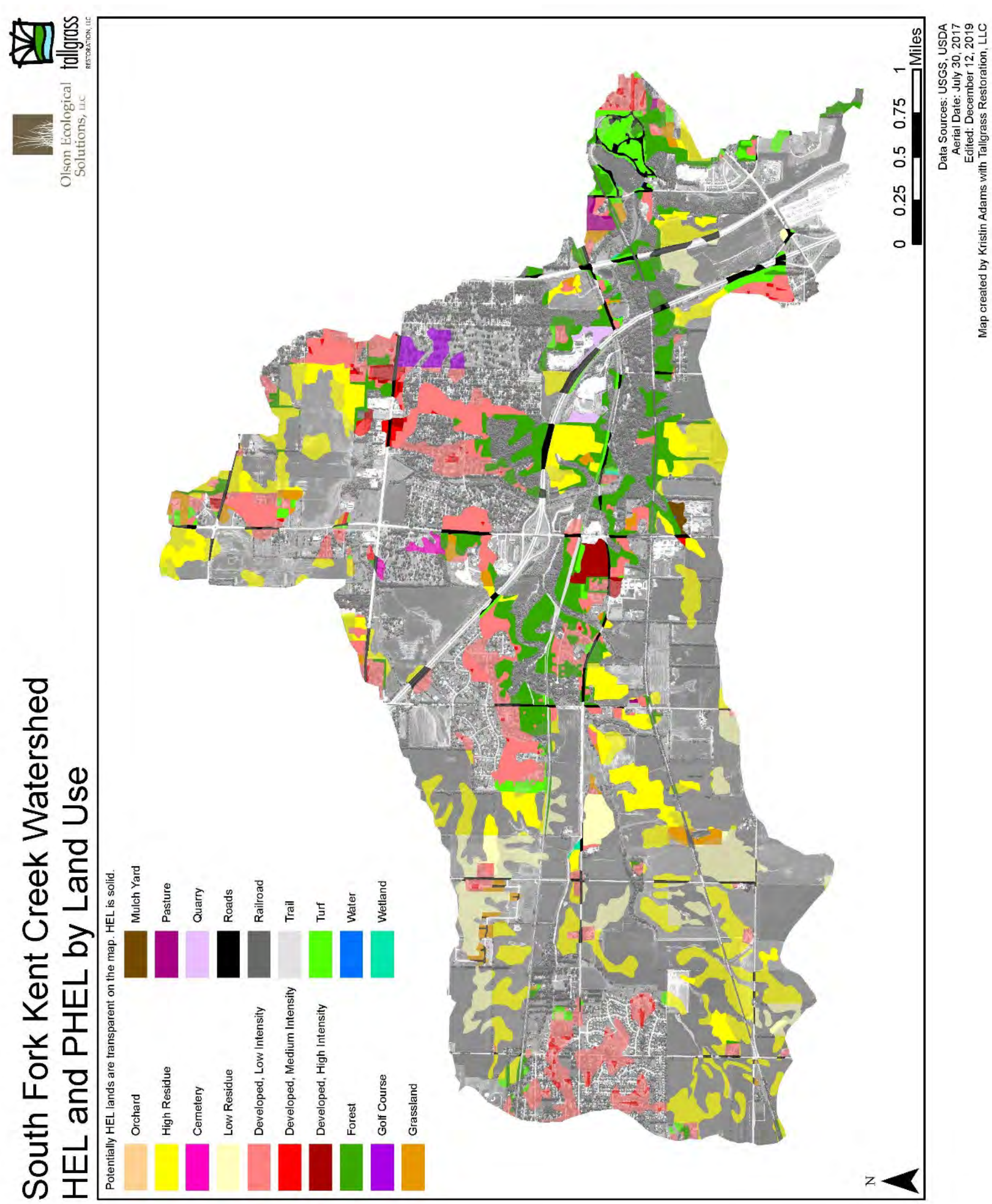
Table 1.4 depicts each land use type with HEL along with their corresponding acreages. Land uses that are the highest polluting per acre located on HEL are highlighted. *Figure 1.4* maps each land use type with HEL and PHEL (potentially highly erodible land). The HEL is shown in solid colors and the PHEL is transparent.

Table 1.4 HEL by Land Use

Land Use Type on HEL	Acreage of Land Use in HEL	%	Highest Polluting Land Uses per Acre in HEL			
			TN	TP	TSS	Bacteria
High Intensity Developed	26	2.29%	X	X	X	X
Medium Intensity Developed	12	1.08%	X	X	X	X
Low Intensity Developed	281	24.44%	X	X	X	X
Roads	58	5.04%	X	X	X	X
Railroad	9	0.79%	X	X	X	X
Trail	10	0.87%	X	X	X	X
Cemetery	0	0.00%				
Turf	72	6.28%				
High Residue Till	265	23.08%			X	
Low Residue Till	40	3.51%			X	
Pasture	2	0.20%				X
Quarry	14	1.24%				
Mulch Yard	6	0.55%				
Forest	321	27.92%				
Grassland	29	2.50%				
Wetland	2	0.14%				
Water	1	0.06%				
Total	**1148**	**100.00%**				

Majority of highly erodible acres within the watershed reside on forestland (27.92%, or 320 acres), residential development (24.44% or 281 acres), and high residue till cropland (23.08%, or 265 acres). If BMPs are implemented to treat HEL, those treating land uses with the highest polluting capabilities per acre will be more effective than placement on a different type of land use that is less polluting per acre. Furthermore, within the HEL on forestland, invasive shrubs have taken over and shaded out stabilizing ground cover. Stewardship of these lands choked with invasive species would allow ground cover to fill in, therefore reducing erosion and protecting water quality.

Figure 1.4 HEL and PHEL by Land Use



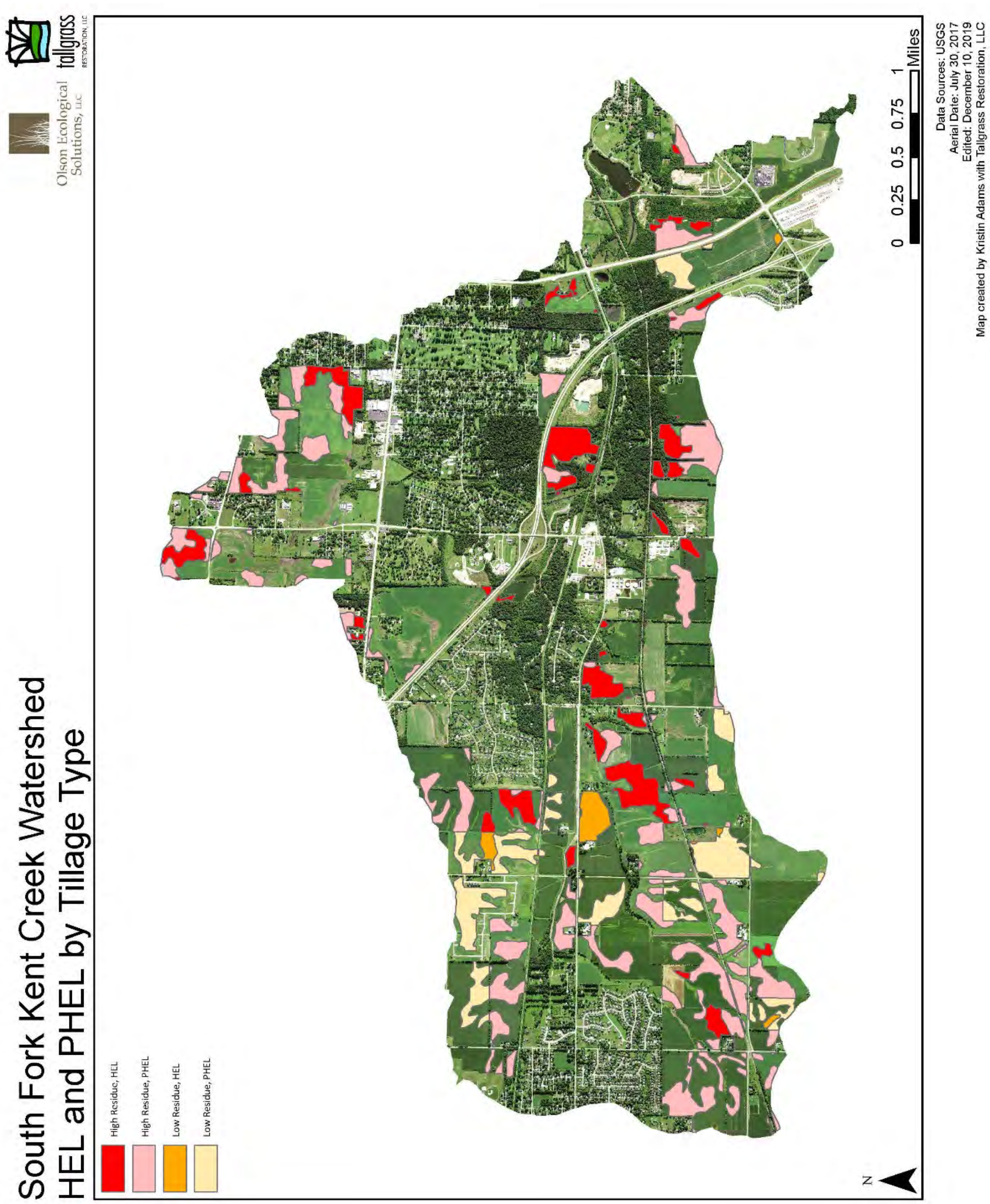
Lastly, the consultants took a closer look at the breakdown of tilled cropland on HEL and PHEL. In the watershed, there are approximately 3,443 acres of cropland. There are 2,726 acres of high residue till and 717 acres of low residue till. 265 acres of the 2,726 acres of high residue till cropland is considered HEL. That means that about 9.7% of high residue till croplands are erodible acres. 40 acres of the 717 acres of low residue till cropland is considered HEL. That means that about 5.6% of low residue till croplands are erodible acres.

Table 1.5 estimates acreage of highly erodible land (HEL) and potentially highly erodible land (PHEL) on both high residue till and low residue till cropland. *Figure 1.5* illustrates HEL and PHEL categorized as high residue till or low residue till throughout the watershed.

Table 1.5 HEL and PHEL by Tillage Type

Tillage Type	Erodibility	Acres
High Residue	HEL	265
High Residue	PHEL	554
Low Residue	HEL	40
Low Residue	PHEL	232
Total		**1092**

Figure 1.5 HEL and PHEL by Tillage Type



Subbasins with Highest Pollutant Loading

Beyond environmentally sensitive land, other areas with substantial opportunity for pollutant reduction are subbasins with the highest amount of pollutants loading into surface water. The South Fork Kent Creek Watershed can be broken down into subbasins. Figures 36-43 on pages 95-105 of Section 1: Watershed Resource Inventory depict these subbasin boundaries as well as total nitrogen (TN), total phosphorous (TP), total suspended solids (TSS), and bacteria loading per subbasin. Pollutant loading by subbasin is assessed in two ways: per acre and total by subbasin. Pollutant loading per subbasin is assessed separately for each pollutant. For example, a subbasin with the highest phosphorus loading may or may not also have the highest bacteria loading. Furthermore, a subbasin with the highest total phosphorus loading for the subbasin may or may not have the highest phosphorus loading per acre. These results are factors of subbasin size and land uses within each subbasin. Because all the subbasins vary in size, priority was given to the areas with higher pollutant loads by acreage as opposed to looking at the total pollutant load.

Subbasins are based on drainage patterns and are not all the same size. With careful consideration and understanding of the land uses within the subbasins, consultants are able to make conclusions as to which subbasins have higher pollutant loading to the streams and water bodies than others. When deciding where to locate a project, the same project will be more effective in a subbasin with higher pollutant loading, at least to the local tributary being impacted.

The following subbasins have the highest pollutant loading considering the following variables:

- Subbasins A, D, and N have the highest total TN loading.
- Subbasins L and N have the highest TN loading per acre.
- Subbasins A and N have the highest total TP loading.
- Subbasins A, L, and N have the highest TP loading per acre.
- Subbasin A has the highest total TSS loading.
- Subbasins A, C, and N have the highest TSS loading per acre.
- Subbasins L and N have the highest total bacteria loading.
- Subbasins L and N have the highest bacteria loading per acre.

Since the subbasins that have higher pollutant loads *per acre* are the areas of high priority, consultants further analyzed any subbasin with the highest pollutant loading for each of the four pollutants by considering prominent land uses within that subbasin:

- Subbasins L and N are predicted to contribute the most amount of nitrogen per acre.
- Subbasins A and N are predicted to contribute the most amount of phosphorus per acre.
- Subbasins A, C, and N are predicted to contribute the most amount of TSS per acre.
- Subbasins L and N are predicted to contribute the most counts of bacteria per acre.

In sum, subbasins A, C, L, and N have the highest amounts of pollutant loading per acre. Land uses within subbasin A are primarily agricultural, turf, and forest. Land uses within subbasin C are primarily agricultural and forest. Land uses within subbasin L and N are primarily residential and agricultural.

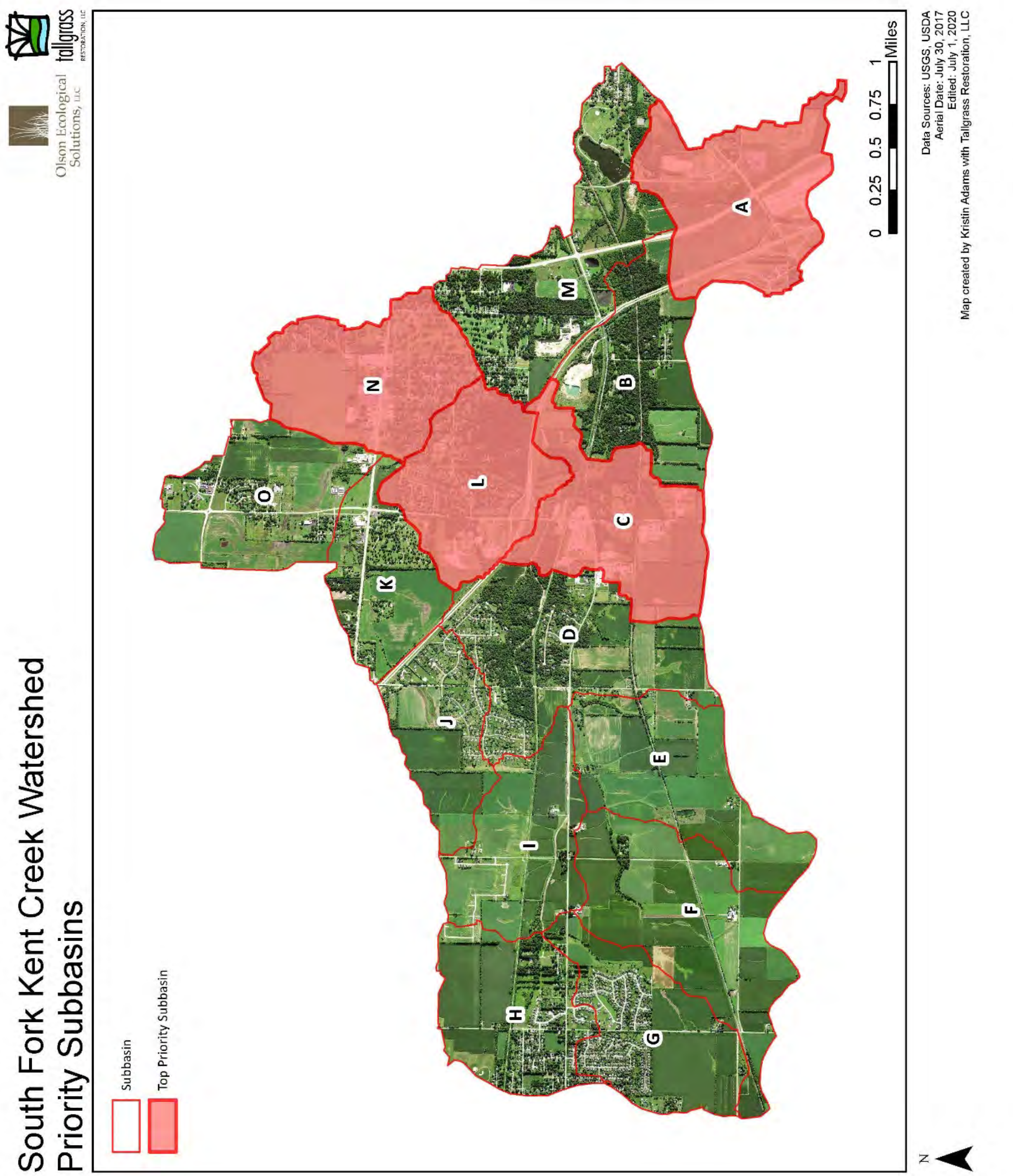
The greatest opportunity for implementation of BMPs in residential areas are within subbasins L and N. Within the agricultural portions of the watershed, areas of greatest opportunity depend on pollutant focus. For practices focused on nitrogen reduction, a practice within subbasins L and N may be more effective than a similar project elsewhere. For practices focused on phosphorus reduction, a practice within subbasins A and N may be more effective than a similar project elsewhere. For practices aimed at reducing sediment loads, subbasins A, C, and N offer the greatest opportunity. For practices aimed at reducing bacteria loads, subbasins L and N offer the greatest opportunity. *Table 1.6* portrays a visual of which subbasin has the great reduction potential per pollutant and what its primary land uses are, while Figure 1.6 depicts the locations of priority subbasins.

Table 1.6 Priority Subbasins

Subbasin	Primary Land Uses	TN	TP	TSS	Bacteria
A	Agricultural, Turf, Forest		★	★	
C	Agricultural, Forest			★	
L	Residential, Agricultural	★			★
N	Residential, Agricultural	★	★	★	★

★ Greatest Reduction Potential

Figure 1.6 Priority Subbasins



Land Uses with Highest Total Pollutant Loading

There are 19 different types of land uses in the watershed; some are more highly represented than others. Certain land uses are more prone to contributing to pollutant loads. Land uses with large amounts of impervious surfaces and pollutant sources have high pollutant loading rates per acre. However, sometimes land uses with high pollutant loading rates per acre are not well represented in the watershed. For example, pasture is one of the highest bacteria contributors per acre, but there are only 37 acres of pasture in the watershed. A land use like low residue till with 717 acres shows a greater opportunity for change, even though it contributes less than a quarter the bacteria per acre when compared to pasture. Therefore, a land use that is largely represented in the watershed and has a high pollutant loading per acre will have the greatest opportunity for reducing pollutant loads.

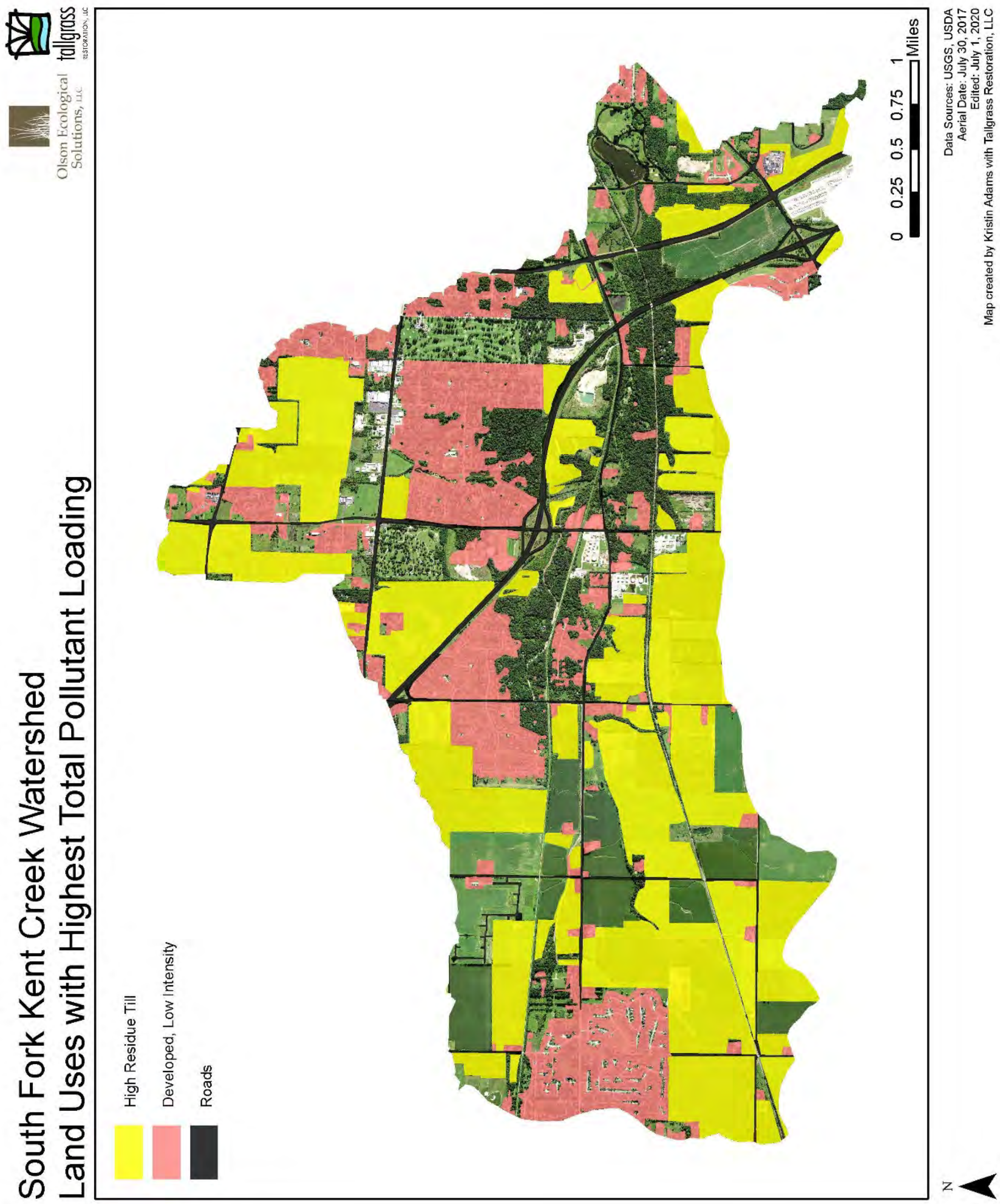
Land uses with the highest total pollutant loading for the watershed are the same for all four pollutants: TN, TP, TSS, and bacteria. They are low intensity development, roads, and high residue till, highlighted in *Table 1.7.*

Table 1.7 Highest Polluting Land Uses in the Watershed (acres multiplied by pollution per acre)

Land Use Type	Highest Polluting Land Uses in Watershed				Acres in Watershed
	TN (lb/yr)	TP (lb/yr)	TSS (lb/yr)	Bacteria (billion counts/yr)	
High Intensity Developed	1,397	200	76,343	3,179	85
Medium Intensity Developed	1,619	235	123,844	5,157	161
Low Intensity Developed	13,679	1,282	312,060	161,466	1,514
Roads	5,776	854	384,224	19,428	367
Railroad	575	98	68,974	2,223	42
Trail	496	30	14,288	903	29
Golf Course	418	70	9,749	1,373	123
Cemetery	202	30	5,469	415	69
Turf	880	70	10,559	1,602	373
High Residue Till	8,011	668	291,955	15,798	2,726
Low Residue Till	2,493	211	109,701	4,155	717
Orchard	7	0	157	23	2
Pasture	65	7	1,269	866	37
Quarry	10	1	40	33	74
Mulch Yard*	29	3	2,591	128	23
Forest	550	59	11,777	1,786	1,090
Grassland	53	10	1,145	347	212
Wetland	14	4	198	44	54
Water	9	1	34	28	63
Total	**36,282**	**3,831**	**1,424,376**	**218,957**	**7,761**

To determine the best opportunity for change, consultants take results of land uses with the highest total pollutant loading for the watershed into consideration, but they also carefully study the relationship between total acreage, pollutant loading per acre, willingness of landowners, and cost/benefit analysis for appropriate BMPs for each land use to make final determinations as to where to best spend efforts. To target the three land uses that contribute the highest total pollutant loading for the watershed, stakeholders need to partner with residents, agricultural producers, and road stewards able to implement BMPs on their properties. Knowing these potential partners can guide landowner outreach efforts as discussed in Chapter 3. Pollutant loading for each land use can be found in Table 35 on page 93 of Section 1: Watershed Resource Inventory. *Figure 1.7* depicts the location of each land use with the highest total pollutant loading.

Figure 1.7 Land Uses with Highest Total Pollutant Loading



Land Uses with Highest Pollutant Loading Rates per Acre

It is a common misconception that agricultural production is the main cause of water quality degradation. This is probably due to the visibility of both the vast expanses of agriculture in the Midwest and the significant degradation of streams and lakes. However, it is well documented that impervious cover like roads, rooftops, driveways, and sidewalks have more of a negative impact on water quality than agriculture. These impervious surfaces are found in much greater abundance within residential and developed areas. Even watersheds with as little as 6% of impervious cover can start to show measurable degradation of the biological, hydrologic, and geomorphic conditions of its streams, although various studies have found that this minimum can be as high as 20% based on site-specific variables (EPA, 2011).

Acre for acre, residential and commercial development have the highest pollutant runoff, with agricultural production as a close second, as indicated by the Event Mean Concentration (EMC) values documented by the EPA and other sources and used in our pollutant load reduction modeling estimates. As watersheds undergo urbanization, developers convert previously vegetated areas to impervious surfaces, i.e. driveways, roadways, parking lots, homes, and corporate/industrial buildings. Impervious surfaces do not allow precipitation to infiltrate into the soil and therefore cause runoff accumulation and flooding. Areas with residential, commercial, and industrial development have more impervious surfaces than agricultural areas, and these impervious surfaces result in more runoff traveling in a concentrated flow. When water quickly runs off impervious surfaces into lower drainages areas or storm drains, it not only causes flooding but also does not allow slow infiltration through the soil. One of nature's ways of filtering out pollutants in precipitation is through soil infiltration. Humans are removing this natural step of filtration by increasingly utilizing impervious surfaces. Moreover, more development results in more pollutant accumulation onto these impervious surfaces. When stormwater flows over these surfaces, it collects pollutants like automobile petroleum by-products, deicing salts, fertilizers, pesticides, pet waste, metals, and sediment and then empties it into the nearest stream, lake, or other waterway. Even areas that are left undeveloped and vegetated may have compacted soils from surrounding development activities. Compacted soils make it difficult for precipitation to infiltrate soil.

Although agricultural areas do have erosion problems and runoff carrying higher concentrations of nutrients than developed lands, generally the amount of runoff leaving the property and reaching the waterway will be less on agricultural lands than on developed, residential lands. Agricultural lands may have bare soil or compacted soil at times (especially if conventional till and no cover crop practices are used), but they have much less impervious surfaces and fewer concentrated water flows. While there may be agricultural erosion and runoff concerns, there are more opportunities for precipitation to infiltrate into the soil.

The runoff coefficient, (C), is a value ranging from zero to one that considers the relation between the amount of precipitation and the amount of resulting runoff within a watershed (Water Boards, 2011). Other factors considered and displayed in *Figure 1.8* are soil type, slope, permeability, and land use. A high runoff coefficient (a value closer to one) means higher runoff and lower infiltration, potentially resulting in flash flooding during storms. Low runoff coefficients have lower runoff rates and higher infiltration. Larger, densely vegetated areas with flat slopes and permeable soil will have the lowest runoff coefficients because they have less impervious pavement. The runoff coefficient increases as impervious surfaces increase, clay content in soil increases, and slope steepens. The different soil groups (Group A, B, C, and D) in the charts below are categorized based on U.S. Soil Conservation Service (SCS) soil identifications and soil infiltration rates. According to *Figure 1.8*, the runoff coefficient for farmland is always less than the runoff coefficient for residential areas, regardless of residential acreage, soil type, or slope.

Figure 1.8 Runoff Coefficient

	Runoff Coefficient, C					
	Soil Group A			Soil Group B		
Slope :	< 2%	2-6%	> 6%	< 2%	2-6%	> 6%
Forest	0.08	0.11	0.14	0.10	0.14	0.18
Meadow	0.14	0.22	0.30	0.20	0.28	0.37
Pasture	0.15	0.25	0.37	0.23	0.34	0.45
Farmland	0.14	0.18	0.22	0.16	0.21	0.28
Res. 1 acre	0.22	0.26	0.29	0.24	0.28	0.34
Res. 1/2 acre	0.25	0.29	0.32	0.28	0.32	0.36
Res. 1/3 acre	0.28	0.32	0.35	0.30	0.35	0.39
Res. 1/4 acre	0.30	0.34	0.37	0.33	0.37	0.42
Res. 1/8 acre	0.33	0.37	0.40	0.35	0.39	0.44
Industrial	0.85	0.85	0.86	0.85	0.86	0.86
Commercial	0.88	0.88	0.89	0.89	0.89	0.89
Streets: ROW	0.76	0.77	0.79	0.80	0.82	0.84
Parking	0.95	0.96	0.97	0.95	0.96	0.97
Disturbed Area	0.65	0.67	0.69	0.66	0.68	0.70

Rational Method Runoff Coefficients - Part I

	Runoff Coefficient, C					
	Soil Group C			Soil Group D		
Slope :	< 2%	2-6%	> 6%	< 2%	2-6%	> 6%
Forest	0.12	0.16	0.20	0.15	0.20	0.25
Meadow	0.26	0.35	0.44	0.30	0.40	0.50
Pasture	0.30	0.42	0.52	0.37	0.50	0.62
Farmland	0.20	0.25	0.34	0.24	0.29	0.41
Res. 1 acre	0.28	0.32	0.40	0.31	0.35	0.46
Res. 1/2 acre	0.31	0.35	0.42	0.34	0.38	0.46
Res. 1/3 acre	0.33	0.38	0.45	0.36	0.40	0.50
Res. 1/4 acre	0.36	0.40	0.47	0.38	0.42	0.52
Res. 1/8 acre	0.38	0.42	0.49	0.41	0.45	0.54
Industrial	0.86	0.86	0.87	0.86	0.86	0.88
Commercial	0.89	0.89	0.90	0.89	0.89	0.90
Streets: ROW	0.84	0.85	0.89	0.89	0.91	0.95
Parking	0.95	0.96	0.97	0.95	0.96	0.97
Disturbed Area	0.68	0.70	0.72	0.69	0.72	0.75

Rational Method Runoff Coefficients - Part II

(Knox County Tennessee Stormwater Management Manual)

The projects and practices recommended for the South Fork Kent Creek Watershed to achieve the vision, goals, objectives, and targets set forth above considered both agricultural and residential settings. With more agricultural land than residential land in the watershed, both are important in reducing sediment and nutrients to meet the goals of the plan. This plan is conducted at the conceptual level. As such, consultants used readily available land use data to estimate impervious surface and each land use's pollutant loading to the streams. This data was used in the Watershed Resource Inventory to compare pollutant loading from the subbasins and to prioritize areas of opportunity within this plan. Estimations of the current and future impervious surface is found in Part 3 of the Watershed Resource Inventory. Pollutant loading within each subbasin and for each pollutant is found in Part 6 of the Watershed Resource Inventory.

Within this watershed, land uses can be compared directly by pollutant loading per acre, regardless of their representation, i.e. total acreage, in the watershed. The land uses with the highest pollutant loading rates per acre for each pollutant are as follows:

- High, Medium, and Low Intensity Development, Roads, Railroads, and Trail are the land uses with the highest *total nitrogen (TN)* loading per acre.

- High and Medium Intensity Development, Roads, and Railroads are the land uses with the highest *TP* loading per acre. In areas without High and Medium Intensity Development, Low Intensity Development and Trail land uses join the list as high *total phosphorus (TP)* polluters per acre.

- High and Medium Intensity Development, Roads, and Railroads are the land uses with the highest *total suspended solids (TSS)* loading per acre. In areas without High and Medium Intensity Development, Trail, Low Density Development, and Low and High Residue Till join the list as high TSS polluters per acre.

- High, Medium, and Low Intensity Development, Roads, Railroads, Trail, and Pasture are the land uses with the highest *bacteria* loading per acre.

- Streambank erosion is the only source modeled for pollution of *sediment*. All land uses are considered as contributors of TSS.

Implementing BMPs on land uses with the highest pollutant loading per acre will likely be highly effective, even when there are not as many acres available to do so throughout the watershed. *Table 1.8* indicates annual pollutant loads per acre for each land use and highlights highly polluting land uses. *Figures 1.9-1.12* depict the location of each land use with the highest pollutant loading rates per acre for each focus pollutant.

Table 1.8 Highest Polluting Land Uses per Acre

Land Use Type	Highest Polluting Land Uses per Acre			
	TN (lb/ac/yr)	TP (lb/ac/yr)	TSS (lb/ac/yr)	Bacteria (billion counts/ac/yr)
High Intensity Developed	16.44	2.35	898.16	37.40
Medium Intensity Developed	10.06	1.46	769.22	32.03
Low Intensity Developed	9.04	0.85	206.12	106.65
Roads	15.74	2.33	1046.93	52.94
Railroad	13.69	2.33	1642.25	52.94
Trail	17.11	1.03	492.67	31.14
Golf Course	3.40	0.57	79.26	11.16
Cemetery	2.93	0.43	79.26	6.01
Turf	2.36	0.19	28.31	4.29
High Residue Till	2.94	0.24	107.10	5.80
Low Residue Till	3.48	0.29	153.00	5.80
Orchard	3.33	0.21	78.37	11.59
Pasture	1.76	0.18	34.29	23.40
Quarry	0.14	0.01	0.54	0.45
Mulch Yard*	1.27	0.15	112.65	5.57
Forest	0.50	0.05	10.80	1.64
Grassland	0.25	0.05	5.40	1.64
Wetland	0.25	0.07	3.67	0.82
Water	0.14	0.01	0.54	0.45
*Very low acreage in watershed, not highlighted although comparable TSS contribution to high residue till land use.				

Figure 1.9 Land Uses with Highest Nitrogen Loading Rates per Acre

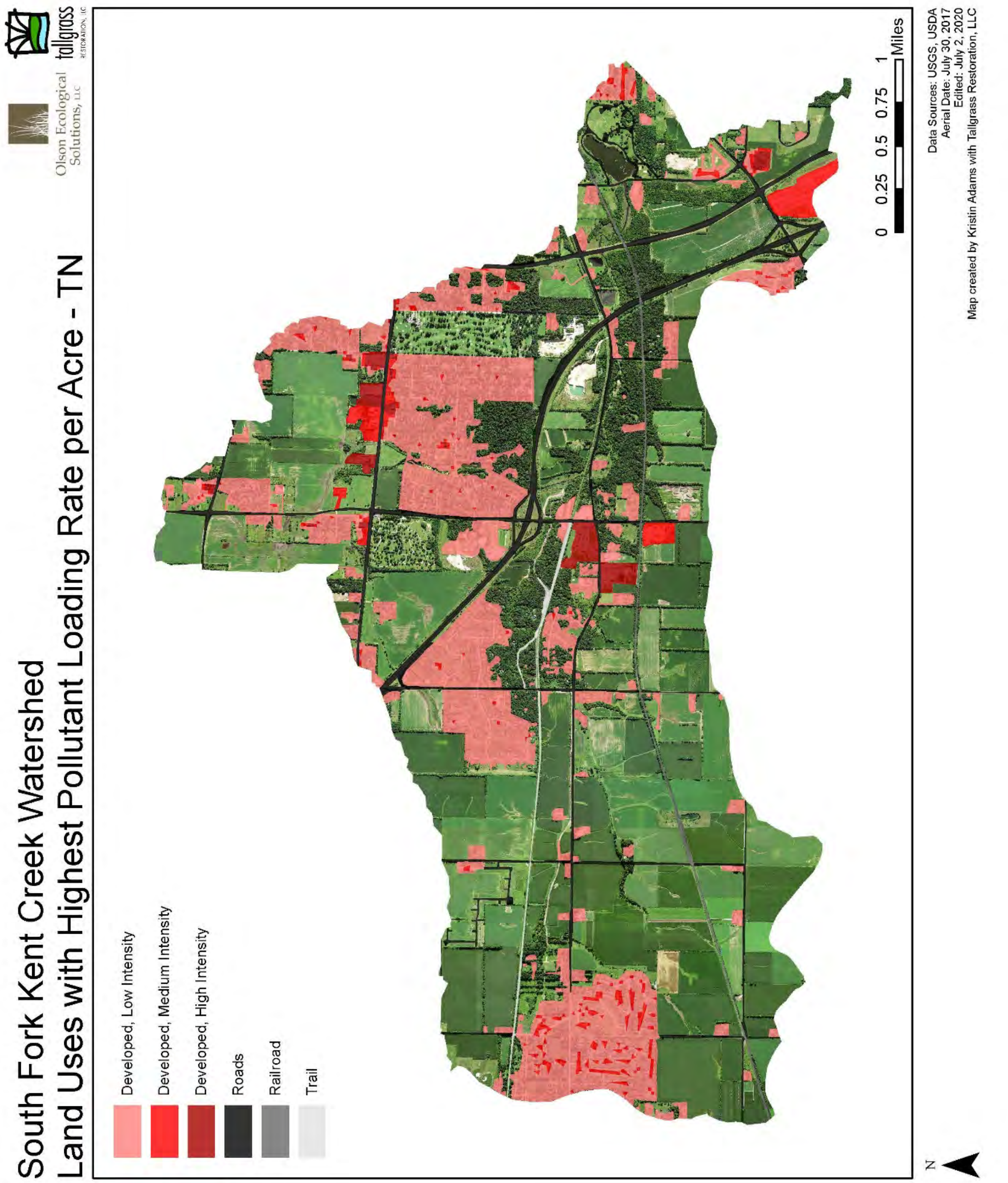


Figure 1.10 Land Uses with Highest Phosphorous Loading Rates per Acre

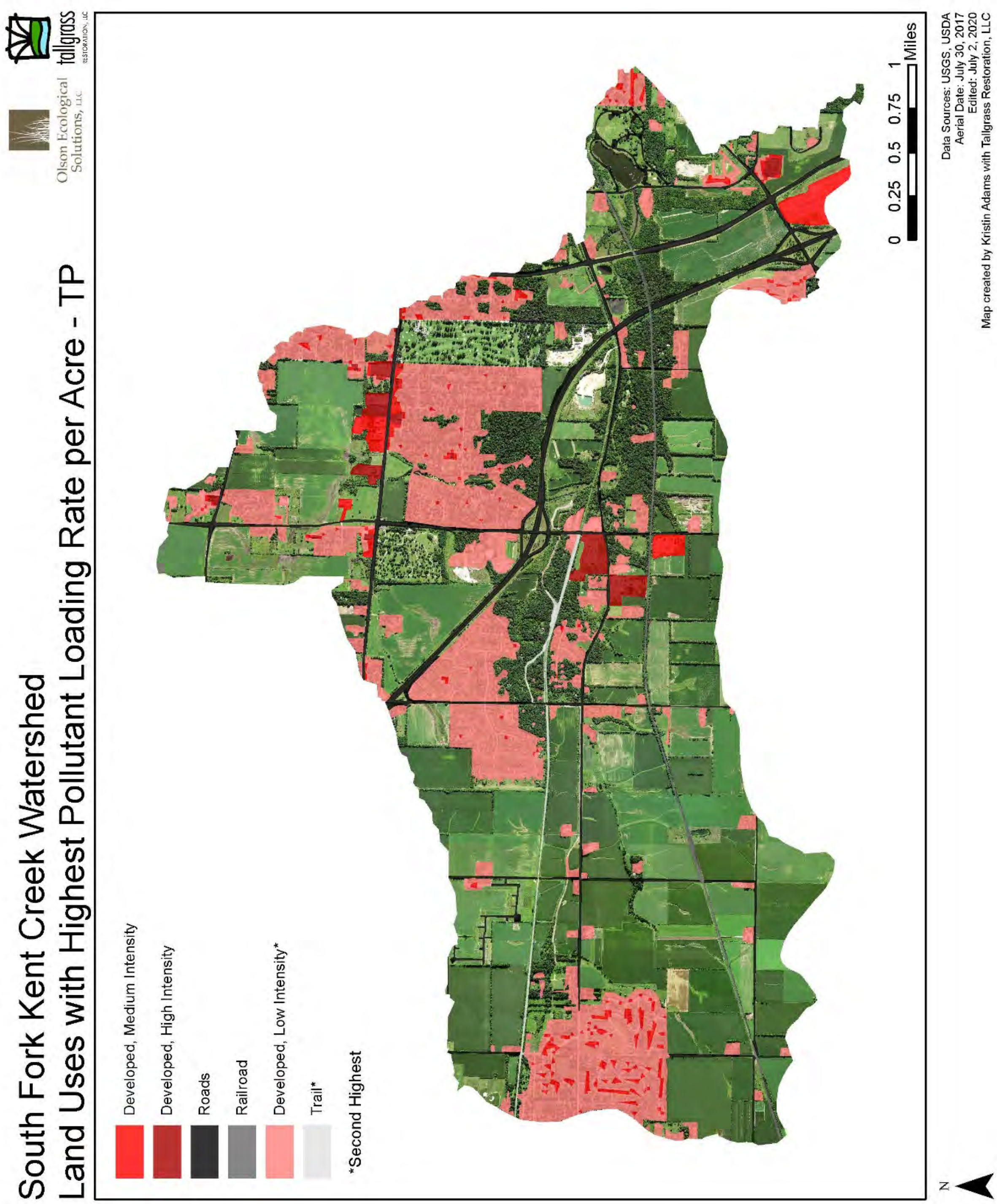


Figure 1.11 Land Uses with Highest TSS Loading Rates per Acre

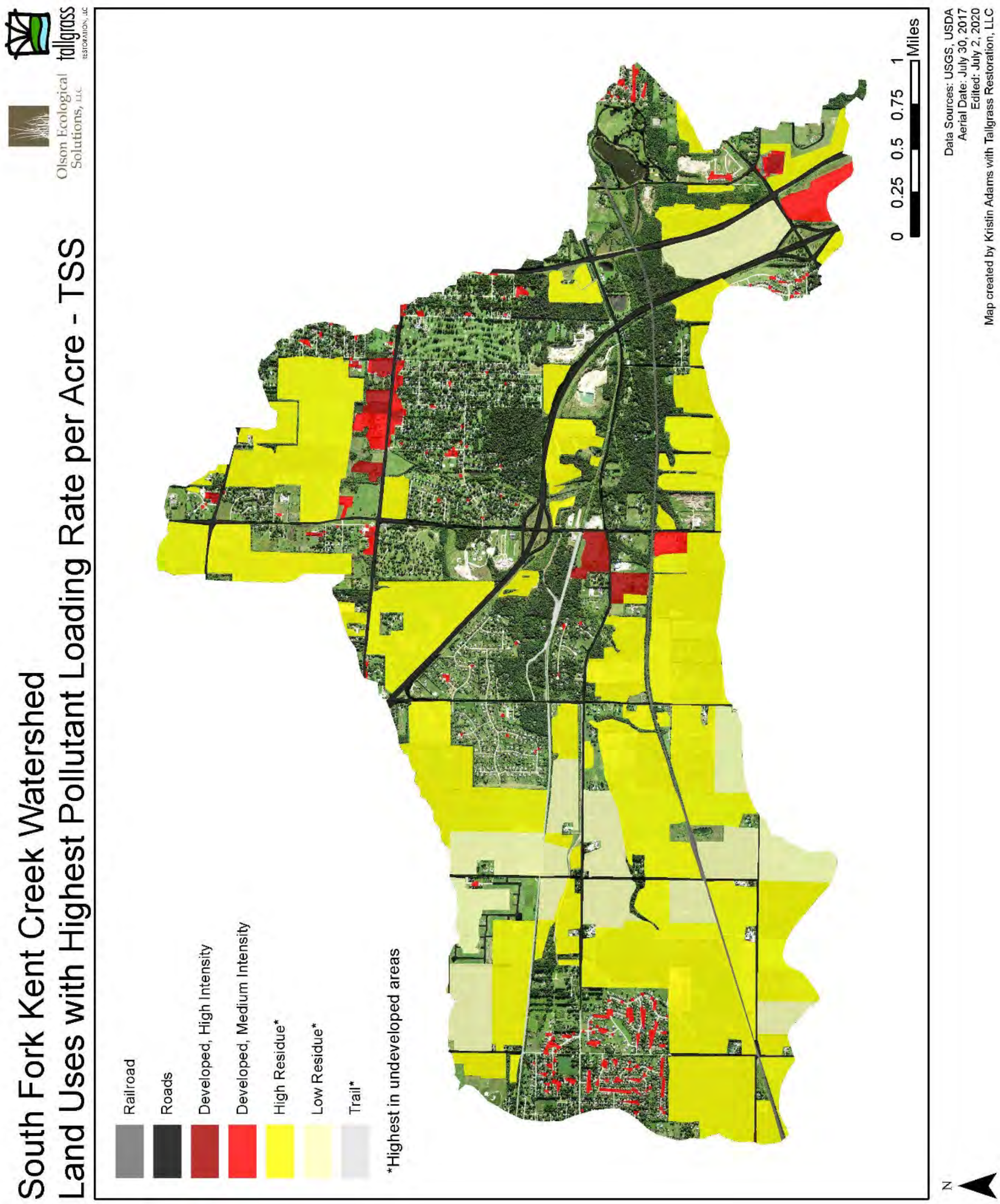
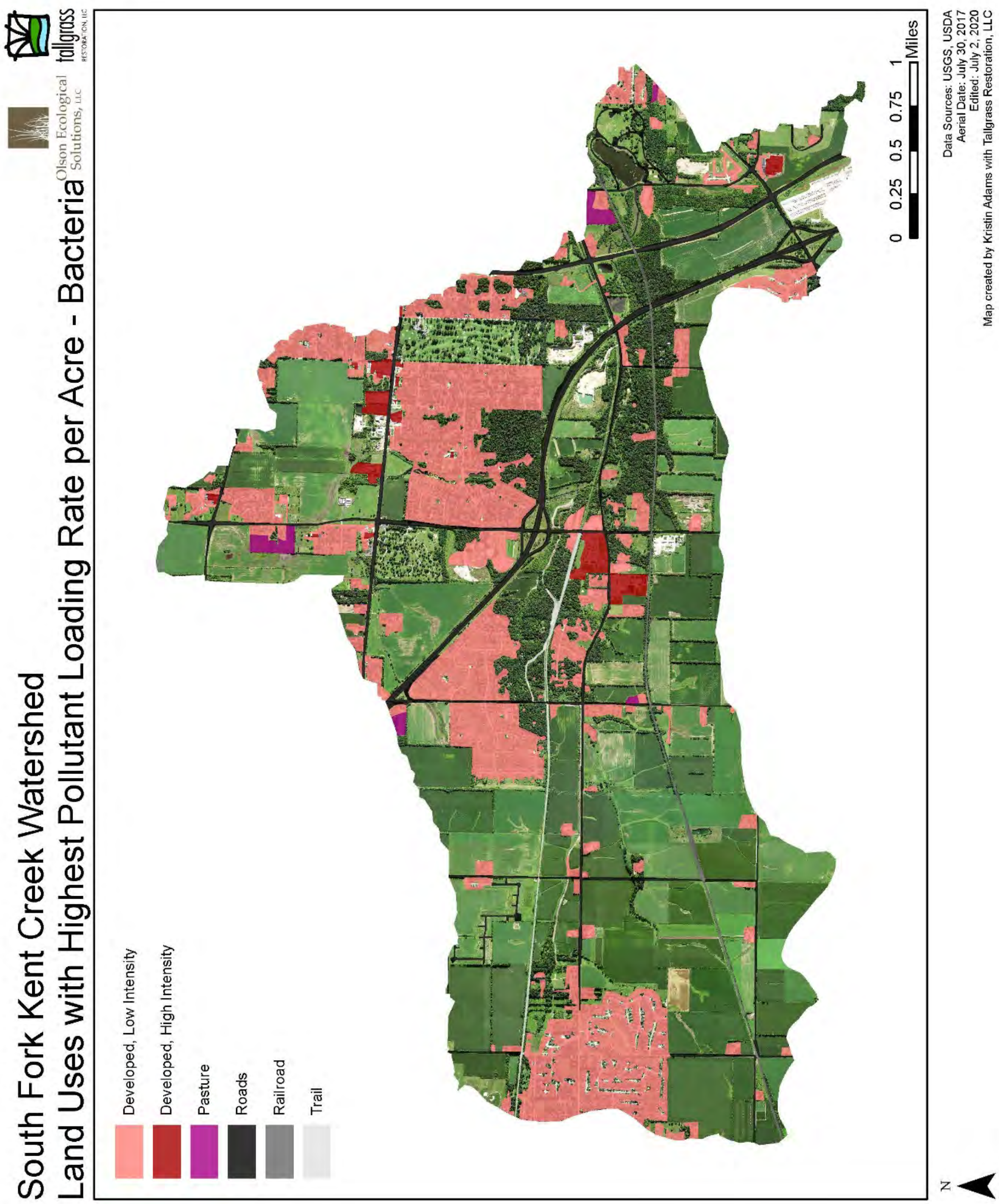


Figure 1.12 Land Uses with Highest Bacteria Loading Rates per Acre



Lands with Willing Landowners

To achieve the chosen pollutant reduction targets, the stakeholders of the watershed, technical advisors, and OES consultants considered best management practices that were pragmatically and fiscally possible. In other words, the best management practices selected are financially possible, likely to be funded by sources detailed in Chapter 6, effective at reducing the targeted pollutants, and likely to be implemented by watershed stakeholders. Once the group prioritized BMPs, OES established objectives using the prioritized BMPs and their corresponding pollutant reduction estimates. These best management practices are discussed within the next chapter of this plan.

Throughout the planning process, stakeholders have come forward who are willing to implement BMPs and are interested in learning more about watershed planning and water quality improvements. Starting with this core group will be a highly effective way to start constructing BMPs and begin outreach efforts that will hopefully lead to more BMP implementation by others inspired by the success. Ideally knowledge and efforts snowball throughout the watershed. Some of the projects with willing landowners are highlighted as Site Specific Practices, found in Chapter 5.

Section 2, Chapter 2
Recommended Projects and Practices

Introduction

Chapter 1 detailed the vision, goals, pollutant reduction targets, and objectives set forth by the stakeholders, technical advisors, and consultants. This chapter details the projects and practices chosen by the stakeholders to meet these goals and targets and fulfill the vision. This chapter describes conservation efforts already in place in the watershed, and it recommends best management practices to be implemented throughout the watershed and at specific locations for chosen projects. Chapters following provide guidance for implementing these projects including costs and benefits.

Prevention, Restoration, and Remediation

Best management practices can be a preventative, remediation, or restoration effort as defined below.

Preventative Practices

Preventative practices reduce, eliminate, or prevent pollution at its source (USEPA, 2020). Since the focus for this watershed is nonpoint source pollution, these practices preserve natural lands and favor lesser-polluting land uses and their arrangement on the landscape. Treating pollutants at the source is ideal, although not always practical. Therefore, for the purposes of this plan, we also include in this definition best management practices that filter pollution close to the source.

- *Highly prioritized preventative practices* in this plan include installing new and widening existing grassed waterways, installing vegetated filter strips and vegetated swales adjacent to the pollutant source, and stabilizing streambank.
- *Preventative practices with high applicability to the watershed* include farming with conservation tillage and cover crops; preserving natural woodlands, grasslands, and wetlands; properly maintaining septic systems; practicing environmentally-friendly lawn care practices; installing of rain gardens and rain barrels; excluding livestock from streams with fencing or stream crossings; and protecting prime farmland from conversion to a more intensive land use with agricultural easements or deed restrictions
- *Preventative practices with low applicability to the watershed* include installing permeable pavers or porous pavement, re-meandering a previously straightened stream channel, constructing infiltration trenches near homes, installing vegetated treatment areas and anaerobic digestors associated with livestock operations, practicing contour farming, and farming with a nutrient management plan.

Restoration Practices

Restoration practices assist the recovery of an ecosystem function that has been degraded, damaged, or destroyed. Damage refers to an obvious harmful impact to an ecosystem, such as draining a wetland or channelizing a stream tributary. Degradation refers to the disruption of an ecosystem’s structure, composition, and functionality by human impacts, such as over-grazing a woodland and persistent invasion of non-native species. Destruction, the most severe level of impact, is when degradation or damage removes the ecosystem completely, such as clearing land for farming or developing land for residential, business, and industrial uses (Society for Ecological Restoration, 2020).

- *Highly prioritized restoration practices* in this plan include constructed stormwater wetlands and conversion to natural areas.
- *Restoration practices with high applicability to the watershed* include restoration and invasive species removal of forest, wetland, and prairie ecosystems;
- There are no *restoration practices with low applicability to the watershed* in this plan.

Remediation Practices

Remediation is a term usually associated with cleaning up contaminated sites. We use it in the context of nonpoint source pollutants to represent practices that remove pollutants directly from surface water.

- The *highly prioritized remediation practice* in this plan is the installation of vegetated swales located downstream of pollutant sources.
- *Remediation practices with high applicability to the watershed* include installing floating treatment wetlands and naturalizing existing detention and retention basins.
- *Remediation practices with low applicability to the watershed* include constructing new or expanding existing detention and retention basins.

Stakeholders' Current Conservation Efforts

This watershed plan addresses how to improve water quality by suggesting ways to improve land use, implement best management practices, and educate residents and land managers about water quality issues. While outlining goals and targets for this watershed's improvement, it is important to first commend efforts already in place. The stakeholders within the watershed already practice conservation in various ways:

Grassed Waterways

Agricultural producers utilize grassed waterways on their croplands in low-lying channels to convey runoff. Grassed waterways protect fields from erosion and deliver stormwater runoff in a controlled manner. There are approximately 133 acres of existing grassed waterways in the watershed. The photograph below depicts one of the grassed waterways within the watershed.

Vegetated Swales

Vegetated swales are utilized throughout the watershed along roadways. A field survey within the watershed estimated that majority of roadway ditches are lined with conventional turf grass. However, approximately 20% of the roadway ditches appear to be properly managed and vegetated to be considered vegetated swales. These swales are planted with more durable and thicker bladed grass species than the Kentucky bluegrass used for turf. These swales are also mowed less often than turf grass swales. The condition and plant species in these roadway swales help to slow the velocity of runoff from the roadways and filter some of the pollutants out of the runoff. The remaining 80% of existing roadway ditches are frequently mowed and planted with conventional turf grass. There are 367 acres of paved roadways with gravel shoulders, with approximate cumulative dimensions of 30 feet in width and 532,884 feet in length. On average in this watershed, roadway ditches are about 17 feet wide. If all paved roadways had roadway ditches in the watershed, then there would be approximately 208 acres of roadway ditches. Therefore 42 acres, or 20% of the 208 acres of watershed-wide roadway ditches, are estimated to be vegetated swales.

Filter Strips

There are currently an estimated 115.5 acres of riparian filter strips along streambanks and 5.5 acres of riparian filter strips along waterbody shorelines, totaling 121 acres. These estimates are based on the streambank and shoreline inventory conducted in the watershed. The filter strips are approximately 50 feet in width, have at least 55% of the area vegetated with vegetation 12 inches or higher. Riparian filter strips help to stabilize streambanks and waterbody shorelines, reduce erosion into streams and waterbodies, and filter runoff before it enters streams and waterbodies.

Constructed Stormwater Wetlands

RPD installed a 0.64-acre constructed stormwater wetland on their Levings Lake property in 2019. The Park District plans to expand acreage upon this existing constructed wetland. The purpose of this wetland is to improve quality of stormwater runoff and control runoff volume (OES 2017).

Floating Treatment Wetlands

There are 20 BioHaven floating islands, more generally known as floating treatment wetlands, serving to filter water of pollutants in Levings Lake. They create an “x” formation in the middle of the West Rock Wake Park, doubling as a wave break for wake board riders. See photograph of Levings Lake below. The

islands are designed as habitat for microfilm consisting of beneficial bacteria that digests nutrients and other pollutants from the water. They are planted with native wetland species, which further aid in uptake of nutrients, heavy metals, and other pollutants. The waves created by the riders create movement that oxygenates the water, which makes the floating islands more effective in filtering pollutants by improving bacterial habitat, and the floating islands in turn dissipate the waves that would otherwise make for a bumpy ride. Nutrient levels in the lake near the islands are significantly less than nutrient levels in other parts of the lake based on 2019 monitoring. RPD will continue monitoring efforts on a roughly annual basis.

Detention/Retention Basins

According to our findings in the Watershed Resource Inventory, the watershed has 27 detention and retention basins covering 47 acres. For more information about the watershed's basins, see page 16 of the Watershed Resource Inventory. Basins help control and divert stormwater, allowing sediment to settle out of the stormwater before the water enters streams. Regular detention basins are sized to function in rainfall events up to 100-year storms. The Winnebago County Stormwater Management Ordinance's release rate for detention is 0.2 cubic foot per second per acre (cfs/acre). For detention purposes, Winnebago County Highway Department uses Type II, 25-hr, 100-Year Rainfall for Winnebago County, which is typically 7.36 inches but can vary from high 6s to low 7s depending on where the site is in Winnebago County (Winnebago County Highway Department).

Ponds

According to our finding in the Watershed Resource Inventory, the watershed has a total of 24 ponds, or waterbodies, totaling 46 acres. The largest waterbody is Levings Lake, a 23-acre lake located in the southeastern portion of the watershed. For more information about the watershed's waterbodies, see page 16 of the Watershed Resource Inventory. Waterbodies help control and divert stormwater, allowing sediment to settle out of the stormwater before the water enters streams.

Natural Areas

In the entire watershed there are 1,090 acres of forest, 212 acres of grassland, and 54 acres of wetlands. In total there are approximately 1,356 acres of natural areas, of varying degrees of quality, in the watershed. RPD manages the district-owned lands by controlling invasive species infestation. They have acquired and in some cases restored natural areas, including Hall Memorial Woods, a 40-acre high-quality woodland; Dennis School Woods, located east of Ingersoll golf course; some natural areas in the Ingersoll Memorial Disc Golf Park; and the riparian buffer of the northern Park-er-Woods pond and other wooded areas and riparian buffer along the tributary near the ponds. The RPD also hopes to treat the two ponds in Park-er-Woods residential area with muck pellets, which break down and reduce the amount of sediment and any pollutants trapped in that sediment.

Cover Crops

According to the USDA National Agricultural Statistics Service's *Census of Agriculture of 2017*, Winnebago County agricultural producers utilize cover crops on approximately 9% of croplands, representing 310 acres in this watershed. Cover crops are grasses, legumes, or other broadleaved plants planted for seasonal vegetative cover. Planting cover crops helps to reduce wind and water erosion, maintain or improve soil health and organic matter, suppress weeds, reduce excessive nutrient or herbicide application, improve soil moisture, and minimize soil compaction.

Farming with Conservation Tillage

Agricultural producers practice conservation tillage, or high residue till, by leaving 30% or more residue on their croplands after harvest. Conservation tillage leaves good vegetative cover on the ground, thus preserving soil moisture and organic matter. Conservation tillage also helps to keep soil in place and reduces the likelihood of gully and rill erosion to occur. High residue till is practiced on 2,726 acres, which represents approximately 80% of the watershed's cropland. The image below depicts the contrast of a crop field with high residue till on the left and low residue till on the right. This photograph is of cropland within the watershed and was taken by OES staff.

Table 2.1 summarizes all conservation efforts already in place in the watershed along with their prospective acreages.

Table 2.1 Current Best Management Practices

Best Management Practices	**Acreage**
Grassed Waterways	133
Vegetated Swales	42
Filter Strips	121
Constructed Stormwater Wetlands	0.64
Detention/Retention Basins	47
Ponds	46
No-Till/Conservation Till	2,726
Cover Crops	310
Natural Areas	1,356
Total	**4,781**

How to Improve Existing Conservation Efforts

Of the many conservation efforts continuing throughout the watershed, stakeholders and consultants recognize ways to better existing practices. Stakeholders have seen more rainfall in recent years when compared to historical trends, leaving some conservation practices undersized. Other practices may retain water only, and filtering capacity may be added. Other improvements may simply build on practices in place to make a bigger impact to the area's water quality.

Widen and Repair Grassed Waterways

As storms have been more frequent and intense in recent years, many area producers have noticed that the grassed waterways need to be widened or repaired to handle the larger flows. The width needed is site-specific and would need to be determined by the Natural Resources Conservation Service or engineer according to standard design parameters.

Naturalize Detention Basins

Existing detention basins that are currently mowed turf grass are suitable to be planted with native plants. Native plant aid in filtering water, and their roots are much deeper than conventional turf grass, extending the detention capacity into the enlarged root zone. Native plants may be installed in existing basins without major changes in basin design. Management shifts from mowing to less-frequent natural area stewardship. This practice is also a wonderful way to provide much-needed habitat for important pollinators like butterflies and bees and will attract a host of migratory songbirds to what was a barren environment.

Install Floating Wetlands at Existing Ponds

Floating treatment wetlands (FTWs) are man-made, floating wetlands that mimic naturally occurring wetlands in a concentrated capacity. Like naturally occurring wetlands, FTWs create an opportunity to filter pollutants in waterbodies (Floating Island International). Since they are installed directly on waterbodies, they filter free-floating nutrients out of the water that would otherwise feed algae.

Wetlands are nature's answer to the ever-increasing need for filtration of pollutants. Creating a floating wetland system introduces this benefit to the water body where only open water previously existed and where other standard best management practices cannot be installed. They are the final location available to treat pollutants, complimenting best management practices installed on lands located upstream within the watershed. Once pollutants and excess nutrients leach into the water system, it is difficult to filter them out unless the ecosystem has a wetland system nearby. Installing these man-made wetlands in areas that have no wetland filtering capacity or have degraded wetlands can greatly increase the filtering capacity of the water body. One 300-square foot island that is 8 inches thick has the capacity to decrease nitrogen by 83 lb/yr, phosphorous by 15 lb/yr, and total suspended solids by 5,850 lb/yr (Mark Reinsel, Apex Engineering, personal communication based on measured performance of BioHaven floating islands by Floating Island International in similar conditions).

Floating islands are already in place at Levings Lake, along with other best management practices like constructed wetlands and native plantings. The image above shows floating wetlands at Levings Lake. Consultants recommend installing additional islands at the mouth of Kent Creek and at the southern inlet to treat surface water as it enters the lake.

What More Can be Accomplished

Addressing Goals 1, 2, and 3

Residents, agricultural producers, and technical advisors chose best management practices (BMPs) recommended by consultants that would most likely be implemented in the watershed while also addressing Goals 1, 2, and 3. The recommended BMPs are split between three categories: top six prioritized BMPs, BMPs with high applicability in the watershed, and BMPs with low applicability in the watershed. All the recommended BMPs will effectively and efficiently reduce the amount of pollutants reaching the stream and waterbodies. By prioritizing six BMPs and determining which of the others are more and less applicable to this watershed, the group offers clear direction within a focused plan. Further details needed to implement recommended practices are explained in Chapter 4 for watershed-wide recommendations and in Chapter 5 for site-specific projects. Each project and practice listed below, no matter the level of prioritization, should consider enhancements to benefit wildlife, when applicable.

If stakeholders choose to implement the recommended BMPs within this plan, then they will help reduce the amount of nutrients that Illinois contributes to waterways, which correlates with the goals of the Illinois Nutrient Loss Reduction Strategy. Moreover, combining multiple conservation practices together allows for compounding benefits. All recommended projects and practices, no matter their priority, would lessen the sedimentation and nutrification of waterways and ease flashy hydrology during storm events. To view how efficient some of these recommended best management practices are at reducing each focus pollutant, see *Table 4.5* in Chapter 4. For the most part, the recommended BMPs address Goals 1, 2, and 3, which focus on reducing pollutants, erosion, and flooding in the watershed. However, there is overlap with some of the other goals, where BMPs recommended in this section not only address Goals 1, 2, and 3, but also address a different goal.

Chosen practices are recommended throughout the watershed, with some locations specified. To apply some of these practices, ordinances in place by homeowner associations and Winnebago County would need to allow for shoreline buffer plantings and other native vegetation associated with BMPS on private, association-owned, and publicly owned properties. Ordinances and associated guidelines would need to describe the allowed function and offer flexibility for the visual effect. Consultants recognize that many of these applications will require cultural change in the appearance and maintenance of the community’s landscape. The hope is that once homeowners understand the importance of these best management practices, they will embrace these changes and see their beauty.

Top Six Prioritized Best Management Practices

After reviewing a menu of best management practices appropriate for the watershed, stakeholders and technical advisors selected to focus on six top best management practices (BMPs):

1. Grassed Waterways
2. Vegetated Swales
3. Filter Strips
4. Constructed Stormwater Wetlands
5. Conversion to Natural Area
6. Streambank Stabilization

These six BMPs are selected based on several factors: high pollutant reduction efficiencies, favorable cost to benefit ratios, applicability to the watershed, and stakeholder interest. Consultants have created objectives, or measurable milestones, for each of these six BMPs to help meet the pollutant reduction targets and address Goals 1, 2, and 3.

Goal 1: Decrease pollutants in the water, including fecal coliform bacteria.
Goal 2: Minimize erosion, sediment, and nutrient loading into surface waters.
Goal 3: Address water volume and velocity to improve water quality and prevent flooding.

Objectives for goals 1-3:

- Install 41.32 acres of grassed waterways.
- Install 21.88 acres vegetated swales into existing swales.
- Install 286.47 acres of herbaceous filter strips.
- Install 18.3 acres of constructed stormwater wetlands on existing hydric soils.
- Convert 328 acres of land into natural areas.
- Stabilize 13.3%, or 5,145 feet, of very severely eroded and severely eroded streambank.

If a specific BMP is not listed in the top six list, it does not mean that implementing it is not worthwhile. Rather, having these six prioritized BMPs establishes a succinct list of pragmatically and financially possible BMPs on which to focus the community's time and efforts.

Grassed Waterways

Grassed waterways are broad and shallow channels that slow water velocity of runoff through crop fields and release water to a stable outlet. While the focus here is more on preventing erosion and enhancing water conveyance capacity, when the width of the grassed waterway is increased, then the filtering capacity and nutrient removal capabilities would also be increased.

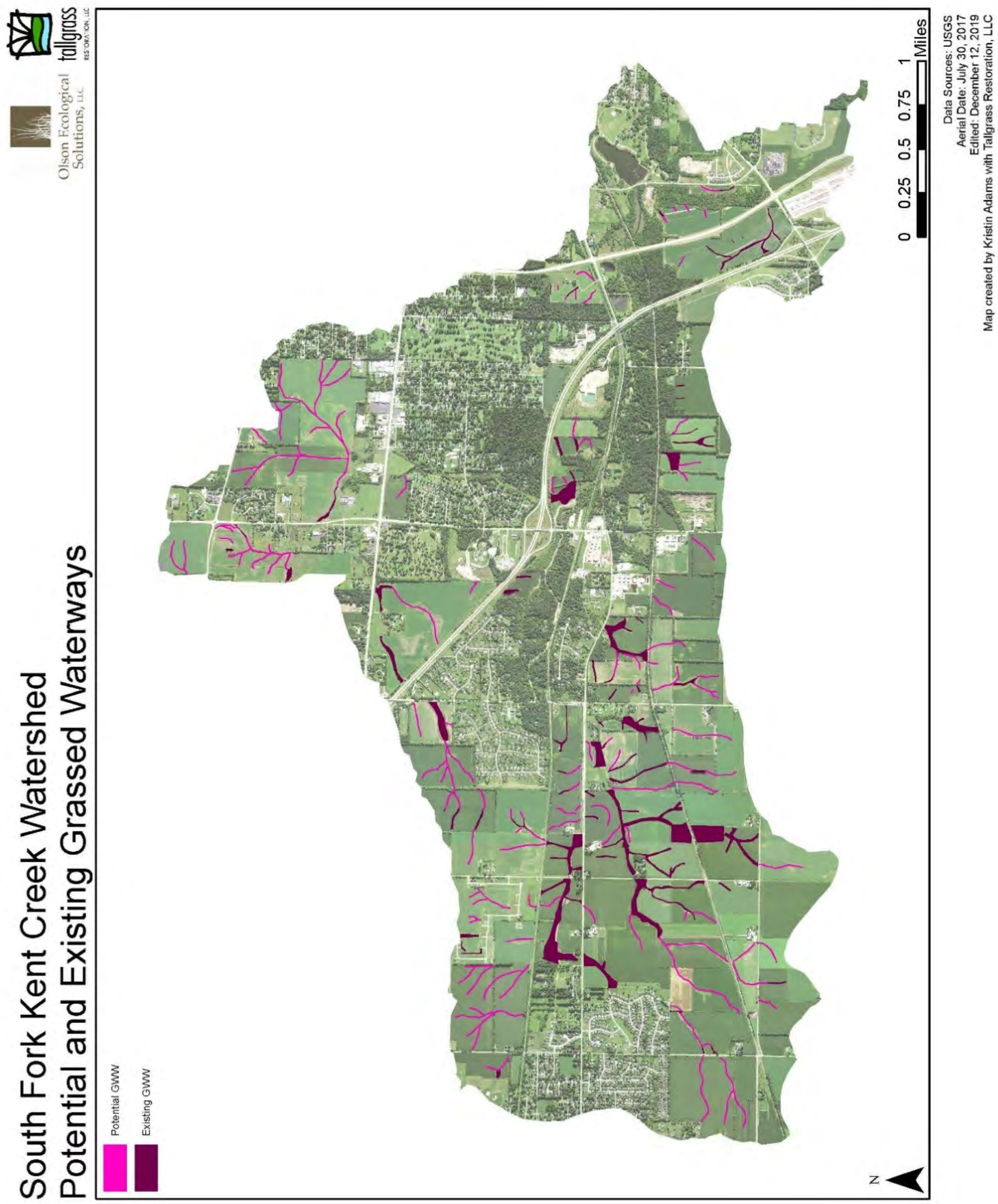
For this watershed, consultants recommend installing grassed waterways where needed and widen existing grassed waterways to handle the more frequent, more intense storms that have been documented in recent years. The watershed currently has 132.5 acres of grassed waterways. There is opportunity to install 75.4 acres of new grassed waterways at a width of 30 feet. Consultants came up with this estimate of 75.4 acres by utilizing aerial imagery to determine where water drainage in agricultural fields was occurring without the use of grassed waterways. Within this plan, consultants recommend installing grassed waterways on about 55% of the area, or 41.32 acres, with dimensions of 59,996.64 feet in length and 30 feet in width. The width of 30 feet is used as a planning standard. The actual width for an individual grassed waterway will need to be determined by the Natural Resources Conservation Service or other engineer based on site-specific factors.

Stakeholders identified one specific project area for installation of grassed waterways: a farm field near the southwest corner of Hawkins Drive and Westfield Road. This project is labeled as Westfield Farm and described in more detail in Chapter 5.

The image below is credited to Clean Water Iowa and depicts an example of a grassed waterway. To view a map of the watershed's existing and potential grassed waterways, see *Figure 2.1*.

Grassed Waterway, Clean Water Iowa

Figure 2.1 Potential and Existing Grassed Waterways



Vegetated Swales

Vegetated swales are shallow channels or swales vegetated with deep rooted plants, which filter out pollutants and slow stormwater. They intercept stormwater runoff from nearby impervious areas, concentrate water flow through the swale, and filter the stormwater through tall, native vegetation as it travels downstream through the swale. Vegetated swales can usually take the place of conventional ditches or storm sewers in developed areas. Their function is enhanced if check dams are added to detain stormwater temporarily. If soils are heavy clay, as is common in this watershed, amending the soil can enhance the infiltration capacity of the vegetated swale.

Throughout the watershed, the majority of roadway ditches are planted in mowed, turf grass. These conventional turf ditches do not allow for much filtration of pollutants out of stormwater or infiltration of stormwater into the ground. Roadways ditches have also been known to flood and eventually lead to flooding in the road. By converting these roadway ditches into vegetated swales with native, dense vegetation and check dams, the deep-rooted vegetation and check dams can slow the flow of water, allow stormwater recharge groundwater slowly, and filter out pollutants and sediment in the stormwater. When check dams are included in these densely vegetated swales, a series of cells are created that can be very effective at reducing runoff velocities and trapping pollutants. These BMPs differ from a ditch planted in turf grass, or grass swale, which does not employ check dams and does not reduce pollutants adequately enough to act as a stand-alone BMP (MNDNR, 2020). Vegetated swales also have advantages over concrete-lined ditches or storm sewers. Vegetated swales are less expensive to build, less expensive to maintain, preserve the drainageway's natural hydrologic characteristics, and clean stormwater (FEMA, p. 8-7). For more information about vegetated swales, also known as bioswales, please see the NRCS Bioswales Factsheet:
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_029251.pdf

Greenways, ditches, and drainage easements conveying water are priority locations for installing vegetated swales within the watershed. Consultants estimate that currently there are about 208 acres of ditches or greenways lining either side of roadways, with the dimensions of 17 feet in width and 532,884 feet in length. Much of the 208 acres are covered in turf grass and mowed at least three times per year. Within this plan, consultants recommend installing vegetated swales on 10.5% of the roadway ditches, or 21.88 acres, with dimensions of 63,540 feet in length and 15 feet in width at the top of the swale. The width is a planning standard, and actual width will need to be determined on-site by an engineer.

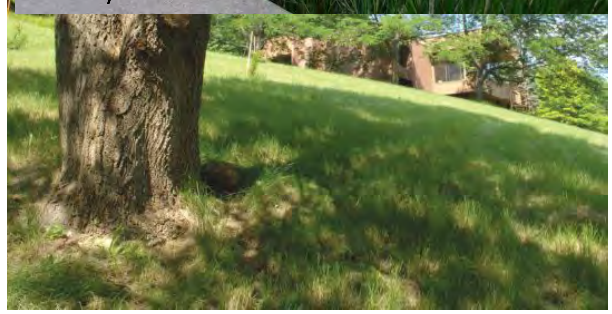
Alternatively, to meet the objective, vegetated swales can be installed along other existing ditches or drainage easements in residential areas, commercial areas, or along railroads. Any drainage easement swale with erosion, sedimentation, or other water quality related impairment poses as a great opportunity to implement vegetated swales. If a swale or ditch is on a residential or commercial property but within a Winnebago County drainage easement property, then the landowners are responsible for maintenance of the swale. The Winnebago County Highway Department sees these types of improvement projects in drainage easement swales as a great opportunity for the watershed to improve water quality and drainage swale function.

Stakeholders identified some locations to install vegetated swales: a wet depression on the south side of the south Park-er-Woods pond, roadway ditches within Park-er-Woods, roadway ditches along Meridian Road, a drainage swale on residential property near Hidden Oak Trail, and wet, eroded areas on the Ingersoll Golf Course. Beyond these site-specific treatments, consultants recommend finding other ditches carrying stormwater that could be filtered and slowed down by converting turf grass to deep-rooted, native sedges, grasses, and wildflowers.

Consultants recommend using native vegetation within the vegetated swale and installing them on areas with existing stormwater ditches containing mowed turf, usually found along roadways or in rural subdivisions. Native vegetation seed mixes and other plant materials can be tailored to the area, accounting for sunny or shady conditions and wet or dry soils. Consultants recommend "low profile" native seed mixes to ensure vegetation does not get too high and becomes dangerous to roadway traffic visibility. The Illinois Department of Transportation recommends any roadway plantings that are not to be mowed within 10 feet of the shoulder should not exceed a height of 3 feet at maturity and should not interfere with sight distances (IDOT 2010).

Current county and township roadway ordinances require rights-of-way (R-O-W) to be mowed three times a year, usually in May, July/August, and October. The Winnebago County Highway Department and Rockford Township, who are some of the public entities responsible for roadway and R-O-W maintenance in the watershed, may consider changing the ordinances

Prairie Moon
Nursery Eco-Grass



to allow for these native plantings alongside roadways and more infrequent mowing when safe for vehicle operations on roadways. If mowing ordinances along certain roadways are not able to be changed or if natives aren't accepted at a certain location, this plan recommends a second option to natives: Eco-Grass. Eco-Grass is a low maintenance, versatile grass blend of fescues created by Prairie Moon Nursery. Eco-Grass establishes quickly, growing into a flowing carpet that can go unmowed or be mowed to a recommended 3" height occasionally or frequently, depending on rainfall, application and intended use. It will tolerate the mowing schedule currently in use as well as variations in sunlight. Eco-Grass is not as tall as native and its root system extends about eight inches deep, which offers more filtering capacity than conventional turf grass. The two photos below show areas stablished with Eco-Grass. https://www.prairiemoon.com/eco-grass

Herbaceous Filter Strips

Herbaceous filter strips are sections of land vegetated with herbaceous cover. Consultants encourage the use of native, deep-rooted vegetation. Stormwater passes through vegetation, and the filter strip slows runoff and filters out sediment, organic matter, and other pollutants before emptying into ditches, swales, or other bodies of water. Filter strips may provide some reduction in stormwater runoff volume, but their primary function is to filter out contaminants in stormwater runoff. Filter strips are usually located between impervious surfaces or agricultural fields and the waters to which they drain. Runoff sheet flows off adjacent lands and creeps through the filter strips in a perpendicular direction prior to entering the nearest waterway. Herbaceous filter strips can be located along streambanks and shorelines or at the edge of farm fields or home lots. Filter strips along streambanks and shorelines are often referred to as buffer strips or riparian buffers.

Recommendations for this watershed are focused on buffering streams and waterbodies that have little to no riparian buffer, although at the border of a crop field or residential lot would be just as highly prioritized and effective. Technical advisors suggest that some agricultural producers near the Village of Winnebago could benefit from installing filter strips. The image above is a photograph of South Fork Kent Creek taken by OES staff. It depicts an example of an ideal location for installing riparian filter strips adjacent to the stream, as it currently has mowed turf grass up to the water's edge.

Filter strips along streams and waterbodies may have forested or herbaceous vegetation. Herbaceous riparian filter strips along streams or waterbodies are planted with permanent, herbaceous vegetation. Whereas, forested riparian filter strips along streams or waterbodies are planted with trees and shrubs. For planning purposes, consultants utilized 35-foot wide, herbaceous riparian filter strips for estimating costs and pollutant reductions in implementing this BMP. An herbaceous filter strip of this width can treat a *pervious* drainage area with linear flow of 150 feet or an *impervious* drainage area with linear flow of 75 feet while offering the reported efficiency. If the run of a drainage area flowing into the filter strip is greater than 150 feet from pervious areas or 75 feet from impervious areas, or if there is room for a filter strip wider than 35 feet, consultants recommend for stakeholders to consider widening the filter strip. A 50-foot filter strip will result in more benefits than a 35-foot filter strip; however, there is not always enough interest or room to accommodate 50-foot filter strips without impacting the uses of the property.

Within this plan, consultants recommend installing 35-foot-wide herbaceous filters strips along 356,532 feet of developed land or streambank for a total installation on 286.47 acres. Consultants recommend the following locations for implementing filter strips.

- Install herbaceous filter strips between impervious surfaces, i.e. parking lots, driveways, etc., and surface water.
- Line streambanks with herbaceous filter strips of permanent, native vegetation.
- Plant herbaceous filter strips above waterbody shorelines, including those lined with rip rap.
- Install herbaceous filter strips along the perimeter of stormwater basins if they receive sheet flow runoff.

Herbaceous Filter Strips along Streambanks

Herbaceous filter strips along streambanks should be created on streambanks with buffers in poor condition. Approximately 55% (or 134,708.2 feet) of streambanks have poor riparian buffers. If 35-foot riparian buffers are installed surrounding all 134,708.2 feet, then that will result in 108.2 acres of newly planted riparian buffers along streambanks. Stakeholders may also want to consider installing riparian buffers along streambank buffers in fair condition, although only about 3% (or 7,347.7 feet) of the watershed's streambanks have fair riparian buffers. If 35-foot riparian buffers are installed surrounding all 7,347.7 feet, then that will result in 5.9 acres of newly planted riparian buffers along streambanks. Within this plan, consultants recommend installing filters strips on all 114.1 acres with dimensions of 142,005.6 feet of bank and 35 feet wide.

Herbaceous Filter Strips along Shorelines of Ponds

Herbaceous filter strips along shorelines of water bodies involves installing, establishing, and then maintaining plant species that can tolerate intermittent flooding as the dominant vegetation cover in the transitional zone between aquatic and upland habitats. This plan recommends a minimum width of 35 feet for riparian buffer strips of lakes and ponds; although, any width is encouraged, as some areas may not be large enough to create 35-foot wide riparian buffers.

There is about 29,063 feet of shoreline perimeter along waterbodies in the entire watershed. Using the 35-foot width dimension for riparian buffers translates to 23.4 acres of shoreline buffers along waterbodies in the entire watershed. Similar to streambanks, the riparian buffers along the pond shorelines varied in riparian condition. Approximately 66% (or 19,182 feet) of shoreline perimeter along waterbodies have poor riparian buffers, resulting from little to no vegetation surrounding the waterbodies. Consultants recommend installing 35-foot riparian buffers surrounding all 19,182 feet, resulting in 15.4 acres of newly planted riparian buffers along waterbody shorelines in poor condition. In addition, stakeholders identified one site for installation of riparian buffer strips along waterbody shorelines: surrounding the two ponds in Park-er-Woods.

Riparian filter strips along streambanks and shorelines only amount to 129.5 acres. Within this plan, consultants recommend installing filters strips on 286.5 acres with dimensions of 356,532.4 feet of bank and 35 feet wide. An additional 157 acres of filter strips can be installed near impervious surfaces like parking lots and roadway; along edges of pervious areas such as farm fields and lawns; or along the edge of drainage channels, basins, or other BMPs. Stakeholders identified two sites, namely the Ingersoll Golf Course and the Westfield Farm, for installation of buffer strips along wet eroded areas or alongside impervious surfaces.

Table 2.2 Recommended locations for vegetated filter strip installation

Vegetated Filter Strip Locations	**Recommended Acreage**
Streambanks - poor condition	108
Streambanks - fair condition	6
Shorelines - poor condition	15
Near impervious surfaces, edge of pervious lawns or farm fields, or edge of drainage channels or basins	157
Total	**286**

Constructed Stormwater Wetlands

In addition to the 58 acres of existing wetlands at the time of the inventory, there are 3,803 acres of hydric soils with wetland creation potential. Hydric soils are one of the field indicators for wetlands; they are formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper portion of soil layers. If one were to construct a wetland, the least expensive and most appropriate site would be one with hydric soils since it historically held wetlands prior to manipulation, has the most ideal soils for wetland creation, and requires the least amount of hydrogeomorphic manipulation.

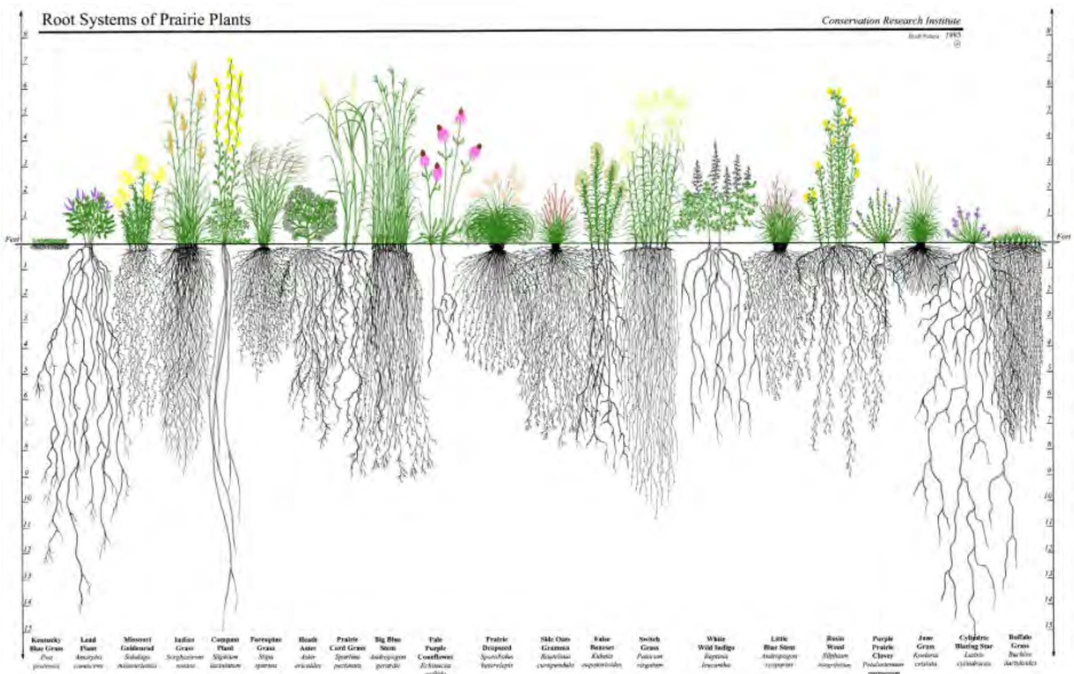
The stakeholders, technical advisors, and consults both recognize the importance of wetland restoration to water filtration and see the vast opportunity within this watershed to implement constructed stormwater wetlands. Another advantageous characteristic of a constructed stormwater wetland is its ability to store and detain stormwater. Since a large issue in this watershed is the seemingly increased volume and velocity of stormwater, this particular BMP, which also filters water, will be a great tool for the watershed, especially when these detention areas are located higher up in the watershed. When stakeholders initially heard about constructed stormwater wetlands as an option for their watershed, some concerns and questions did arise: Will they actually store water and reduce flooding? Will they attract mosquitoes? Not all wetlands have areas of persistent, standing water, as areas with soils saturated within 12 inches of the surface continuously for at least 14 days of the year function as wetlands (US Army Corps of Engineers, 2010). If designed correctly with the right depths, water table consideration, drainage flow, and proper vegetation, wetlands will drain effectively and not harbor mosquitoes.

For size considerations, consultants recommend a constructed stormwater wetland average size of 3 acres per 100 acres of drainage area. Within this plan, consultants recommend installing constructed stormwater wetlands on 0.5% of the area containing hydric soils, or 18.3 acres. One reason why this watershed-wide target is such a low percentage of its possible opportunity is because technical advisors believed it would be difficult to find areas large enough to install constructed stormwater wetlands.

Stakeholders identified two sites for installation of constructed stormwater wetlands that would filter nutrients and sediment: the northwest corner of Cunningham Rd. and S. Weldon Rd. and on the southwest side of the Westfield Farm.

Conversion to Natural Area

Plants native to the region provide benefits to water quality, streambank stabilization, erosion control, animal and insect habitat, and aesthetic appeal. Many native plants have much deeper roots than cultivated or invasive plants. For instance, *Poa pratensis*, or Kentucky bluegrass, is the traditional species used for lawns/turf grass areas. However, Kentucky bluegrass has root systems that reach about 2-4 inches deep. The image below is from the Conservation Research Institute. Kentucky bluegrass is located on the far-left side. Compared to the complex 3+ foot root systems of some native prairie plant species, like Big bluestem, Pale purple coneflower, and Prairie dropseed, Kentucky bluegrass absorbs much less water and requires more maintenance (regular watering and regular mowing) than native plants. Natural areas containing a diverse array of native plants stabilize soil, thus reducing soil erosion, improve water quality by filtering out pollutants, provide wildlife habitat, reduce ponding, and provide stormwater storage.



Stakeholders see the value in natural areas and native plants. Stakeholders and public entities can consider converting portions of lawn, open fields, or parks into natural areas planted with native vegetation. Using deep-rooted, native vegetation for other recommended BMPs like herbaceous filter strips and vegetated swales. Using native plants within these BMPs increases infiltration of runoff, making it a benefit over cultivars no matter where they are planted. Planting natives in the path of water flow is prioritized for water filtration; however, any native planting will improve the overall environmental health of the area and provide important wildlife habitat.

Conservation easements and deed restrictions are two ways to ensure the continued protection of natural areas, open space, and wildlife habitat. Both are voluntarily put into place on natural lands with willing landowners. Conservation easements represent a legally binding agreement that restricts certain types of land uses or prevents development from taking place on the land in perpetuity while the land remains in private hands (The Nature Conservancy). The landowner voluntarily donates or sells certain rights associated with their property, i.e. the right to subdivide or develop land, and a private organization or public entity holds the right to enforce the landowner's agreement to not exercise those rights. A conservation easement is one option to protect a property's conservation value for future generations while allowing landowners to retain many private property rights, including living on and using their land and a potential for tax benefits. If the landowner donates the right to develop or farm, then they are eligible for tax benefits. The conservation easement only targets and restricts the right necessary to protect the conservation values of the land, like water quality. If the property is sold or passed on to heirs, the conservation easement still stands as legally binding.

Deed restrictions and conservation easements are very similar. The most significant difference is that that conservation easements, if written properly, are allowed much more protections of the law under most states' statutes (Marchetti Ponte, Land Trust Alliance). Another difference is that conservation easements that meet certain qualifications are eligible for income tax treatment as a charitable gift. A dead restriction is not permanent unless it is "appurtenant" to nearby land, meaning that the deed restriction must benefit nearby land and run with the title to both properties. Therefore, a deed restriction is only enforceable during the lifetime of the landowner. Moreover, the grantee, i.e. land trust or public entity holding the right to develop, cannot transfer a simple deed restriction to another land trust or public entity. Courts can terminate deed restrictions based on economic hardship or impracticability, without regard to public benefit. Therefore, the conservation easement is stronger legally.

Within this plan, consultants recommend converting turf areas to natural areas with native plants on 5% of high intensity development, 10% of medium intensity development, 15% of low intensity development, 5% of the golf course, and 20% of turf, totaling 328 acres.

RPD identified several specific locations for expansion or continued restoration of natural areas, namely Ingersoll Memorial Park, Dennis School Woods, and Hall Memorial Woods. Below are photographs from natural areas, specifically grasslands and forest, within the watershed.

Streambank Stabilization

Streambank Stabilization (i.e. Streambank Protection) is the process of stabilizing and protecting streambanks to reduce the negative effects of sedimentation, both on-site and downstream, resulting from bank erosion. Sediment eroding into streams often contains high levels of nitrogen and phosphorous. Thus, if eroding streambanks within the watershed are stabilized, then less nitrogen and phosphorous containing sediment enter the streams and lakes. Consultants categorize the streambanks by severity of erosion using four categories: slight, moderate, severe, and very severe. See *Table 2.3* for a breakdown of this criteria. For more information about streambank erosion within the watershed, please see pages 77-78 of Section 1: Watershed Resource Inventory. Streambank stabilization reduces sediment, nutrients, and bacteria loading by varying amounts depending on its severity. For instance, stabilizing a streambank that is very severely eroded will reduce more pollutant loading to waterways than stabilizing a streambank that is severely, moderately, or slightly eroded. Therefore, this watershed priorities stabilizes very severely and severely eroded streambanks.

The amount of very severely eroding streambanks within the watershed was estimated as 9%, or 22,043 feet of streambanks. The amount of severely eroding streambanks within the watershed was estimated as 27%, or about 66,129 feet of streambanks. Consultants estimate that the severity of streambank erosion is likely due to intensive adjacent land uses combined with lack of herbaceous filter strips and forest stewardship.

The plan aims to stabilize 8.3%, or 1,835 feet, of very severely eroding streambank and 5%, or 3,310 feet, of severely eroding streambank. The photographs below represent severely eroded streambanks and very severely eroded streambanks, respectively, within the watershed.

Severely eroded streambank

Very severely eroded streambank with tree roots exposed

Table 2.3 Erosion Category for Streambanks

Lateral Recession Rate (Erosion)		
LRR (ft/yr)	**Category**	**Description**
0.01 - 0.05	Slight	Some bare bank but active erosion not readily apparent. Some rills but no vegetative overhang. No exposed tree roots.
0.06 - 0.2	Moderate	Bank is predominantly bare with some rills and vegetative overhang.
0.3 - 0.5	Severe	Bank is bare with rills and severe vegetative overhang. Many exposed tree roots and some fallen trees and slumps or slips. Some changes in cultural features such as fence corners missing and realignment of roads or trails. Channel cross-section becomes more U-shaped as opposed to V-shaped.
0.5+	Very Severe	Bank is bare with gullies and severe vegetative overhang. Many fallen trees, drains and culverts eroding out and changes in cultural features as above. Massive slips or culverts eroding out and changes in cultural features as above. Massive slips or washouts common. Channel cross-section is U-shaped and streamcourse or gully may be meandering.

Other Best Management Practice Options

Consultants prioritized other practices beyond these six BMPs, ranging from BMPs with high applicability within the watershed to BMPs with low applicability within the watershed. These other BMP options are based on stakeholder interest and watershed applicability. Again, if a BMP is not listed in this plan, it does not necessarily mean it should not be implemented in this watershed. If a stakeholder can find a site where implementing a specific BMP not mentioned in this plan is efficient at reducing nitrogen, phosphorous, TSS, or bacteria and is cost-effective, then the stakeholder should move forward with that project. Moreover, it is important to note the need to stay current with best management practice options and adapt the plan accordingly over time, as some opportunities might come into existence after this plan is written. The objectives created for Goals 1, 2, and 3 do not consider pollutant load reductions from implementing any of the other BMP options detailed below; therefore, specific amounts of each BMP listed below are not specified. However, if stakeholders are unable to completely meet the objectives listed for the top six prioritized BMPs, then consultants recommend considering implementing BMPs with high applicability to supplement pollutant reductions and ensure pollutant reduction targets are met.

Best Management Practices with High Applicability

BMPs with high applicability either apply to the entire watershed or differed between the residential and rural portions of the watershed.

Those that can be applied to the entire watershed included the following:

- Forest stabilization by addressing erosion and invasive brush removal in forest, particularly in forest riparian zones and 100-year floodplains.
- Wetland restoration and prairie restoration to restore ecosystem functions and protect wildlife habitat.

In addition to the practices above that apply to the entire watershed, other highly applicable residential practices within the residential community given high priority by stakeholders and consultants include:

- Septic system maintenance
- Lawn care
- Rain gardens
- Rain barrels

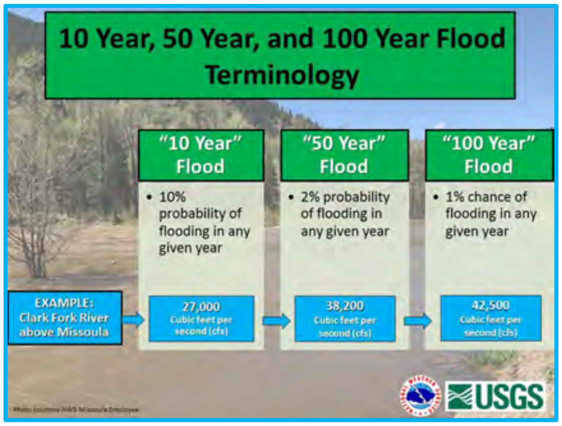
Within the rural community, practices considered to have high applicability in addition to those listed above are:

- Livestock exclusion fencing
- Stream crossing
- Critical area planting
- Cover crops
- No till
- Agricultural easements to preserve prime farmland.

Any of the highly applicable BMPs can be used to achieve the overall pollutant load reduction targets. Pollutant load reductions are not calculated for each BMP with high applicability, nor are watershed-wide or site-specific objectives selected. Rationale for listing each of these practices as highly applicable is discussed below.

Forested Buffer Strip

A forested buffer strip is an area predominantly vegetated with trees and/or shrubs located adjacent to and up-gradient from watercourses or water bodies. Forested buffer strips can reduce excess sediment, nutrients, and pesticides from surface runoff, reduce excess nutrients and chemicals in shallow ground water flow, reduce pesticide drift from entering surface water, and improve riparian habitat (University of Missouri Extension). This watershed already has a large amount of forest, so the recommendation is not to create new forested buffer strips, but rather, consultants recommend managing existing forests so that forested buffers 100 feet wide from streambanks or shorelines can function properly to provide the benefits described above. Forest covers 14%, or 1,090 acres, of the entire watershed. It is the third most abundant land use followed by high residue till cropland (35.1% area coverage) and low intensity development, i.e. residential areas (19.5% area coverage). Moreover, forest is the highest land use type located within the 100-year flood zone. Approximately 135 acres of forest reside within the 100-year flood zone. The 100-year flood zone is a designated area that has a 1% chance of flooding in any given year. However, a flood can occur in the 100-year flood zone more than once in a 100-year period and is possible to flood more than once in the same year. Essentially what this means is that a good portion of the watershed's streams flow through forest. Stakeholders value the forest and desire to preserve and restore the forest. Consultants recommend addressing erosion and invasive brush invasion in forest, particularly within forest riparian zones. Stakeholders can stabilize these forest riparian areas by removing invasive shrubs or other non-native vegetation and allowing natural ground cover to re-establish. Invasive shrubs have taken over these forested areas and shaded out stabilizing ground cover. Stewardship of these lands choked with invasive species would allow ground cover to fill in, therefore reducing erosion and protecting water quality.



By managing these forest buffer strips along streams and waterbodies, stakeholders are also improving forest stands. One purpose of forest stand improvement that correlates to the NLRS is to "alter quantity, quality, and timing of water yield" (NRCS eFOTG, 2018). This calls for diversity in tree age classes and for canopy openings to foster a diverse array of understory vegetation. Trees and understory vegetation should vary in plant species and height. These considerations further improve precipitation infiltration, reduce runoff and erosion, and reduce nutrient loading into the watershed. The photo to the right depicts a tributary in the watershed flowing through a woodland. The woodland has a thick canopy, which results in very little herbaceous understory. Herbaceous understory can help with water infiltration and reduce the amount of runoff into nearby streams and ponds.

Wetland Restoration & Prairie Restoration

As towns and development occurs, many former prairies and wetlands are converted into residential and commercial development. Wetlands act as nature's kidneys by filtering water. Prairie plants have adapted to the hot summers and cold winters of Illinois. The roots of prairie plants can grow to up to 12 feet deep and have extensive biomass. These native prairie plants and their roots soak up stormwater, filter stormwater, and stabilize soil. Restoring wetlands and prairies can help improve the water quality, wildlife habitat, and aesthetics in the watershed. Consultants recommend restoring wetlands and prairies wherever enough land is available and landowners are interested.

Septic System Maintenance

Approximately 488.3 acres of residential land are serviced by septic systems. Of the 488.3 acres of residential land serviced by septic, about 330 acres are located along the main stem of the creek. The remaining 158.3 acres of residential land likely to be serviced by septic systems are located about one mile north of the main stem in the very northern portion of the watershed. Consultant recommend focusing primarily on the 330 acres residential neighborhoods that are both likely to be serviced by septic and also located in close proximity to the main stem of the South Fork Kent Creek. See *Figure 2.2* for locations and acreages of the neighborhoods serviced by septic systems in the watershed.

This watershed is deemed an impaired stream by the Illinois EPA due to elevated levels of fecal coliform from unknown sources. Since faulty septic systems are one possible source of fecal coliform, stakeholders believe septic system maintenance and education on this topic is extremely important. Proper use and maintenance of septic systems are necessary to prevent it from malfunctioning and leaking pollutants into local waterways. In particular, stakeholders desire to inform all homeowners of the fecal coliform impairment in the creek. Education and outreach for this topic are further discussed in Chapter 3.

The Lake County Stormwater Commission lists some ideas to help address the possible issue of septic system failure:

- Pumping or inspecting the system once every three years
- Diverting surface water away from the drain field
- Avoiding driving or parking on the drain field to prevent soil compaction
- Keeping the roots of trees and shrubs away from the drain field pipes to avoid obstructed drain lines
- Consider aerobic digesters when it is time to replace the system

Beyond prioritizing septic system maintenance as an education topic, the group discussed different options of how to best address septic system maintenance and the possibility of septic failure in the watershed. Stakeholders and technical advisors suggest that subdivisions on septic could elect to hook up to the sewer line, which is already in place. According to the Rock River Water Reclamation District and State law, if a septic system failure occurs within a certain distance of the sewer line (300 feet), then the Winnebago County Health Department will not issue the landowner a permit to build a new septic field. The landowner must connect to the sewer line. A concern in this watershed related to septic systems is that households that formerly used septic systems but are now connected to the sewer line may be leaking into surface water. However, the RRWRD confirmed that when areas are converted from septic to sewer service, the abandoned septic fields are required to be properly filled by a licensed plumber. Some stakeholders wonder if the Winnebago County Health Department should enact certain requirements for septic system maintenance. This topic is quite controversial since this plan is meant to be voluntary and not regulatory. On one hand, the group does not want to enforce requirements onto landowners, but on the other hand faulty septic system seem to be a likely source of these elevated fecal coliform levels, and stakeholders think something should be done to address that possibility. Winnebago County currently does not have any septic system maintenance standard requirement besides the owner of the septic system being responsible for upkeep and action if the septic system shows signs of failure. Moreover, some stakeholders acknowledge that septic fields are not emptied at the recommended timeframe of every 2-3 years.

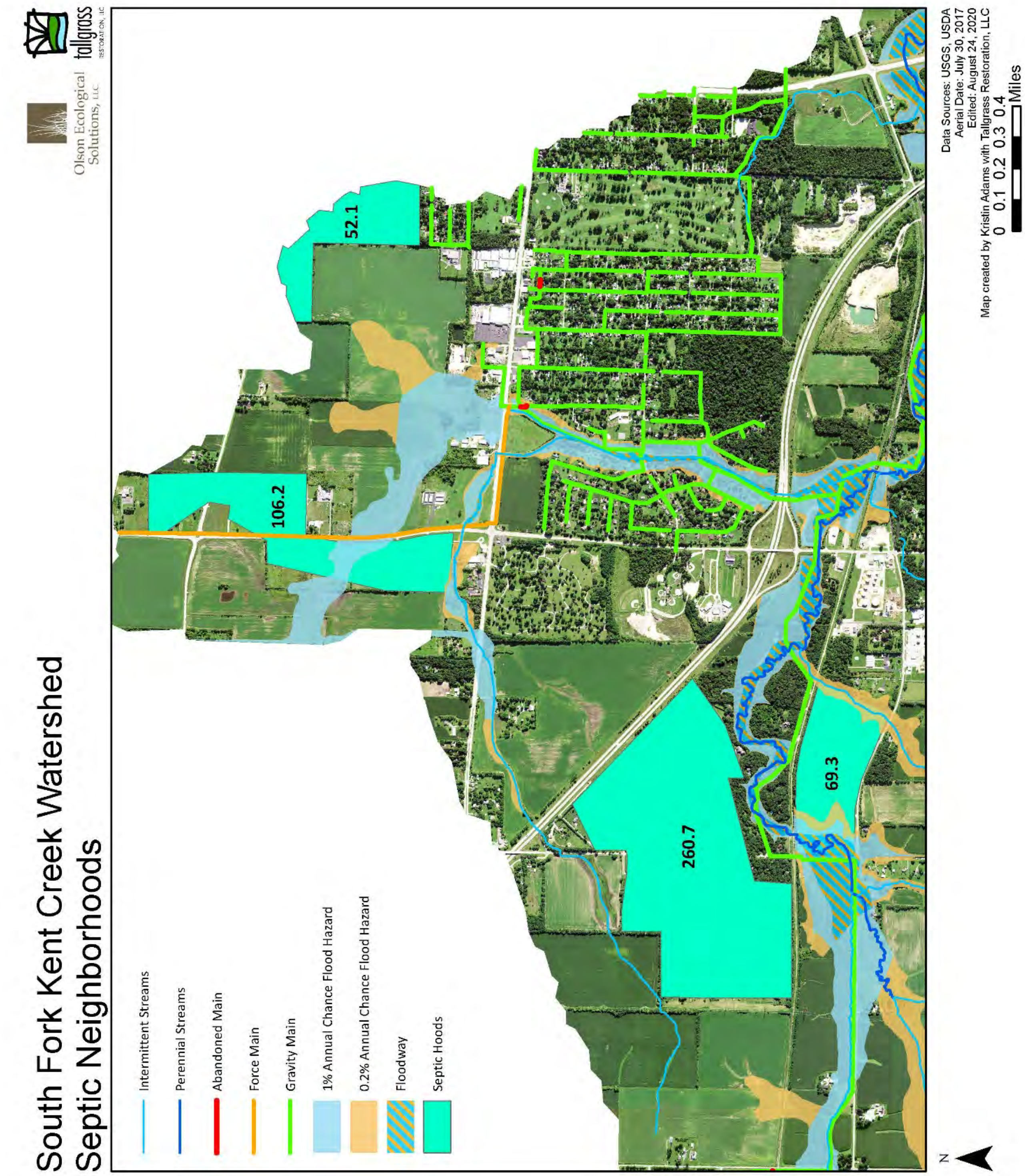
According to the University of Kentucky College of Agriculture, approximately 33% of septic systems from two Indiana counties installed between 1950 and 1990 required repairs throughout their lifetime (Lee 2012). However, after Indiana updated their septic code system, less than 3 percent of new septic systems required repairs. This reduction in septic failure for these two Indiana counties reveals the importance of septic maintenance and improved design.

The state of Wisconsin provides another example of septic maintenance code that successfully reduces the amount of faulty septic systems. The state of Wisconsin has septic system maintenance agreements, which set different requirements based on the type of septic system. For instance, the servicing frequency for an anerobic treatment tank for a septic system is required by Wisconsin legislation to occur "at least when the combined sludge and scum volume equals 1/3 of the tank volume" (Wisconsin State Legislature, 2019). Wisconsin septic systems with a holding tank require servicing when tank wastewater is one foot below the inlet invert of the tank. Lastly, Wisconsin septic systems that use a treatment or dispersal component consisting in part of in situ, or original, soil must be visually inspected at least once every three years. This legislation ensures proper maintenance and inspection so that leaking septic systems do not contaminate surface water.

Stakeholders agree that the Winnebago County Health Department should advocate for the people of the Winnebago County and protect the natural resources in the watershed, but they are hesitant to petition for enacting septic system maintenance and cleaning requirements. Recommendations for the involvement of the Winnebago County Health Department in septic system maintenance are further discussed on page 2-37 of this chapter.

This plan recommends following Illinois EPA guidelines for septic systems: homeowners with septic systems inspect their septic systems annually and pump out their septic systems regularly. According to the Illinois EPA, a three-bedroom house with a 1,000-gallon tank should be pumped every two to five years, whereas, smaller tanks should be pumped more often.

Figure 2.2 Septic System Neighborhood Acreages



Lawn Care

Residential homes and lawns contribute to nutrient pollution. Roadside storm drains often lead to local streams without treatment (Illinois EPA, Nutrient Pollution). Residential areas can largely contribute to excess nitrogen and phosphorous in waterways from a number of sources: fertilizer, pet waste, and leaf and grass litter. Homeowners or landscaping services can over fertilizer and/or over-water lawns. When excess fertilizer is applied to lawns, precipitation or over-watering can carry the fertilizer into nearby ponds and stream or into storm drains. Pet waste that is not properly disposed of contributes nitrogen, phosphorous, parasites, and bacteria into nearby surface water. Additionally, grass clipping and leaf litter near storm drains, streams, or ponds can release excess nitrogen and phosphorous in surface water. The Illinois EPA provides tips and suggestions for homeowners to help reduce nutrient pollution in and around the home on various topics: cleaning supplies, pet waste, septic systems, water efficiency, vehicles, lawn care, and garden care. These tips are found on the Illinois EPA website under Nutrient Pollution: What You Can Do at https://www.epa.gov/nutrientpollution/what-you-can-do.

In an effort to reduce fertilizer application on lawns and crop fields, this plan encourages testing soils for its nutrient content prior to applying additional nutrients. Agricultural producers are often aware of resources for such services, but homeowners would benefit from an organized community program and education. Nutrient reduction potential varies, and no specific targets for lawn care and soil testing are proposed within the life of this plan, although this plan recommends increasing education on the topic of lawn care.

Rain Gardens

A rain garden is a depressed, landscaped garden designed to retain and infiltrate stormwater runoff from individual residential or commercial lots, sump pumps, and roofs. Rain gardens are versatile features that can be installed in almost any unpaved space. Rain gardens have also been used successfully along streets to reduce and filter street runoff. (Lake County Stormwater Management Commission). Installed next to rooftops, driveways, parking lots, or other impervious surfaces, rain gardens are one of the first conservation features to intercept stormwater runoff from the source. They are small detention features planted with water-tolerant vegetation that are suitable for use in private lawns that can be maintained as attractive gardens. Preferably, the vegetative is deep-rooted native vegetation, which is more capable of infiltrating runoff than cultivars. They minimize the amount of runoff leaving the property since much of the water will be allowed to infiltrate and evaporate, thus alleviating issues downstream.

Rain Barrels

A rain barrel is a container used to capture and temporarily store rainwater for future use. Generally, landowners connect rain barrels to roof downspouts. Landowners can use the water captured in the rain barrels to water lawns and gardens. Rain barrels not only reduce runoff but also captures runoff before it has a chance to become polluted and end up in nearby waterways. For more information about rain barrels please see the Lake County Stormwater Management Commission website at https://www.lakecountyil.gov/3609/Residential-Rain-Barrels.

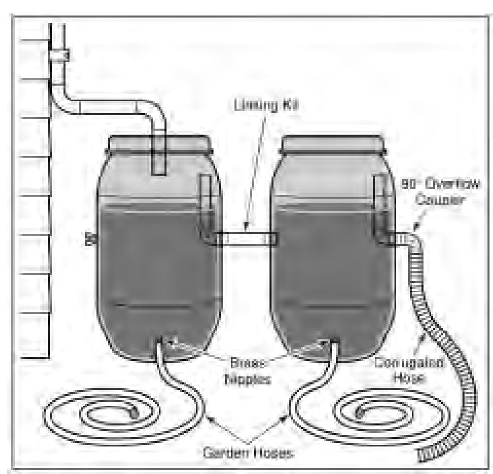


Image Source: Lake County Stormwater Management

Livestock Exclusion Fencing with Alternative Water Supply

There are approximately 37 acres of pasture in the watershed. The pastureland has fencing around property borders, but not all pastureland has fencing along streambanks and waterbody shorelines to keep livestock out of surface water. If cattle and other livestock are allowed to freely roam into streams and ponds then it causes significant bank and shoreline erosion, sediment build-up in the water, and animal waste, e.g. fecal coliform, in the stream. This plan recommends providing alternative water supply and installing fencing along all streambanks or shorelines present on pastureland. The image below, sourced from the NRCS, demonstrates how livestock exclusion fencing along streams and alternative water supplies for livestock can immensely stabilize the bank, allow vegetation to return, and reduce the livelihood of animal waste from reaching waterways.

Before and after cattle exclusion on a stream. Photos from NRCS

Livestock Exclusion Fencing with Stream Crossing

If a livestock producer is unable to provide livestock with an alternative water source, then the second recommended option is to install livestock exclusion fencing and a stream crossing. Stream crossings are structures constructed across a stream to allow controlled passage over a stream for livestock, people, equipment, or vehicles. Common types of streams crossing are constructed access bridges, culverts, or fords. The function of the crossings is to keep direct contamination out of a stream while maintaining the integrity of the physical streambank and streambed. This practice can improve water quality by reducing sediment, nutrients, and bacteria loading into a stream. This practice also reduces streambank and streambed erosion (NRCS eFOTG). This BMP is less effective at reducing pollutant loads into surface water than fencing with an alternative water source, but it is better than no fencing at all.

A stream crossing must be non-erosive and structurally stable. Bridges typically cause the least amount of disturbances to the stream bed or flow, but they are the most expensive to implement. Culverts are the most common and least expensive crossing to construct because building material can be reclaimed. Culvert crossings result in higher disturbance of a stream and surrounding area. Fords are best suited to areas where crossing is left at a minimum, they are most common in areas prone to flash flooding.

Critical Area Planting

Critical area planting is the establishment of permanent vegetation on sites that have or are expected to have high erosion rates and sites that have difficultly establishing vegetation due to physical, chemical, or biological conditions, e.g. severe slopes, sand dunes, construction or urban restoration sites, or other areas degraded by human or natural disturbance. Examples of critical area planting are establishing permanent vegetation on the following areas: natural or constructed waterways, degraded sites, areas with high rates of soil erosion by wind or water, stream banks, or pond shorelines.

Cover Crops

Cover crops help to stabilize soil in bare crop fields after harvest while also proving to curb nitrogen loss. Planting cover crops reduces wind and water erosion, maintains or improves soil health and organic matter, suppresses weeds, reduces excessive nutrient or herbicide application, improves soil moisture, and minimizes soil compaction. The exact amount of cover crop usage in the watershed is unknown; however, extrapolating the 9% of cover crop usage estimated by the USDA National Agricultural Statistics Service's *Census of Agriculture of 2017* for Winnebago County, approximately 310 acres of cropland have cover crops. This plan does not set specific targets for cover crop usage; however, it is an important and valuable practice for agricultural producers to implement on their croplands if they haven't already.

No Till/Conservation Till

Agricultural producers currently practice conservation tillage, or high residue till, by leaving 30% or more residue on their croplands after harvest. There are approximately 3,443 acres of cropland in the watershed. Approximately 80%, or 2,726 acres, of the cropland has 30% or more residue left on it after harvest. When applicable, there is opportunity to convert 717 acres of low-residue or conventional till into no-till or conservation till farming.

Conservation tillage leaves good vegetative cover on the ground, thus preserving soil moisture and organic matter. Conservation tillage also helps to keep soil in place and reduce the likelihood of gully and rill erosion to occur. Tilling the soil with conventional plow-based systems leaves the soil vulnerable to erosion and intensifies agricultural runoff. Reduced tillage as a BMP is the process of utilizing any tillage practices that are less intensive or aggressive than conventional tillage. For example, if a tillage process that requires less energy per unit area replaces a conventional tillage process, then the producer has achieved reduced tillage. The term reduced tillage sometimes implies conservation tillage, but conservation tillage systems require producers to cover 30 percent of the soil surface with residue after planting (EPA BMP Descriptions for STEPL and Region 5 Model 2018).

This plan does not set specific targets for no till or conservation till application; however, it is an important and valuable practice for agricultural producers to implement on their croplands if they haven't already.

Agricultural Easements

Agricultural easements are an important tool for conserving natural areas, while also allowing landowners to keep ownership of private land. The landowner forfeits certain rights to their land that lies within the agricultural easement, namely to right to farm or develop the land. Agricultural producers are encouraged to utilize agricultural easements on areas of land that do not farm well, including areas that are inundated or saturated during portions of the growing season. For more details on agricultural easements, please see Conversion to Natural Area on page 2-15.

Best Management Practices with Low Applicability

Just as important as determining which projects will provide the most efficient, cost-effective water quality benefits to the watershed, the group also decided which projects have less applicability to the watershed. These include practices that are either already implemented and do not have much capacity for expansion or not currently practiced and have less applicability due to various factors, such as cost, lack of room for implementation, site-specific needs that are not often met within the watershed, and/or lower pollutant reduction efficiencies.

Projects and practices that are either already in place or not currently practiced that do not have great potential for growth include the following:

- Construct detention features, such as infiltration basins, detentions ponds and basins, and retention ponds and basins
- Install porous pavement or pavers at new driveways, access roads, sidewalks, and other low traffic impervious surfaces.
- Remeander stream

In addition to the practices above that apply to the entire watershed, other residential practices within the residential community given low applicability by stakeholders include:

- Infiltration trenches near homes to capture runoff to filter and recharge rainfall.

Within the rural community, practices considered to have low applicability for agricultural producers in addition to those listed above are:

- Vegetated Treatment Area
- Heavy Use Protection Area
- Prescribed Grazing
- Anaerobic Digestor
- Nutrient Management Plan
- Contour Farming

In general, agricultural producers are either already regulated or already practicing these techniques to the best of their ability. As the collective knowledge about such practices improve, the community anticipates that the agricultural producers and livestock handlers of this watershed will improve their techniques and conservation practices accordingly. The rationale for each is discussed below.

Detention Features

Detention features, such as infiltration basins, detentions ponds and basins, and retention ponds and basins, could ease flashy hydrology, detain and store stormwater, and filter stormwater. This BMP addresses both water quality *and* stormwater storage/flood mitigation. In all likelihood, where a detention features is required by ordinance there already is one, and there are not many open places to install a detention feature. Two potential locations identified by technical advisors for possible installation of detention features are the headwaters and the Village of Winnebago. Detention features could also be considered to further enhance any streambank stabilization project. These could either be designed deep for stormwater storage or as shallow marsh features for wildlife habitat. Another recommendation of this plan is to ensure that all existing detention features are working as they are intended to.

Porous Pavement or Pavers

Porous pavement or pavers are alternative pavement systems to the conventional impervious pavements, such as concrete or asphalt, normally utilized. Porous pavement or pavers turn impervious surfaces into pervious areas that allow stormwater to soak into the ground at first contact with the ground, minimizing runoff from the source. They are designed to allow water to pass through the surface into the subsurface for storage and infiltration and to also reduce peak runoff rates and volumes, as well as reduce pollution loads. Porous pavements or pavers can be applied to parking lots, driveways, alleys, low traffic roadways, boat ramps, paths and sidewalks, fire lanes, and community spaces (Illinois Urban Manual). Essentially, they can replace conventional, impervious pavement in low-traffic areas. There was not much stakeholder interest expressed for this practice. This plan encourages stakeholders to consider porous pavement or pavers when constructing or repairing driveways, sidewalks, parking lots, trails, and low traffic roads. Future opportunities may be defined as construction or repair plans are formed.


(Water Environment Federation)

Remeander Stream

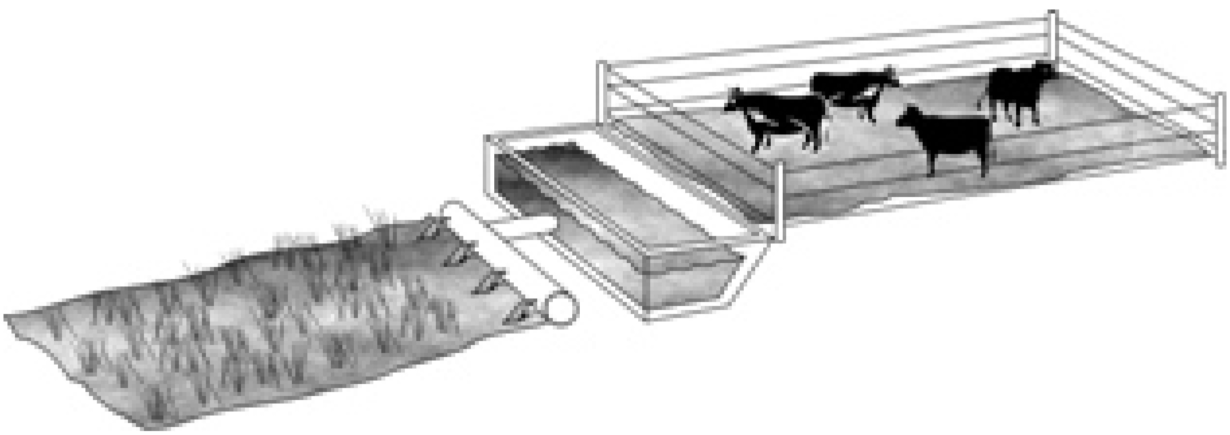
As towns and cities develop around streams, humans have straightened, or channelized, waterways for various reasons, including draining wetlands, directing water flow, controlling flooding, improving navigation on waterways (Brooker 1985). Channelization increases water velocity, reduces drainage time, eliminates river channel habitat. Most channelized stream segments are found along intermittent and perennial streams through agricultural land and residential development. Restoring stream meanders did not have great potential or applicability to this watershed due to lack of room for remeanders and high cost estimates. However, certain areas where this practice might be possible are where a public entity, like the Village of Winnebago, City of Rockford, RPD, etc., own are larger undeveloped parcel or municipal ROW. Otherwise, the 21% of stream segments that are highly channelized and 19% of stream segments that exhibit moderate channelization could be studied for their channel stabilization needs and suitability for rock riffles. For more information about stream channelization within the watershed, please see pages 78 and 90 of the Natural Resource Inventory.

Infiltration Trench

An infiltration trench is an excavated trench filled with coarse granular materials in which stormwater runoff is collected for temporary storage and infiltration (Illinois Urban Manual). In developed areas, overflow of sewers is a common occurrence during a heavy rainfall, contributing organic pollutants to storm water. Moreover, pollutants and faulty septic systems threaten local water quality. Infiltration trenches are excavated near infrastructure where running water could be captured, like the end of a sloped driveway or beneath a roof downspout, and temporarily held beneath ground. They are lined with a geotextile material and then filled with granular stone. This facilitates the infiltration of water into the ground to recharge the water table with uncontaminated water. This plan encourages stakeholders to consider installing infiltration trenches near homes or our impervious surface to capture runoff before it becomes polluted.

Vegetated Treatment Area

A vegetated treatment area consists of permanent vegetation placed near livestock feedlots, barnyards, compost and solid waste operations, and other agricultural facilities to treat agricultural wastewater. The purpose of this area is to collect and treat contaminated runoff and reduce the amount of excess nutrients, sediment, and bacteria from entering local waterways (NRCS eFOTG). Runoff is first directed into a basin in which sediments settle before releasing the controlled liquids into the treatment area. Next, natural processes take place, using the nutrients and killing off any pathogens (LPELC). When designing a vegetative treatment structure, it is imperative that the land is graded or terraced to allow for both the basin, in which runoff is sorted, and a lower land area with enough surface area to evenly release liquids. High capacity nutrient cycling is contingent on the size of this area as is harvesting the vegetation to promote denser growth. Selection of vegetation should be contingent on species that can grow there permanently and withstand flooding. This plan encourages livestock handlers to consider installing vegetated treatment areas near pasture to capture runoff and wastewater from pastureland. The image below, sourced from LPELC, depicts a vegetated treatment area for cattle.



Heavy Use Protection Area

Heavy Use Area Protection (HUAP) is a technique used to stabilize the ground's surface in an area that is heavily used by livestock, people, or vehicles (NRCS eFOTG). HUAP surface treatments can be made of concrete, asphalt, gravel, mulch, or any other non-erosive surface. This BMP is often practiced but not limited to livestock feeding areas and watering facilities. HUAPs can operate as a standalone solution if proper maintenance and waste disposal practices are implemented. Fences, vegetated treatment areas, and filter strips are commonly used to accompany this conservation practice. Placement of HUAP should be away from any surface water. In addition, any surface water flow should be diverted from the treatment area. Other considerations should be made to collect, store, and treat manure when it may be a cause for concern. HUAP operations work best when introduced with a prescribed grazing plan on a site. This plan encourages livestock handlers to consider installing heavy use protection areas near livestock operations. Since no livestock feedlots are within the watershed, this practice has low applicability to the watershed.

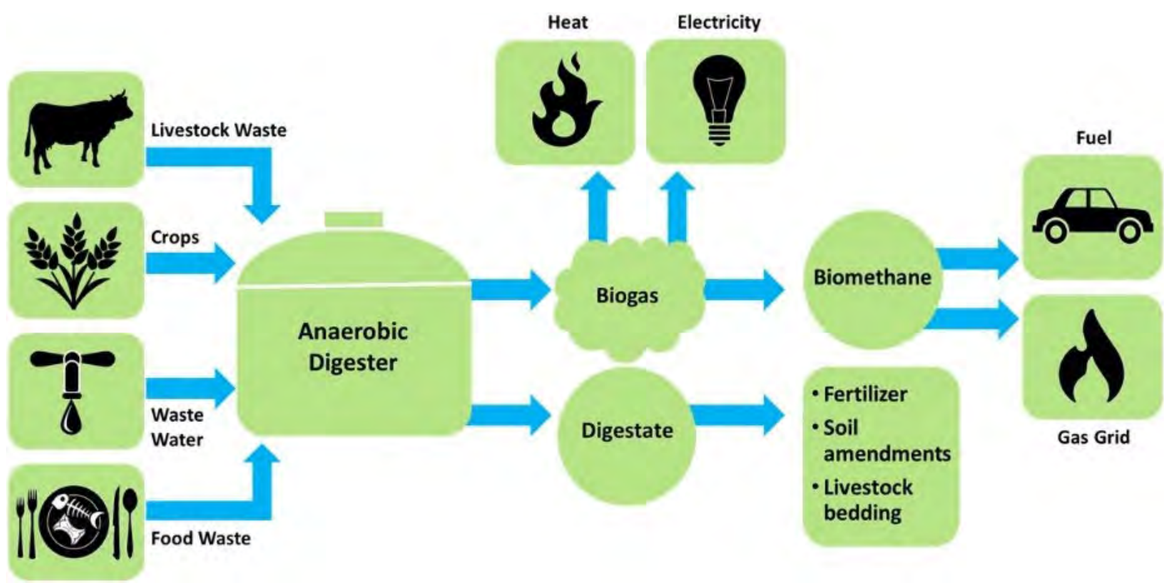
Prescribed Grazing

Prescribed grazing is the practice of managing the frequency, duration, and location of grazing or browsing by livestock (NRCS eFOTG). Prescribed grazing can improve quality and quantity of forage for grazing animal health and productivity, improves surface and subsurface water quality, improve riparian and watershed function, reduce soil erosion, improves soil quality, and extend grazing season.

Harvesting in prescribed grazing areas increases productivity and diversity of plant communities, which in turn is beneficial to wildlife habitation. Soil and water quality also benefit from a balanced nutrient load while not being stripped of their vegetative cover. This cyclical practice should be used away from any surface water to protect from direct contamination. After grazing, livestock should be returned to their quarters, preferably in an area with heavy use protection (NRCS eFOTG). This plan encourages handlers of grazing and/or browsing animals to consider practicing prescribed grazing.

Anaerobic Digestor

An anaerobic digestor, also known as a bioreactor, is a type of waste management system where biological treatment breaks down animal manure and other organic materials in the absence of oxygen (NRCS eFOTG). Microorganisms break down organic materials, such as livestock waste, agricultural waste, wastewater, and inedible food waste, in an oxygen free environment to produce biogas and digestate (Environmental and Energy Study Institute 2017). This process is called anaerobic digestion. If improperly managed, these organic materials can runoff into surface water or leach into groundwater thus polluting water sources with bacteria, chemicals, antibiotics, and excess nutrients. A digester can reduce odors, eliminate pathogens, combat water pollution, optimize the use of biogas as a renewable energy source, and efficiently manage waste. Operations using anaerobic digesters must comply with federal, state, and local laws. The digester is to be located outside of a floodplain to protect the facility from damage. Other considerations to account for before using this type of facility include proximity to sensitive areas and inhabited areas, characteristic of inputs (animal waste, wastewater, food waste), and soil properties and nutrient availability. The image below, sourced from the Environment and Energy Study Institute, displays the possible inputs and outcomes when using an anaerobic digestor.



This plan encourages agricultural producers and livestock handlers to consider installing anaerobic digestor when biogas or digestate can be responsibly utilized.

Nutrient Management

Nutrient management assists agricultural producers to manage the amount, source, placement, and timing of plant nutrients and soil amendments. By utilizing nutrient management plans, agricultural producers can budget and conserve nutrients for plant production, minimize nonpoint source pollution from contaminating waterways, properly apply manure as a plant nutrient source, and maintain or improve soil quality (NRCS eFOTG). The majority, if not all, of agricultural producers utilize nutrient management plans in the watershed. Therefore, the opportunity for further implementation is limited.

Contour Farming

Contour farming is the practice of aligning ridges, furrows, and roughness formed by tillage, planting, or other operations in order to alter velocity and direction of water to flow around hillslopes as opposed to directly down hillslopes. This practice helps reduce sheet flow erosion. Row patterns in contour farming are planted on the contour alternated with strips of oats, grasses, or legumes. It is unknown if contour farming is currently in practice within the watershed. This plan encourages agricultural producers to consider practicing contour farming on sloping land, especially if it is also highly erodible land (HEL).

Addressing Goal 4: Enhancements for Wildlife

Stakeholders value wildlife and wildlife habitat in the watershed enough to create a goal and corresponding objectives specific to protecting it.

Goal 4: Protect, enhance, and manage wildlife habitat.
Objectives for Goal 4:

- Whenever applicable, utilize a diversified mix of native plant species when installing any recommended BMP.
- Protect and enhance wildlife and wildlife habitat whenever implementing BMPs.
- Protect, expand, and enhance existing forests, wetlands, and grasslands using BMPs such as forest stand improvement, wetland and prairie restoration, and conversion to natural areas.

When implementing any conservation project or practice, this plan encourages stakeholders to consider how it could be enhanced to better serve wildlife. All practices recommend in this plan, no matter the level of prioritization, should also consider enhancements to benefit wildlife, when applicable. Some of the recommended BMPs in this plan are specifically adept at protecting and conserving wildlife habitat:

- Riparian filter strips
- Constructed stormwater wetlands
- Conversion to natural areas
- Streambank stabilization
- Forest stand improvement
- Wetland and prairie restoration

Diverse Mix of Native Plants

Native plants provide food and habitat structure for many of our native wildlife species. Small scale native plantings benefit birds, butterflies, and other beneficial pollinators. Larger scale plantings can provide homes for a variety of wildlife species, especially when a natural water source is available. Adding diversity to the planting is a fool-proof way of maximizing benefits to multiple species. Consider including milkweed plants to contribute to the campaign to help monarch butterflies. For other tips, visit

The Conservation Foundation website and consider a Conservation@Home, Conservation @Work, and Conservation@School certification through the Natural Land Institute in partnership with the Wild Ones Rock of River Valley. More information about native plantings can be found in Chapter 3, Education and Outreach, and more information about each organization can be found in Chapter 6, Financial and Technical Support.

The Conservation Foundation Conservation@ website:
https://www.theconservationfoundation.org/conservation-home/

Natural Land Institute Conservation@ Programs website:
https://www.naturalland.org/conservationatprograms/

Wildlife Habitat

Beyond utilizing a diversified mix of vegetation native to the region, other practices can protect and enhance wildlife habitat. Fish, birds, amphibians, reptiles, and invertebrates including pollinators, and mammals like insect-eating bats could all benefit from adding simple features in and near streams, ponds, and lakes (Hastings, 2009). This plan recommends that stakeholders pay special attention to habitat enhancements that support federally threatened and endangered species found in this watershed and species in greatest conservation need (SGCN) according to the Illinois Wildlife Action Plan (IDNR, 2020). Federally threatened and endangered species found in Winnebago County include the Indiana bat, Northern long-eared bat, Rusty patched bumble bee, Hine's emerald dragonfly, Eastern prairie fringed orchid, Prairie bush clover (U.S. Fish & Wildlife Service). In addition, many migratory birds have populations in peril. Pollinators are important to our food sources, and their populations have been suffering due to pesticide use in lawns and crop fields. Bats consume hundreds of insects per hour including mosquitos and are threatened by wind energy turbines and habitat loss, although some species are most threatened by a fungus called white-nose syndrome.

Through the Endangered Species Act, the United States Fish and Wildlife Service (USFWS) recognizes the value of threatened or endangered species as well as the ecosystems and habitats these species rely on. Winnebago County has six federally threatened and endangered (T&E) species in the watershed (U.S. Fish & Wildlife Service). *Table 2.4* lists all the federally T&E species in the county. For further information concerning these species and their habitats, please see the below sources and facts sheets for the Indiana bat, Northern long-eared bat, Rusty patched bumble bee, and Hine's emerald dragonfly located in Appendix A.

https://www.fws.gov/midwest/endangered/lists/illinois-spp.html

https://ecos.fws.gov/ecp0/reports/species-by-current-range-county?fips=17201

Table 2.3 Federally Threatened and Endangered Species in Winnebago County

Class	Common Name	Scientific Name	Status
Mammals	Indiana bat	*Myotis sodalis*	Endangered
	Northern long-eared bat	*Myotis septentrionalis*	Threatened
Insects	Rusty patched bumble bee	*Bombus affinis*	Endangered
	Hine's emerald dragonfly	*Somatochlora hineana*	Endangered
Flowering Plants	Eastern prairie fringed orchid	*Platanthera leucophaea*	Threatened
	Prairie bush clover	*Lespedeza leptostachya*	Threatened

Trout Unlimited has produced a Nongame Wildlife Habitat Guide, which provides design specifications for each recognized habitat feature (Hastings, 2009). Suggestions include the following habitat features for each group of wildlife:

Fish

- Lunkers
- Brush bundles
- Deep pools created with cross channel logs and rock weirs
- Rock and log deflectors
- Minnesota skyhook
- Random boulder placement
- Side channels
- Vortex weirs

Birds

- Dead trees and bird perches to provide perches for hawks and other birds of prey
- Various riparian habitat for nesting such as native grasslands, trees, and brush

Amphibians

- Microhabitats including downed woody debris and healthy duff layers

Reptiles

- Open canopy providing varied habitat structure
- Basking logs and rocks
- Turtle and snake hibernaculum

Birds, Amphibians, and Reptiles

- Wetland scrapes near streams and in floodplains
- Vernal pools with shallow standing water that warms up faster than streams and larger ponds
- Mud flats and backwater refuge areas next to streams
- Oxbows
- Riparian prairie plantings

Invertebrates

- Flat and embedded rocks in terrestrial areas
- Various types and sizes of downed woody debris

Note that any surface area placed within water as a habitat structure would aid in pollutant reduction as well, as it would grow biofilm, a sticky collection of microorganisms including beneficial bacteria instrumental in digesting excess nutrients and cycling them into the food chain. For more information, consult the Nongame Wildlife Habitat Guide: Complementary Opportunities for Stream Restoration Projects prepared by Jeff Hastings at http://www.darestoration.com/documents/2ndEd_Nongame_Wildlife.pdf.

Protect, Expand, and Enhance Existing Forests, Wetlands, and Grasslands

Existing wildlife habitat needs protection, expansion, and enhancement to maximize the benefit to wildlife. Each wildlife species has unique habitat needs. Some need large patches of undisturbed forest or grassland while others only need small patches of habitat or a habitat with a mosaic of forest, grassland, and other features. Wetlands are known as wildlife "hotspots," because these areas attract the most variety of wildlife to a small, concentrated area. First, protect what exists, keeping it a natural area instead of allowing it to become developed or farmed. Second, consider expanding the existing habitat to accommodate species that need larger patches of forest, grassland, or wetland. While expanding, try to fill in patches that create extra edge habitat. Habitat edges house many less desirable species that provide competition for those species that prefer the interior of the habitat area. Third, enhance the habitat by planting native plants that offer excellent food and shelter and controlling invasive and non-native weeds.

Addressing Goal 5: Enhancements for Recreational Opportunities

Stakeholders value the recreational opportunities within the watershed and want to ensure the continued existence of recreation Goal 5 addresses this value.
Goal 5: Sustain and enhance the recreational opportunities of the watershed.

Objectives for Goal 5:

- Consider leaving up to 25% of the shoreline exposed to provide recreational access when installing riparian filter strips or other naturalized BMPs.
- Consider paths through riparian filter strips or other naturalized BMPs to access the water's edge or enjoy a walk, birdwatching, and other nature-based activities. Mow zig zag paths that geese will not follow when appropriate.

It is important to ensure recreational access when installing naturalized BMPs. Consultants recommend riparian filter strips along waterbodies to cover 75% of the shoreline (Minnesota Shoreland Management). Other ideas include mowing zig zag trails through filter strips and installing pedestrian, bicycle, or equestrian trails within naturalized BMPs.

Addressing Goal 6: Community Education

This plan describes stakeholder concerns regarding water quality, potential solutions, and how to implement them. Without stakeholder input, awareness, and implementation, this plan will not be executed to its full capacity. Many stakeholders have been involved in the planning efforts of creating this plan, but there are a lot of unreached stakeholders who do not know about this plan and the financial and technical assistance it provides towards addressing erosion, sedimentation, and water quality. Moreover, stakeholders involved in the planning process highlighted the need for more education on certain topics. Stakeholders agree that educating the community about the importance of water quality and this plan is vital. Goal 6 highlights just that, and the objectives for goal 6 give the community tangible action items for education and outreach.

Goal 6: Educate the community about water quality and this plan.

Objectives for Goal 6:

- Reach 500 homeowners that utilize septic systems to increase awareness of septic system maintenance and its relationship to the fecal coliform impairment of the stream.
- Reach 500 homeowners to increase awareness of lawn care practices and native plantings and their relationship to water quality of the stream.
- Increase awareness of this plan, the importance of implementing BMPs, potential for funding assistance, and educational topics by
    - posting the plan on websites of planning partners,
    - making 100 copies of the plan's executive summary available through the facilities of planning partners, and
    - holding five annual community events.
- Appoint a leadership group to educate community about water quality and this plan.
- Promote partnerships with community groups that can assist in creating public awareness (adopted from EPA's "Developing an Outreach Strategy" website).
- Invite local municipalities and developers to educational events and meetings and provide them with educational publications and materials.

Chapter 3 further details education and outreach recommended in this plan. Further information about septic system maintenance and lawn care can also be found earlier in this chapter in Addressing Goals 1, 2, and 3.

Addressing Goal 7: Governing and Policy-Making Bodies' Involvement in Current and Future Land Use

Stakeholders desire to partner with local governing bodies to enhance water quality improvement efforts. It is important that water quality is not only considered and protected currently in policy and land uses, but also planning and zoning for future land use should consider how to protect water quality.

Goal 7: Work with governing and policy-making bodies to protect water quality currently and in future land use planning.

Objectives for Goal 7:

- Present the findings and recommendations of this plan to the Executive Committee of the Region 1 Planning Council (RPC).
- Create relationships with the Village of Winnebago, City of Rockford, Winnebago County, and other local organizations to promote cooperation in land and water conservation efforts and to assist stakeholders in addressing current concerns for water quality and concerns with future development.
- Implore developers and governing bodies to create and approve development plans that incorporate BMPs that address water quality and mitigate the effects that intensive land use has on water quality.
- Urge governing bodies to advocate for the stakeholders' desire to improve water quality by allowing water conservation practices in ordinances and by-laws.

Present Findings and Recommendations

The first presentation to the Environmental Planning Committee (EPC) of the Region 1 Planning Council took place on July 23, 2020.

Create Relationships to Promote Cooperation and Assist Stakeholders

Involving local governing bodies in this watershed plan shows local governments that the people they represent care about water quality improvements. By creating relationships with governing bodies and local organizations, stakeholders can potentially receive technical and financial assistance in implementing projects that benefit the whole community. This local leadership is imperative to the success of implementing this plan.

Promote Incorporation of BMPs in Development Plans

This plan recommends protecting water quality both now and in the future. Currently 17% of the watershed, or 1,322 acres, has impervious surfaces, such as concrete, asphalt, buildings. Impervious surfaces exacerbate runoff volume and velocity since stormwater flows over impervious surfaces instead of infiltrating into the soil. Higher amounts of impervious surfaces not only increase runoff but also increase the likelihood of stormwater contamination of the stream by pollutants found on these impervious surfaces. Based on estimated future land use changes from the Winnebago County 2030 Plan, the watershed is projected to have 36.9%, or 2,862 acres, of impervious surfaces. In other words, by 2030, the watershed should expect to have double the amount of impervious surfaces than it does now. Currently two out of the fifteen subbasins within the watershed have between 25-100% impervious surface cover. In the future, it is estimated that eleven subbasins will have between 25-100% impervious surface cover. With more impervious surface projected in the future, water quality and flooding issues will only get worse if current and future watershed stakeholders do nothing. Implementing the recommendations in this plan will help to alleviate some of these issues. One particular avenue to address the increase in impervious surface is to work with developers and planners so that future land use planning considers the recommendations in this plan and watershed concerns at-large. By imploring developers and planning/zoning departments to create and approve development plans that incorporate BMPs, the community can protect water quality even as new development occurs.

The requirements for the design of new developments in the Kane County Stormwater Management Ordinance provides a working example. This ordinance states that new development shall not increase water surface elevations or decrease conveyance capacity upstream or downstream. The ordinance also states that development design must, to the extent practicable, convey water through vegetated swales, preserve existing open channels, use BMPs to reduce volume of stormwater runoff and the quantity of runoff pollutants, and avoid impacts to wetlands and their buffers (Kane County Stormwater Management Committee, p. 29-30). Other examples and local models can be found in the Lake County Watershed Development Ordinance (Lake County Stormwater Management Commission) and the Watershed Management Ordinance of the Metropolitan Water Reclamation District of Greater Chicago (MWRD) by following the online links provided below. Consultants encourage the voluntary incorporation of BMPs in a manner suggested by these local examples.

Kane County Stormwater Management Ordinance (Revised June 1, 2019):
https://www.countyofkane.org/FDER/Documents/waterOrdinances/adoptedOrdinance.pdf

Lake County Watershed Development Ordinance (Effective October 13, 2015):
https://www.lakecountyil.gov/DocumentCenter/View/3445/Lake-County-Watershed-Development-Ordinance-October-13-2015-PDF?bidId=

MWRD Watershed Management Ordinance (as Amended May 7, 2020):
https://mwrd.org/sites/default/files/documents/WMO_050720.pdf

Advocate for Allowing BMPs in Ordinances and By-Laws

Stakeholders wish for local governing bodies to advocate for the stakeholders and their desire to improve water quality. Some topics that stakeholders desire governing bodies to advocate for are septic system maintenance and allowing ordinances or by-laws that encourage native plantings and other BMPs that improve water quality. As an example, governmental bodies with jurisdiction over roadways could allow native plantings in roadway ditches (i.e. vegetated swales) and possibly fewer mowing requirements for roadway ditches or sloped R-O-W converted into native planted swales or filter strips.

Addressing Goal 8: Preserving Prime Farmland

In terms of farmland classification, prime farmland produces the highest yield with the lowest cost of energy and economic resources and least environmental damage. More than half of the South Fork Kent Creek watershed (59.7% or 4,629 acres) is categorized as prime farmland. This plan encourages stakeholders to preserve prime farmland *now* by ensuring proper BMPs are implemented not only to improve water quality on-site and downstream but also to preserve the soil necessary to farming. This plan encourages stakeholders to preserve prime farmland *in the future*, by working with developers and land use planners and ensuring that they consider the value of prime farmland and allow agricultural producers' voices to be heard in future land use planning decisions.
Goal 8: Preserve prime farmland during future land use changes.

Objectives for Goal 8:

- Implement proper BMPs not only to improve water quality on-site and downstream but also to preserve the soil necessary to farming.
- Encourage interested agricultural families farming for generations to continue farming their lands, with or without the use of agricultural easements or deed restrictions.
- Collaborate with developers and land use planners to ensure that they consider the value of prime farmland and allow agricultural producers' voices to be heard in land use planning decisions.

Implement Proper BMPs

Some of the recommended BMPs in this plan, discussed in more detail earlier in this chapter, are specifically adept at preserving prime farmland:

- Grassed waterways
- No till or conservation till
- Cover crops
- Agricultural easements
- Livestock fence
- Critical area planting

Continue Farming

One way that farmland is protected and always has been is simply to keep farming it. The reason that there's prime farmland worthy of protection is that families have been protecting it for generations. Simply keeping it in farming at the landowner's choice can ensure prime farmland preservation. Other tools that offer farmland protection in perpetuity once the land changes hands are agricultural easements and deed restrictions. Some programs and organizations, namely the NRCS Agricultural Conservation Easement Program (ACEP), the American Farmland Trust, and the Natural Land Institute (NLI), offer agricultural easements. Each of these are described in further detail in chapter 6. NLI has accepted a few agricultural easements to preserve working farms. They take farms that incorporate BMPs and work on building soil integrity through farming practices. All three programs are applicable now and in the future. Deed restrictions protect the land in perpetuity similarly to an agricultural easement, but they are private agreements without the involvement of a third party.

Collaborate for Future Prime Farmland Protection

Landowners have the choice to continue to farm their property or sell it to someone for a different use. Many different uses are slated for this watershed in the 2030 Plan, including residential, commercial, and industrial development. If a landowner chooses to sell the property and allow it to be changed from a farm to another type of development, another way to ensure prime farmland is preserved in the future is to incorporate farming into the open spaces of a development plan. In other words, encourage developers to concentrate the more intensive land uses, leaving open space for farming, as opposed to a sprawling industrial campus or other development. This manner of including farmland in the future landscape would most successfully be implemented by collaborating with developers and land use planners to ensure understanding of the importance of farmland and create an arrangement that meets everyone’s needs as closely as possible.

A Note on Flood Mitigation

The velocity and volume of stormwater is a significant concern in the watershed. By implementing BMPs that store, detain, and filter water higher up in the watershed so that it slowly releases water, stakeholders can help improve water quality and alleviate some flooding issues. Flood mitigation can be paired with water quality projects if certain practices address both water quality and flood mitigation; however, the scope of the plan does not include the tools necessary to inventory and plan for more complete flood mitigation. The Federal Emergency Management Agency (FEMA) offers technical and financial assistance for flood mitigation projects.

This plan does recommend some BMPs that improve water quality *and* provide stormwater storage so as to alleviate flooding issues:

- Constructed stormwater wetlands
- Conversion to natural area
- Wetland restoration and prairie restoration
- Rain gardens and rain barrels
- Detention features
- Preserving open space, especially in upstream areas of the watershed, for BMP implementation

Moreover, any BMP that allows water to infiltrate into the ground and reduces the amount of stormwater runoff also helps to alleviate flooding.

Winnebago County, through the Region 1 Planning Council, updated their 2019 Winnebago County, Illinois Multi-Hazard Mitigation Plan. This addresses hazards such as flooding, extreme drought, thunderstorms, and more. The RPC led the update process in coordination with local organizations, including Winnebago County Highway Department staff, the City of Rockford, and others. This hazard mitigation plan identifies assets, individuals, and areas vulnerable to man-made and natural disasters; assesses those risks; and creates and implements strategies to mitigate loss of life and damage impacts. Flooding and stormwater management is one of the hazard profiles analyzed in this report. The City of Rockford has already taken measures to address flood mitigation items outlined in this plan. Some mitigation items that are completed or still ongoing for the City of Rockford include mapping priority acquisition of areas unsuitable for development; limiting or restricting development in floodplain areas; enforcing landscaping and buffer requirements, open space requirements, and impervious ratio requirements; mapping structures in floodplains and repetitive loss and substantially damaged properties; and relocating, elevating, or demolishing flood-risk properties (RPC 2019). Some mitigation items that are still ongoing for the Village of Winnebago include supporting compliance with the National Flood Insurance Program (NFIP) and updating existing or creating new floodplain and stormwater management ordinances. The 2019 Winnebago County Multi-Hazard Mitigation Plan can be found here: https://wincoil.us/media/274268/2019_winnebago_county_mhmp_final.pdf.

Conclusion

Successful implementation of any project or practice will require the support of the community. The local governments and land use organizations are poised to organize and manage programs to assist private homeowners, such as educational events and materials, organization of group efforts such as soil testing, and guidance toward technical assistance. Further information for outreach is provided in Chapter 3. Chapters 4 and 5 provide details regarding the costs and benefits of the recommended projects. Financial and technical assistance is also available to all stakeholders of the watershed as referenced in Chapter 6.

Section 2, Chapter 3
Outreach and Education

Introduction
Chapter 2 identified prioritized best management practices based on stakeholder interest, consultant and technical advisor recommendations, and applicability to the watershed. This chapter highlights recommended educational resources and engagement efforts for watershed stakeholders. Later chapters describe BMP implementation planning, financial and technical resources available, and monitoring the success of implementing this plan.

Education and outreach efforts focus on engaging landowners, homeowners, agricultural producers, and the supporting community, such as local businesses and organizations. The recommended best management practices detailed in Chapter 2 are solely up to the stakeholders to implement; therefore, it is essential to prioritize education and local engagement. The education, active participation, follow-through, and maintenance of these projects is vital to long-term success. Local stakeholders will need to recognize the value in addressing water quality concerns and feel empowered to implement and maintain the recommended conservation practices. Topics of education are the creation of this watershed plan and what it entails, existing concerns throughout the watershed, the potential improvement that recommended projects could have if implemented on stakeholder property, and who to ask for technical assistance and potential grant funding. Education and outreach efforts will continue throughout the 5-year duration of the plan.

Existing Opportunities
Various outreach groups and education opportunities already exist within the area to encourage local participation and increase awareness of water quality issues and natural resource conservation. Many of the local outreach groups also offer financial assistance in funding implementation of conservation practices. With local interest, these ongoing efforts could be geared toward watershed stakeholders. Financial and technical assistance is detailed in chapter 6.

Some local outreach organizations with existing outreach efforts that encompass the watershed include:

- Winnebago-Boone Farm Bureau (Farm Bureau)
- Winnebago County Soil and Water Conservation District (SWCD)
- Winnebago County Natural Resources Conservation District (NRCS)
- University of Illinois Extension (U of I Ext.)
- Pheasants Forever (PF)
- Natural Land Institute (NLI)
- Wild Ones Rock River Valley Chapter (Wild Ones)
- Severson Dells Nature Center (SDNC)
- Rockford Park District (RPD)
- Forest Preserves of Winnebago County (FPWC)
- Winnebago County Special Water District

In 2019, the *Winnebago-Boone Farm Bureau* conducted seminars for local producers on nutrient loss reduction and co-sponsored events about soil compaction, nitrogen management after wet seasons, and inter-seeding cover crops. They offer free webinars, updates on Illinois Department of Agriculture and University of Illinois Extension resources and programs, and events and activities that can be found at https://www.winnebagoboonefarmbureau.org/home.html.

The *Winnebago County SWCD* offers educational natural resource programs to schools and groups in the county in the form of classroom presentations, group assemblies, guest speakers, or hands-on projects. Program topics range from rain barrels and gardens, groundwater, watersheds, aquatics, soils, forestry, recycling/composting, and prairies. They provide helpful links to other conservation resources as well as cost-share programs when implementing conservation practices. They also conduct tree, rain barrel, native seed, and conservation book sales. More information can be found at http://winnebagoswcd.org/swcd/.

The *Winnebago County NRCS* works with owners of agricultural lands to implement best management practices offered through the Farm Bill. They provide consultation, technical advice and planning, and financial cost-share assistance including annual payments to offset lack of crop production on acreage enrolled in some of their programs. See https://www.nrcs.usda.gov for more information.

The *University of Illinois Extension* offers conferences, education programs, crop science research, public engagement, training workshops, and certifications. They also have resources for at home gardening at https://extension.illinois.edu/global/core-program-areas. The University of Illinois Extension has staff and resources geared specifically towards serving Jo Daviess, Stephenson, and Winnebago counties at https://extension.illinois.edu/jsw.

Pheasants Forever offers Illinois seed mixes for farmland in the USDA Conservation Reserve Program (CRP). These seed mixes could also be used in other vegetated BMPs. See chapter 6 for more information about CRP and https://www.pfhabitatstore.com/store/items/IL/.

The *Natural Land Institute (NLI)* preserves natural land for wildlife habitat, ecological benefits, and offering recreational hiking and wildlife observation. They also partner with the Wild Ones Rock River Valley Chapter to offer Conservation@Home, Conservation@Work, and Conservation@School Programs, which encourage landowners, businesses, churches, and schools to actively participate in conservation efforts. See https://www.naturalland.org/conservationatprograms/ for more information. They also have a list of local vendors and resources, including native landscape designers, native plant nurseries, and other resources for rain barrels, rain gardens, pollinators, and native/invasive plant identification at https://www.naturalland.org/.

Wild Ones is a national non-profit with local chapters that promote the benefits of using native plants in landscaping. The Wild Ones Rock River Valley Chapter members meet monthly, publish monthly newsletters detailing events and information about native plants, and conduct two native plant sales every year. http://wildonesrrvc.org/index.html

Severson Dells Nature Center in Rockford has a mission is to link people to nature through education and research. They provide programs about natural resources, environmental education, biology, ecology, and geology and also conduct lectures on forest ecology, ecosystems, landscape of Winnebago County, prairies, savannas, and wild turkeys. https://www.seversondells.com/

The mission of the *Rockford Park District* is to help people enjoy life. One of their current focuses is neighborhood parks, including several in this watershed. They have a webpage dedicated to this watershed plan, including updates, resources, surveys, and links to the watershed plan and natural resource inventory. See https://rockfordparkdistrict.org/levings-park.

The *Forest Preserves of Winnebago County* offer public natural areas for hiking, biking, birdwatching, canoeing, fishing, picnicking, camping, and other passive recreation activities. They regularly offer community events to get people in touch with nature. Find locations and events at https://winnebagoforest.org/.

The *Winnebago County Special Water District* is responsible for maintaining a drainage district contained within the South Fork Kent Creek Watershed, including an area of problematic broken drain tiles.

Opportunities of Interest

The watershed planning participants met once to specifically discuss educational topics, outreach opportunities, and channels of communication for those in residential, agricultural, and industrial and commercial areas. At this meeting they decided that an effective marketing plan using proven communication channels would help raise awareness of the watershed issues, importance of BMP implementation, and the watershed plan at-large.

There are three target groups for outreach: residential, agricultural, and commercial/industrial. For each target group, stakeholders created a list of outreach efforts. Stakeholders also want to target outreach efforts towards governmental entities. Local government, policymakers, land use planners, and developers can all play a role in improving water quality, and it is important to get the people in these roles on board with the watershed plan. These efforts are covered within the outreach efforts for each of the three target groups. To conduct each outreach effort, consultants estimated an appropriate time frame, suggested potential lead organizations for each effort with feedback from technical advisors, and estimated the cash needed for materials to conduct each effort. Outreach ideas are detailed for each group below.

Residential Outreach

For residential areas, stakeholders recommend making outreach efforts personal and educating the local community about fecal coliform using existing platforms for communication.

Stakeholders recognize the importance of communicating a persuasive “story” or reasons why improving the water quality enhances not just the watershed but also each individual resident. They recommend informing landowners about the homeowner benefits of action and discuss the risks of inaction. For example, if a homeowner addresses excessive runoff issues by installing a rain garden, rain barrel, or infiltration trench, they can improve water quality to downstream waters while reducing the chances of their lawn or basement flooding. Other ways to make water quality issues personal is to quantify how poor water quality affects individuals via well water, recreation, and property values. For instance, it is possible for a leaky septic system to contaminate nearby wells. The actions they take on their property can also encourage neighbors to follow suit.

The stakeholders selected four specific topics for residential or homeowner outreach:

- Septic System Maintenance
- Lawn Care
- Native Plants
- Retention Pond Maintenance

Table 3.1 outlines seven prioritized steps to provide the recommended outreach to residential portions of the watershed. Each topic of interest is detailed further below.

Table 3.1 Residential Outreach Program

Residential Outreach Program* (RP)					
Ref #	**Quantity**	**Est. Time Frame**	**Program Description**	**Suggested Lead**	**Cash Needed****
RP-1	Semiannual meeting or event	Year 1-3	Septic system maintenance advocacy with Winnebago County Health Department.	Homeowner Associations	$0-$750/event
RP-2	Ongoing program	Year 1-5	Voluntary septic system maintenance program for current homeowners. Program to distribute septic system flyers.	Homeowner Associations	$0-$1,000 /year
RP-3	3 properties by third year	Year 1-3	Demonstrate native planting or other BMP installations (e.g., rain gardens, filter strips). Distribute BMP fliers at demonstration.	NLI Conservation@ Home, Rockford Park District, Wild Ones	$0-$1,000/ property
RP-4	3 properties by third year	Year 1-3	Demonstrate conscientious lawn care (e.g. no pet waste, water conservation, responsible use of fertilizer). Distribute BMP fliers at demonstration.	Homeowner Associations, NLI Conservation @Home	$0-$1,000/ property
RP-5	1 distribution/ year	Year 1-5	Create and distribute fliers with helpful tips and empower citizen volunteers and landowners to maintain retention basins and ponds.	SWCD, MS4 Community, Homeowner Association	$0-$1,000/year
RP-6	1 event/year	Year 1-5	Conduct educational tours to demonstrate residential BMP implementation within the watershed and larger region.	Wild Ones, NLI Conservation@ Home, Rockford Park District	$0-1,500/year
RP-7	Monthly	Year 1-5	Create neighborhood-wide action groups	Homeowner Associations, Special Drainage Dist.	$0

*During each Residential Program, advertise the publications referenced below.
** Cash includes only raw materials, printing/production, not the value of time or hiring staff or intern.

Each outreach recommendation for residents is further described below.

RP-1: Septic System Maintenance Advocacy

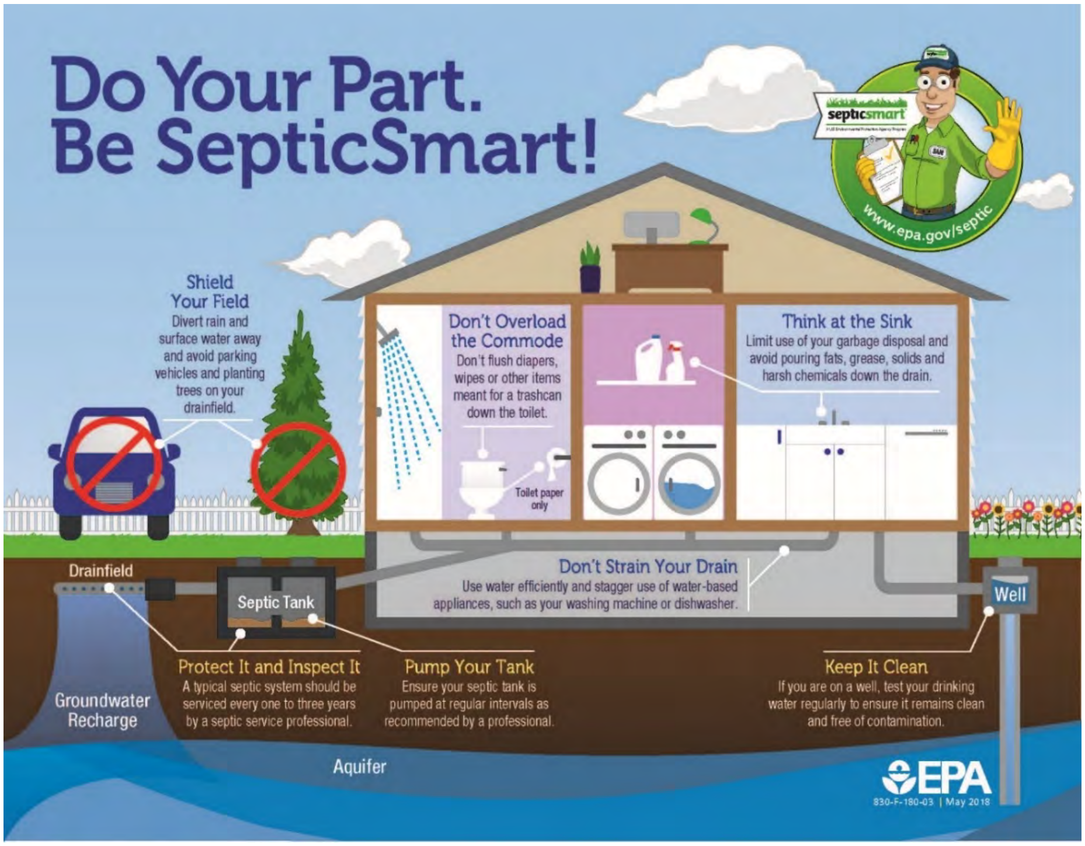
Septic system maintenance is a topic of major focus for landowner outreach in this watershed and is addressed by RP-1 and RP-2 in Table 3.1 above. Since faulty septic systems are a potential source of bacterial contamination to the watershed, proper septic system design, installation, and maintenance are all very important to the watershed. A malfunctioning septic system can contaminate surface water or groundwater, which could include drinking water wells. Moreover, a malfunctioning septic system will lower property value and cause difficulty in selling a home. Stakeholders would like to advocate for proper septic system maintenance with the Winnebago County Health Department and provide a program to encourage voluntary septic system maintenance by current homeowners.

Currently the Winnebago County Health Department inspects septic systems when they are initially installed to ensure proper design and installation. Residents are required to maintain their septic systems once installed and self-report that they have had their system checked by a professional plumber every 5 years. However, there is no enforcement by the Health Department if people do not self-report. Some stakeholders voiced their concern about residents possibly electing to not self-report or conduct the proper pumping every 5 years. In the end, stakeholders agree that this plan is a tool to *advocate* for the health of the watershed, the health of the people living in it, and for change to make things better. Therefore, the stakeholders, if in agreement, should be able to petition the Health Department to advocate for the greater good by ensuring septic tanks are operating properly and not leaking into surrounding waters. This may be controversial, as this plan is intended to be voluntary, and should be considered carefully.

RP-2: Septic System Maintenance Program

Many stakeholders were surprised to learn their streams have elevated levels of fecal coliform and desire to highlight how this is tied to improper septic system maintenance. Subdivision residents would like to devise a voluntary, neighborhood septic system maintenance program. Such a program could be headed by an interested group formed under the umbrella of a homeowner's association and use educational fliers below.

Education materials, brochures, or fliers should answer questions like "why is fecal coliform bad?" and "how can it harm humans or pets?". Below is an example of one flier created by the USEPA and offered to communities for outreach:



Beyond the importance of continued maintenance, stakeholders would like outreach efforts to include:

- Educate homeowners on the cost of periodic septic system inspection and cleaning versus the high cost of replacing a leaking septic system. Regular cleaning and inspection do take time, effort, and money, but it in no way compare to the much larger hassle, expense, and environmental and health hazard of replacing a failed septic system.
- Realtor Associations can educate potential buyers on septic systems when they are buying a home serviced by a septic system.
- Explore the County Health Department's role in septic system maintenance and promoting septic system cleaning and pumping.
- Determine where the fecal coliform contamination to the creek originates.

Stakeholders are very interested in learning more about possible sources of fecal coliform. A Rock Valley College Environmental Science professor along with students involved in the Students for Responsible Environmental Sustainability (SRES) club have volunteered to conduct water sampling above and below potential sources of fecal coliform. The Rock River Water Reclamation District (RRWRD) has graciously offered pro bono lab processing of the water sampling up to a specified amount. These efforts are further discussed in Chapter 7.

RP-3: Native Landscaping

Stakeholders suggest demonstrating native plantings and other best management practice installations that fit within a residential lawn, such as rain gardens, filter strips, vegetated swales, and no-mow areas. These demonstrations will be most helpful if conducted on three properties during the first three years of this plan. Fliers below can be distributed at demonstrations. Organizations best suited to conduct the three demonstrations include:

- Demonstration 1: The Natural Land Institute could highlight nearby residences enrolled in the Conservation@Home program.
- The Rockford Park District could show residents BMPs installed within the parks of the watershed that could also be useful in residential lawns.
- Wild Ones could explain the benefit of native landscaping at nearby residences.

RP-4: Lawn Care

Stakeholders recognize the role of proper lawn care, water conservation efforts, and residential stormwater best management practices in protecting the water quality of our streams, ponds, and lake. To improve these actions, stakeholders wish to provide demonstrations of conscientious lawn care on three properties within the first three years of the implementation of this plan. During these demonstrations, they will distribute information to homeowners and local lawn care companies considering contamination from lawns are fertilizers, pesticides, pet waste, and even mulched grass clippings and leaves using the educational fliers provided below. Demonstrations could include how to install rain barrels and create a rain garden. Through the Conservation@Home program, administered by the Natural Land Institute, homeowners can purchase and learn how to install rain barrels on their property.

RP-5: Retention Pond Maintenance

Stakeholders are interested in learning more about the proper maintenance of private retention ponds. Some specific ideas concerning this topic came to mind:

- Identify who is responsible and accountable for private pond evaluation.
- Send educational mailings to known sites of private ponds.
- Funding options for private pond maintenance.

Private landowners are responsible for maintaining private ponds on their property. Ensuring long-term function of retention ponds requires routine maintenance, periodic inspections, and corrective actions. Property owners are responsible for conducting frequent inspection and maintenance items such as mowing, checking for clogs, and debris removal.

The Winnebago County SWCD is willing to update an existing retention pond flier and direct mail it to landowners responsible for upkeep. Furthermore, citizen volunteers or landowners can perform routine pond and wetland maintenance, such as mowing and removing debris or trash. Routine maintenance is recommended multiple times each year. More specialized laborers with specific equipment should perform more substantial maintenance such as removing accumulated sediment. Removal of sediment and other substantial maintenance tasks are often necessary less frequently. Certified engineers should perform inspection and repair of critical structural features such as embankments and risers. Inspections and repairs of structural features usually occur every five to 25 years depending on the size and complexity of the system.

RP-6: Educational tours and demonstrations

Residential best management practices are not mainstream within the region, but examples exist. Most likely, environmental organizations that focus on native landscaping like Wild Ones and the Conservation@Home program through the Natural Land Institute would be able to provide guidance, locate examples, engage the owners, and organize tours and demonstrations on residential properties of private individuals. The Rockford Park District has examples suitable for residential properties within their parks and could also provide tours and guidance. This plan aims for the community to hold one event per year highlighting residential best management practices and providing guidance for interested attendees.

RP-7: Neighborhood Action Groups

Under the umbrella of a homeowner's association or Winnebago County Special Water District, a group can be formed with a focus on engaging the community to take action within the neighborhood to improve water quality. This plan recommends that the group meet monthly for the five-year life of this plan.

Agricultural Outreach

For agricultural areas, the stakeholders that identified as agricultural producers brainstormed ideas for outreach to producers. The NRCS, Winnebago-Boone Farm Bureau, and Winnebago County SWCD already have working relationships with many local producers and continuously provide education to producers. The agricultural community listed some communication channels for outreach: mailings, webinars, recordings, podcasts, seminars, articles, and social media posts.

Stakeholders are interested in several main topics, including:

- restoring and widening ineffective grassed waterways,
- BMPs for smaller fields,
- critical area plantings,
- opportunities for non-tillable land adjoining the fields (e.g. filter strips, perennial cropping),
- improving existing woodlands,
- reaching absentee landowners about the importance of BMPs, and
- sources of funding assistance.

Stakeholders believe that agricultural outreach should promote the main ideas and follow the steps outlined in *Table 3.2* to provide outreach to agricultural producers.

Table 3.2 Agricultural Outreach Programs

Agricultural Outreach Programs* (AP)					
Ref #	**Quantity**	**Est. Time Frame**	**Program Description**	**Suggested Lead**	**Cash Needed****
AP–1	1 event or mailing/year	Year 1-5	Provide educational events, programs, or mailings for agricultural BMP topics of interest. Utilize agricultural BMP fliers.	SWCD, NRCS, Farm Bureau	$0-$1,500/ year
AP-2	1 event/year	Year 1-5	Provide demonstrations and technical expertise.	SWCD, NRCS, Farm Bureau, U of I Ext.	$0-$1,000/ year
AP-3	1 project/ year	Year 2-5	Partner with local municipalities and private individuals and organizations who may have a vested interest in helping to fund BMP projects or outreach.	RPC, SWCD, NRCS	$0-$1,250/ year
AP-4	1 event or mailing/year	Year 1-5	Absentee landowner outreach.	SWCD, NRCS, Farm Bureau	$0-$500/ year
AP-5	1 event/year	Year 1-5	Offer rural peer-led workshops to share experience in applying agricultural BMPs.	SWCD, NRCS, Farm Bureau	$0-$1,000/ year
AP-6	1 event/year	Year 1-5	Invite educational speakers to present at watershed meetings.	NRCS, SWCD, Farm Bureau, NLI	$0-$200/year
AP-7	1 event/year	Year 1-5	Promote preserving farmland with agricultural easements.	NRCS, NLI	$0

*During each Agricultural Program, advertise the publications referenced below.
** Cash includes only raw materials, printing/production, not the value of time or hiring staff or intern.

Each outreach program for agricultural producers is further described below.

AP-1: Educational Events and Programs

Organizations focusing on Winnebago County that provide similar events and programs are the SWCD, NRCS, and Farm Bureau. This plan aims for one or more of these organizations to host one event or mailing per year for five years. These efforts could be combined with events already occurring through these organizations with special attention given to attracting watershed stakeholders. Much of the desired information is reflected in the agricultural BMP fliers included in this plan.

AP-2: Demonstrations and Technical Expertise

For those interested in taking the next step to implement a best management practice on their property, stakeholders would like to see demonstrations and have access to technical expertise. This plan recommends that organizations such as the local SWCD, NRCS, Farm Bureau partner with the University of Illinois Extension office to host one event per year for five years to work with interested landowners on the topics of interest.

AP-3: Partner with local funders

Some of the stakeholders in the watershed are interested in helping to improve water quality but are limited in the land they have to implement BMPs. Another way to be part of the solution is to provide private funding for projects elsewhere in the watershed. To recognize these partnerships, leadership will need to come from a local volunteer. The Region 1 Planning Council's watershed coordinator (pending grant funding) is best suited to bring partnerships together and provide structure. Other organizations well-suited to help match funders with projects are the SWCD, NRCS, Farm Bureau, Rockford Park District, and Natural Land Institute. This plan recommends focusing on raising the funds for an interested landowner to implement one project per year for five years. Efforts should be timed with writing one grant application per year, using the private funds as required match for a suitable funding agency.

AP-4: Outreach to Absentee Landowners

Stakeholders recognize that many farms are not owned and operated by the same family. There is a common disconnect between the agricultural producers who work the land and those who own the land and make decisions related to land use and best management practice implementation. All parties involved with working the landscape are important recipients of outreach efforts, although absentee landowners can be the hardest to reach. Therefore, this plan recommends placing specific effort on providing outreach to absentee landowners by holding one event or sending one mailing per year for five years and following up when there is interest. The Winnebago County SWCD suggests that their S.T.A.R. program, found at https://winnebagoswcd.org/swcd/?page_id=2241, could be helpful for this purpose.

AP-5: Peer-Led Workshops

No one knows farming better than the agricultural producers themselves. This plan recommends providing a platform for producers to share their conservation trials and techniques with other producers. This is especially important when it comes to conservation tilling techniques, such as continual no-till and perennialization of crops. The Natural Land Institute Organizations that may be able to facilitate one event per year for five years include NRCS, Farm Bureau, and the Natural Land Institute.

AP-6: Speakers at Watershed Meetings

Watershed meetings are expected to continue, led by a coordinator hired by the Region 1 Planning Council (pending grant approval) and involving the core group of stakeholders involved in planning plus newly interested stakeholders. Once per year for five years, they plan to invite a speaker to present on agricultural topics of interest. Organizations likely to suggest speakers are the NRCS, SWCD, Farm Bureau, and Natural Land Institute.

AP-7: Promote Agricultural Easements

The Natural Land Institute holds agricultural easements in northern Illinois on working farms that promote soil health and conservation farming. They work with agricultural producers through their Healthy Land & Water Working Land (Farmland) Group, which geographically encompasses this watershed. This plan recommends ensuring that watershed producers are invited to take part one regional event per year for five years so that they can become versed in agricultural easements and decide if they are right for them.

Industrial & Commercial Outreach

For commercial and industrial areas, stakeholders of local businesses or other commercial and industrial entities brainstormed ideas for outreach. These stakeholders acknowledge that stormwater conveyance is already regulated via permitting. However, there are certain outreach topics geared towards industrial and commercial facilities and business that can help improve stormwater management and natural resource issues on these properties. One participant acknowledged that their group wants to be a good steward of natural resources, but regulation for their dairy operations requires them to have mowed turf to detract raccoons, mice, etc. They would not be allowed to implement a BMP with vegetation other than turf, but they could consider implementing underground storm sewers, receptors, mechanical separators, permeable pavers, etc. where appropriate.

Recommendations to provide outreach to the commercial and industrial leaders of the community are outlined in *Table 3.3* below.

Table 3.3 Commercial/Industrial Outreach Programs (CIP)

Commercial/Industrial Outreach Programs (CIP)*					
Ref #	**Quantity**	**Est. Time Frame**	**Program Description**	**Suggested Lead**	**Cash Needed****
CIP-1	2 projects by second year	Year 1-2 (launch), Years 1-5 (maintain)	Offer an avenue for businesses to provide funding for off-site BMP projects.	RPC, SWCD, NLI	$10,000 total
CIP-2	1 event/year	Year 1-5	Conduct commercial/industrial tours or workshops for stormwater BMPs. Utilize BMP fliers.	SWCD, NLI Conservation@Work	$0-$2,000 /year
CIP-3	1 event/year	Year 1-5	Provide on-site consultation for business/industrial BMPs	SWCD, NLI Conservation@Work, Farm Bureau	$0

*During each Commercial/Industrial Program, advertise the publications referenced below.
** Cash includes only raw materials, printing/production, not the value of time or hiring staff or intern.

Each outreach program for business and industrial staff is further described below.

CIP-1: Provide Funding for Off-Site Projects

If a commercial or industrial group cannot implement certain BMPs on their land, they could instead invest in other projects in the watershed that improve water quality. This plan recommends promoting such partnerships, which could also help the business's positive public relations within the community. The Region 1 Planning Council's watershed coordinator (pending grant approval) could be the link between business who would like to contribute and projects throughout the watershed in need of funding. The coordinator could meet with business owners and landowners, determine project needs, and write grant applications using private funds as match required to obtain grant funding.

CIP-2: BMP Tours and Workshops

BMPs on commercial and industrial properties within the watershed often have room for improvement and expansion. For example, most detention basins and swales could be planted with native vegetation to improve stormwater infiltration and filtration. Other BMPs could be added to further treat and detain stormwater coming off parking lots, rooftops, and other impermeable surfaces such as permeable pavers and vegetated filter strips. Business owners would better understand how they can improve and add BMPs to their properties if they could see first-hand how it works for other businesses. Tours of nearby BMPs on business and industrial campuses will organically provide opportunities for interested parties to ask questions to the tour guide. The Winnebago County SWCD hosts a sediment and erosion control workshop, typically every March, that sometimes includes a speaker talking about stormwater BMPs for existing businesses that could be directly advertised to watershed business and industry staff.

CIP-3: BMP Consultation

As a follow up to BMP tours (CIP-2), local environmental organizations such as the Farm Bureau, SWCD, and NLI through their Conservation @Work program could offer one-on-one consultation for business and industrial staff, suggesting which BMPs might work and how they would fit on their unique properties. These organizations should provide the business and industrial staff with a clear set of instructions on how to take steps toward implementing BMPs on their properties and contacts of contractors who can either conduct the installation and stewardship or work alongside and train staff.

Watershed-Wide Outreach and Publications

Some efforts span residential, agricultural, and business and industrial involvement. They are summarized in *Table 3.4* and described below. Overall costs are summarized in Table 3.5 below. These costs include raw materials, printing, and production. They do not include hiring someone or the monetary value of volunteered time. Knowing the cash amount needed to conduct outreach efforts will help determine needed budgets, while volunteer time can be provided as match to raise necessary capital from partners and funding agencies. This chapter highlights costs of outreach efforts only. Costs for best management practices are found in Chapters 4 and 5.

Table 3.4 Publications and Watershed-Wide Outreach Efforts

Publications (P) & Watershed Wide Outreach Efforts (WW)					
Ref #	**Quantity**	**Est. Time Frame**	**Publication Description**	**Suggested Lead**	**Cash Needed**
WW-1	Ongoing program	Year 1 (launch), Years 1-5 (maintain)	Volunteer outreach coordinator to oversee and accomplish the advocacy, outreach, and events listed.	RPC	$0
P-1	As needed or at each event	Year 1 (launch), Years 1-5 (maintain)	Establish a website link to this Plan, Executive Summary, and Educational Fliers from this Chapter and guide stakeholders to it.	RPC, Rockford Park District	$0
P-2	Semiannually	Year 1-5	Publish semiannual newsletter articles or mailings to send to private homeowners and landowners.	SWCD, Municipalities, Homeowner Associations	$0-$750/ distribution
P-3	As needed	Year 1-5	Distribute a Welcome Packet to new homeowners and businesses that includes a copy of this plan's Executive Summary and other relevant BMP information.	Homeowner Associations	$0-$200/year
P-4	As needed	Year 1-5	Provide updates of BMP project implementation, watershed planning meetings, and other efforts related to this plan.	RPC	$0-$500/ year

Each publication and watershed-wide outreach effort is further described below.

WW-1: Outreach Coordinator

Education efforts would greatly improve if a volunteer outreach coordinator is established to oversee and accomplish the advocacy, outreach, and events listed. The Region 1 Planning Council (RPC) and Olson Ecological Solutions (OES) partnered to provide a watershed coordinator to be staffed by RPC and technically supported by OES. RPC applied for a grant from the Illinois Environmental Protection Agency through their Section 319 Program to fund the position. This staff member would provide outreach coordination on an ongoing basis in addition to other aspects of implementing this watershed plan.

P-1: Website

A website link exists and will be maintained by the Rockford Park District. If Region 1 Planning Council receives funding to provide a watershed coordinator, it would also make sense that they maintain a website in addition to the Rockford Park District. The website should house this plan with its executive summary and inventory and maintain a link directly to the educational fliers from this chapter. Stakeholders can be guided to this resource during outreach efforts. The website link is https://rockfordparkdistrict.org/levings-park.

P-2: Newsletter Articles

Newsletter articles or mailings may feature how to install a prairie garden, rain garden, vegetated filter strip, or vegetated swale, for example. Successful articles will answer the questions, "what's in it for me?" and "how are excessive nutrients, total suspended solids, and fecal coliform harmful to surface water?". These articles can also address the need to focus on critical or priority areas discussed in Chapter 4 to thwart the misconception that a person would need to rip up their entire yard and forego enjoyment and use. This plan recommends publishing semiannual newspaper articles and mailings promoting BMPs on private lands. These articles could be published in the SWCD newsletter, homeowner association news blasts, or be distributed with City of Rockford and Village of Winnebago mailers to residents within the watershed.

P-3: Welcome Packet

When new residents move into one of the neighborhoods on septic systems, the homeowner's association could provide them with a welcome packet that includes a copy of this plan's Executive Summary, link to the Rockford Park District Levings Lake website (see P-2), and other relevant BMP information and ways to become involved. This would happen consistently throughout the 5-year life of this plan as needed.

P-4: Updates to Watershed Partners

Providing updates to stakeholders and technical advisors concerning BMP project implementation, watershed coordination meetings, and other efforts related to implementing this plan will be necessary throughout the five-year life of this plan. The watershed coordinator proposed to be hired by the Region 1 Planning Council pending grant funding would be responsible for providing updates. The website (P-1) would be a good resource for posting updates. Other communication channels for residential areas include social media (Facebook, Nextdoor, etc.), community/neighborhood groups (e.g. homeowner associations), and newsletters, word-of-mouth, and email blasts.

Cost Summary

Table 3.5 estimates a minimum cost of $10,000 for education and outreach over five years and a maximum cost of $84,500.

Table 3.5 Cost Summary for Outreach

Year	Minimum Estimated Cost	Maximum Estimated Cost
Year 1	$ 5,000.00	$ 21,400.00
Year 2	$ 5,000.00	$ 21,400.00
Year 3	$ -	$ 15,900.00
Year 4	$ -	$ 12,900.00
Year 5	$ -	$ 12,900.00
Total	**$ 10,000.00**	**$ 84,500.00**

The costs outlined in *Table 3.5* are broken down for a better understanding in *Table 3.1* through *Table 3.4*. Costs represent cash needed for printing, publications, and other raw materials. Although stakeholders, technical advisers, and grant agencies recognize the value of volunteer time, this value is not reflected by the estimated costs. Years 1 through 3 require additional funds to launch programs for septic system maintenance advocacy (RP-1), demonstrations of BMP installation and native planting (RP-3) and conscientious lawn care (RP-4), and connecting funds from businesses and industrial decision-makers with projects throughout the watershed (AP-3 and CIP-1). All other outreach efforts call for consistent funding throughout the five-year lifespan of this plan. Willing stakeholders will need to absorb costs, or grant funds will need to be secured to cover costs.

Expected Outcomes and Behavioral Changes

As these outreach programs are carried out, we expect outcomes and behavioral changes from the watershed's stakeholders. The three main stakeholder groups (residents, agricultural producers, and commercial and industrial leaders) will similarly come away more enlightened and in tune with their surroundings. Various outreach efforts will likely have different outcomes.

We anticipate that the events, mailings, and speakers will:

- introduce new ideas to residents about how septic system maintenance, water conservation, and lawn care are tied to the water quality of their streams, ponds, and lake;
- give producers a better realization about how their land uses and farming techniques relate to stream and lake health;
- engage absentee landowners, and
- make all stakeholders aware of what they can do to positively affect water quality.

Tours and demonstrations will:

- show residents how to easily incorporate BMPs in their yards,
- connect businesses and industries within the watershed with those in the region who have implemented BMPs, and
- motivate residents and business owners to take action on their own properties.

Creating a voluntary septic system maintenance program and advocacy with the Winnebago County Health Department will:

- make residents using septic systems more aware of their responsibilities to the health of the watershed,
- improve septic system maintenance in the watershed, and
- decrease fecal coliform bacteria in South Fork Kent Creek and its tributaries.

Creating neighborhood-wide action groups and peer-led workshops of agricultural producers will:

- create a means for neighbors to work together for the good of their entire subdivisions, and
- help agricultural producers realize how they can work together to make a bigger impact.

Connecting landowners and businesses with local municipalities, environmental and agricultural agencies, and private individuals and organizations will:

- link decision-makers for private properties with local experts to provide consultation and answer specific questions about unique opportunities at each site,
- provide additional funding from local, private sources that can be used to attract grant funds to local projects, and
- give all stakeholders the tools they need to turn ideas into action.

Overall, expected outcomes and behavioral changes should lead to projects on-the-ground that will make the desired changes to the watershed happen.

Indicators of Success

Outreach efforts will be considered successful once the relationships needed to make change have been formed, or after 75% of the outreach efforts have occurred. For changes to occur, many stakeholders will need to act in small ways, or a few stakeholders will need to act in big ways. All recommended actions lead to this measure of success over time in stages.

Stages of success include:

1. Stakeholders are made aware of water quality issues and their solutions.
2. Stakeholders understand how their properties are connected to the watershed.
3. Stakeholders see examples of successful BMPs.
4. Stakeholders are motivated to make a positive difference, however big or small.
5. Stakeholders know who they can contact for help.
6. Stakeholders have the tools they need to act, such as technical expertise, funding, and a project.

For outreach efforts to be successful, no BMPs need to be implemented yet. Success for the outreach portion of this plan simply refers to behavioral changes of the stakeholders.

Educational Fliers and Links

Educational fliers that describe recommended best management practices for developed and agricultural areas within the watershed and information about pollutants can be found in *Exhibit C and D*. These fliers can be used to support the education and outreach efforts discussed above.

Stakeholders see the value in utilizing already published information as educational materials. The links below provide additional information about best management practices appropriate for Illinois:

Background Guidance about Nonpoint Source Pollution

- The Environmental Protection Agency's website for Polluted Runoff: Nonpoint Source Pollution provides *Resources for Students and Educators about Nonpoint Source (NPS) Polllution* at https://www.epa.gov/nps/resources-students-and-educators-about-nonpoint-source-nps-pollution

Comprehensive Agricultural Best Management Practice Guides

- The Natural Resources Conservation Service (NRCS) Field Office Technical Guide (eFOTG) details many best management practices that are most often used by agricultural producers. The electronic Field Office Technical Guide can be found at https://efotg.sc.egov.usda.gov/#/details.
- The Winnebago County SWCD can make fliers available as they are created.

Comprehensive Residential Best Management Practice Guides

- The Lake County Stormwater Management Commission published *A Citizen's Guide to Maintaining Stormwater Best Management Practices for Homeowners Associations and Property Owners* that can be found at https://www.lakecountyil.gov/DocumentCenter/View/2961/A-Citizens-Guide-to-Maintaining-Stormwater-Best-Management-Practices-PDF?bidId=
- The Illinois Urban Manual (IUM) has a comprehensive list of residential best management practices that are geared toward improving and protecting water quality for landowners at https://illinoisurbanmanual.org/practice-standards/.
- Heartland Water Resources Council has an informative *Homeowners Guide to Stormwater Best Management Practices* that further details native plantings, rain gardens, downspout runoff ideas, and more found at https://tricountyrpc.org/wpcontent/uploads/Central_Illinois_Guide_to_Stormwater_BMPs-1.pdf.
- More tips are found at https://www.epa.gov/nutrientpollution/sources-and-solutions-and-around-home.

Guides for Specific Best Management Practices

- The University of Illinois Extension has information about Illinois septic systems, including types of treatment systems, soil evaluations, buying or selling a house serviced by septic, proper maintenance, cleaners and additives, tank pumping, system failures, and more. This resource can be found at https://web.extension.illinois.edu/septicsystems/.
- The US Environmental Protection Agency has created *A Homeowner's Guide to Septic Systems* that may be another valuable resource to landowners in the watershed. This guide can be found at https://www3.epa.gov/npdes/pubs/homeowner_guide_long.pdf.
- The US EPA has a program with technical resources, tips, and outreach materials dedicating specifically to septic systems called Septic Smart at https://www.epa.gov/septic/septicsmart-homeowners.
- The US EPA has a Septic System Outreach Toolkit with free and accessible outreach materials for communities serviced by septic systems with friendly reminders and tips at https://www.epa.gov/septic/septic-systems-outreach-toolkit.
- The Wisconsin Department of Natural Resources provides a detailed guide for creating rain gardens at https://dnr.wi.gov/topic/shorelandzoning/documents/rgmanual.pdf.
- The Natural Land Institute has a rain barrel brochure with installation tips at https://www.naturalland.org/wp-content/uploads/2018/02/Rain-Barrels-with-bleeds4.pdf.
- The Natural Land Institute's *Guide to Natural Areas in Northern Illinois*, which can be found online at https://www.naturalland.org/wp-content/uploads/2017/03/Natural_Areas-Guide3_finalfullbook-2.pdf, provides stakeholders with locations to visit to appreciate native plants recommended for use in many of the recommended BMPs as vegetated swales, filter strips, and rain gardens.
- The USEPA has a Stormwater Wet Pond and Wetland Management Guidebook found at https://www3.epa.gov/npdes/pubs/pondmgmtguide.pdf. It provides recommended timelines

and frequencies for general inspections and maintenance, including pooling, clogging, pipe repairs, vegetation management, dredging and much removal, access, and other nuisance issues for wet ponds, wetlands, infiltration trenches and basins, vegetated swales, and filter strips.

Section 2, Chapter 4
Implementation of Watershed-Wide Practices

Introduction

Chapter 2 discusses the six highly prioritized best management practices (BMPs) to be implemented watershed-wide. Chapter 3 provided the foundation for outreach to stakeholders of the watershed that have the power to make positive landscape, land use, and cultural changes to the watershed. This chapter details the steps needed to implement the top six prioritized BMPs watershed-wide recommended in Chapter 2. The next chapter will detail site-specific projects. Support resources for financial and technical needs to implementing these practices and projects are found in Chapter 6.

To implement BMPs watershed-wide in a planned manner, it is important to understand the benefits of implementation in terms of pollution load reduction estimates and the costs from various perspectives such as total cost and cost effectiveness. With this information, consultants have planned a general schedule over the next five years and have predicted improvement to be experienced along the way. The costs are analyzed per pound of nutrient and TSS or per counts of bacteria to determine how cost effective each practice would be to implement. Determining methods that result in the most pollutant load reduction and are the most cost-effective at keeping pollutants out of the water gives stakeholders direction.

The highly prioritized BMPs used to create the plan outlined in this chapter are:

1. Grassed Waterways
2. Vegetated Swales
3. Filter Strips
4. Constructed Stormwater Wetlands
5. Conversion to Natural Area
6. Streambank Stabilization

The following pages estimate how much nitrogen, phosphorus, TSS, sediment, and bacteria would be removed from the water utilizing each of the prioritized watershed-wide BMPs; estimate the cost of implementing each practice; establish a schedule for implementing watershed-wide BMPs; and recognize parties who can facilitate implementing BMPs. Other BMPs with either high or low applicability to the watershed listed in Chapter 2 can be substituted to meet the goals, objectives, and targets set forth in Chapter 1. The estimates given below are generalized to fit in any landscape without taking into consideration site conditions that may affect their efficacy. To increase efficacy, place BMPs within prioritized locations as detailed in Chapter 1.

High Priority BMP Pollution Load Reduction Efficiencies & Estimates

The six practices highly prioritized in this plan and named above would add significant value to the efforts of reducing nutrients, total suspended solids (TSS), sediment, and bacteria in the waters of South Fork Kent Creek. This next section considers how efficient various BMPs are at reducing each of the pollutants. Using these BMP efficiencies and current pollutant baseline loading, consultants model how much pollutant load reduction is estimated once the top six prioritized BMPs are implemented. The next section details BMP cost and sizing estimates.

Pollutant Load Reduction Efficiencies for Watershed-Wide BMPs

In order to focus the watershed efforts, pollutant load reduction estimates primarily consider the effects of implementing the top six prioritized BMPs, which are grassed waterways, vegetated swales, herbaceous filter strips, constructed stormwater wetlands, conversion to natural area, and streambank stabilization. Many factors affect the capability of a specific BMP to reduce pollution including size, location, design, installation, and maintenance. However, a certain BMP can be more effective at reducing certain pollutants than another BMP, even when both BMPs are designed, sized, installed, and maintained properly. Moreover, BMP pollutant reduction efficiencies can vary for the same BMP depending on size, placement, maintenance, etc. Considering these factors, consultants examined reliable sources to compile BMP pollutant reduction efficiencies. These pollutant load reduction efficiencies for the six highly prioritized BMPs are listed in *Table 4.1*. The efficiencies of other BMPs with high and low applicability to the watershed, plus BMPs beyond those discussed in Chapter 2 are listed in *Table 4.2*, if stakeholders have interest in BMPs not listed in Chapter 2.

Table 4.1 Pollutant Load Reduction Efficiency per Highly Prioritized BMP

Efficiencies of the Top Six Prioritized BMPs						
BMP Type	**Bacteria**	**TN**	**TP**	**TSS/ Sediment**	**Treatment Area**	**Resources**
Grassed Waterway	**50%**	**30%**	**25%**	**45%**	**Drainage Area**	Lake County 2018
Vegetated Swale	**30%**	**10%**	**45%**	**60%**	**Drainage Area**	DuPage 2008, USEPA 1999, USEPA Region 5
Grassed Filter Strip	**30%**	**40%**	**45%**	**53%**	**Drainage Area**	USEPA Region 5, USEPA 1999, DuPage 2008
Stormwater Wetlands	**78%**	**35%**	**43%**	**70%**	**Drainage Area**	Lake County 2018, USEPA 1999, R. Winer 2000
Conversion to Natural Area	**60%**	**90%**	**80%**	**90%**	**BMP Footprint**	Lake County 2018, USEPA STEPL 4.4
Streambank Stabilization	**95%**	**95%**	**95%**	**95%**	**BMP Footprint**	Lake County 2018, USEPA Region 5

Table 4.2 Pollutant Load Reduction Efficiency per Other BMP

Efficiencies of Other BMPs Applicable to the South Fork Kent Creek Watershed						
BMP Type	**Bacteria**	**TN**	**TP**	**TSS/ Sediment**	**Treatment Area**	**Resources**
Rain Garden	37%	56%	75%	81%	Drainage Area	Center for Watershed Protection 2007, R. Winer
Bioretention Area	37%	56%	75%	81%	Drainage Area	Center for Watershed Protection 2007, R. Winer
Wet Retention or Pond	70%	32%	49%	80%	Drainage Area	R. Wiener 2000, USEPA 1999, Homer Glen DuPage 2008
Extended Wet Detention	UNK	55%	68%	86%	Drainage Area	USEPA Region 5
Dry Detention	78%	25%	19%	47%	Drainage Area	USEPA 1999, R. Winer 2000, DuPage 2008
Infiltration Basin	85%	60%	65%	75%	Drainage Area	USEPA 1999, USEPA Region 5
Infiltration Trench	85%	55%	60%	75%	Drainage Area	USEPA 1999, Schuler 1992, USEPA Region 5, Homer
Forested Buffer Strip	30%	48%	47%	59%	Drainage Area	USEPA STEPL 4.4, USEPA 1999
Livestock Exclusion Fencing with Alternate Water Supply	UNK	34%	42%	81%	Drainage Area	USEPA STEPL 4.4
Livestock Exclusion Fencing with Stream Crossing	UNK	20%	30%	62%	Drainage Area	USEPA STEPL 4.4
Bioreactor	UNK	45%	UNK	UNK	Drainage Area	USEPA STEPL 4.4
WASCOB	35%	20%	60%	70%	Drainage Area	Lake County 2018
Porous Pavement	40%	85%	65%	90%	BMP Footprint	Lake County 2018, USEPA Region 5, USEPA 1999
Remeander Channelized Stream	UNK	95%	95%	95%	BMP Footprint	Lake County 2018, USEPA Region 5
Grade Control Structure	25%	10%	20%	30%	BMP Footprint	Lake County 2018
Critical Area Planting	UNK	18%	20%	42%	BMP Footprint	USEPA STEPL 4.4
Cover Crop	35%	30%	30%	40%	BMP Footprint	Lake County 2018
No Till / Strip Till	20%	10%	50%	70%	BMP Footprint	Lake County 2018
Conservation Tillage	UNK	15%	36%	40%	BMP Footprint	USEPA STEPL 4.4
Terrace	UNK	25%	31%	40%	BMP Footprint	USEPA STEPL 4.4
Nutrient Management Plan	0%	15%	7%	0%	BMP Footprint	Lake County 2018, USEPA STEPL 4.4
Heavy Use Area Protection	UNK	18%	19%	33%	BMP Footprint	USEPA STEPL 4.4
Prescribed Grazing	UNK	41%	23%	33%	BMP Footprint	USEPA STEPL 4.4
Feed Area Management	80%	85%	83%	79%	BMP Footprint	Lake County 2018

The BMP pollutant load reduction efficiency charts (*Tables 4.7* and *4.8*) above show the most efficient practices, disregarding cost, for removing bacteria, nitrogen, phosphorus, and either total suspended solids or sediment from the treatment area. Keep in mind when using this chart that the treatment area refers to either the drainage area treated by the BMP or the footprint of the BMP. This is important to realize when comparing efficiencies of the various BMPs.

Of the six highly prioritized BMPs, stabilizing streambank and converting land from a different land use to natural area efficiently reduce pollutants within the footprint of the BMP. They are both highly effective at treating nitrogen, phosphorus, suspended solids, and bacteria within the acreage of ground of feet of bank that they cover. The other four, grassed waterways, vegetated swales, stormwater wetlands, and filter strips treat runoff coming from a larger drainage area. Although their percentages look lower than those treating the BMP footprint, their efficacy applies to a much larger baseline of pollutants coming from a larger area. These four are applicable to different settings and are better than other BMP options within this watershed according to technical advisors, consultants, and stakeholders.

The next section takes these top six prioritized BMPs and estimates the amount of pollutant load reductions that would be achieved if they were to be implemented at their recommended amounts.

Pollutant Load Reduction Estimates and Milestones for Top Six Prioritized BMPs

The watershed planning group deem the following BMPs as top priority for implementation:

- grassed waterways,
- vegetated swales,
- herbaceous filter strips,
- constructed stormwater wetlands,
- conversion to natural area, and
- streambank stabilization.

Since these six BMPs are the focus for implementation, consultants applied them to appropriate land uses throughout the watershed to achieve the pollutant load reduction targets given in Chapter 1. Each of the prescribed best management practices above plays a role in reducing all target pollutants. Their ability to address each pollutant varies, but all are chosen because they are highly effective. Various factors were considered as discussed above. *Table 4.3* denotes how many acres per land use type are affected by each BMP in the scenario used to achieve the pollutant load reduction targets.

Table 4.3 Land Uses Treated by Top Six BMPs

BMP Type	High Residue Till	Low Residue Till	High Intensity Development	Medium Instensity Development	Low Intensity Dev elopment	Road	Railroad	Trail	Golf Course	Turf	Severely Eroded Streambanks	Very Severely Eroded Streambanks
	Land Uses with Drainage Area Acreages Treated by Top Six BMPs											
	acre	acre	acre	acre	acre	acre	acre	acre	acre	acre	ft	ft
Grassed Waterway	818	215									N/A	N/A
Vegetated Swale			17	32	303	184	11				N/A	N/A
Vegetated Filter Strip	545	143	17	32	303			15	6		N/A	N/A
Constructed Stormwater Wetland	327	36	7	13	227						N/A	N/A
	Land Uses with BMP Footprint Treated by BMP											
	High Residue Till	Low Residue Till	High Intensity Development	Medium Instensity Development	Low Intensity Dev elopment	Road	Railroad	Trail	Golf Course	Turf	Severely Eroded Streambanks	Very Severely Eroded Streambanks
	acre	acre	acre	acre	acre	acre	acre	acre	acre	acre	ft	ft
Convert to Natural Area			4	16	227				6	75		
Streambank Stabilization											3,310	1,835

Table 4.4 shows the estimated pollutant load reduction for each focus pollutant if each of these six BMPs are implemented at the recommended amount. According to *Table 4.10*, once the top six prioritized BMPs are implemented at the recommended amount, then the surface water in the watershed will experience the following reductions in the target pollutants:

- reduction in total nitrogen loading by 7,933 pounds per year, or 15.95% (exceeds 7.5% target),
- reduction in total phosphorous loading by 1,321 pounds per year, or 12.5% (meets 12.5% target),
- reduction in total suspended solid loading by 474,309 pounds per year, or 33.3% (exceeds 7% target),
- reduction in sediment by 360 tons every year, or almost 5% (exceeds 4% target), and
- reduction in bacteria loading by 66,844 billion counts year, or 24% (exceeds 20% target).

Table 4.4 Pollutant Load Reduction Estimates for Top Six Priority BMPs

#	Recommended BMPs - Watershed Wide	Description (All possible in the watershed)	Amount	Unit	Total Nitrogen Reduction (lbs/yr)	Total Phosphorus Reduction (lbs/yr)	TSS Reduction (lbs/yr)	Sediment (ton/yr)	Bacteria Reduction (bil counts/yr)
1	Grassed Waterways	Install 41.32 acres of 30 ft-wide grassed waterways in waterways that are currently bare throughout the watershed (dimensions of 30 ft by 60,000 ft) to treat 1033 acres of drainage area.	41.32	ac.	945	66	54266	N/A	3003
2	Vegetated Swales	Install vegetated swales into 10.52% of existing roadway ditches throughout the watershed (21.88 acres, dimmensions of 15 ft by 63,539.52 ft) to treat 547 acres of drainage area.	21.88	ac.	637	357	187822	N/A	13263
3	Herbaceous Filter Strips	Install 286.47 acres of 35 ft-wide herbaceous filter strips along streambanks, ponds, basins, roadways, etc. (dimensions of 35 ft by 356,532.37 ft) to treat 1061 acres of drainage area.	287.47	ft.	2283	242	100939	N/A	11539
4	Constructed Stormwater Wetlands	Install 18.3 acres of constructed stormwater wetlands on existing hydric soils to treat 610 acres of drainage area.	18.30	ac.	1184	136	72524	N/A	21049
5	Conversion to Natural Area	Convert 328 acres of land into natural areas.	328	ac.	2233	194	58758	N/A	15182
6	Streambank Stabilization - Very Severe & Severe	Stabilize 8% of very severely eroded streambanks, or 1,835 feet, and 5% of severely eroded streambanks, or 3,310 feet, throughout watershed.	5,145	ft.	652	326	N/A	360	2808
TOTAL POLLUTANT REDUCTION POST IMPLEMENTATION					**7,933**	**1,321**	**474,309**	**360**	**66,844**
POLLUTANT REDUCTION TARGETS					**3,730**	**1,321**	**99,701**	**295**	**55,610**

Because *Table 4.4* only considers the top six prioritized BMPs, it is possible for more reduction to take place by immeasurable effects of outreach efforts to increase awareness of focus topics, such as septic system maintenance and lawn care. Other BMPs can be used to supplement pollutant reductions to reach targets if implementing the top six BMPs proves difficult or a different practice is desired by a landowner, business owner, or homeowner.

As the top six prioritized BMPs are implemented, pollutant load reduction targets established in Chapter 1 will be met or exceeded. Some of the targets will be met before others. Total phosphorus will likely to be the last target met as it will require the implementation of all prescribed BMPs to achieve it. The others will be achieved in the interim with implementation of some but not all the BMPs as follows.

- *Milestone #1: Meet 7% reduction target for suspended solids, install 22% of prescribed BMPs.* The current amount of TSS loading from land uses and stream erosion is estimated to be 1,424,200 pounds per year. If all top six prioritized BMPs are implemented at the recommended amounts listed above, then the watershed will experience a TSS loading reduction of 474,309 pounds, or 33%, every year. The 7% reduction target will be met after installing only 22% of these BMPs, likely being the first reduction target met and milestone reached.

- *Milestone #2: Meet 7.5% reduction target for nitrogen by installing 47% of prescribed BMPs.* Currently in the watershed, the amount of nitrogen loading from land uses and stream erosion is at a baseline loading of 49,739 pounds per year. If all top six prioritized BMPs are implemented at the recommended amounts listed above, then the watershed will experience a nitrogen loading reduction of 7,933 pounds per year, or a 15.95% reduction in total nitrogen loading every year. The 7.5% reduction target for nitrogen will be met after about half of the BMPs have been installed.

- *Milestone #3: Meet 4% reduction target for sediment by installing 80% of prescribed BMPs.* The current amount of sediment loading from bank erosion of streams and other waterbodies is at a baseline loading of 7,384 tons per year. If all top six prioritized BMPs are implemented at the recommended amounts listed above, then the watershed will experience a sediment loading reduction of 360 tons per year, or a 4.8% reduction in sediment. The reduction target of 4% will likely be reached when about 80% of the BMPs have been installed.

- *Milestone #4: Meet 20% reduction target for bacteria by installing 83% of prescribed BMPs.* The current number of bacteria counts from land uses and stream erosion is at a baseline loading of 278,052 billion counts/year. If all top six prioritized BMPs are implemented at the recommended amounts listed above, then the watershed will experience a bacterium loading reduction of 66,844 billion counts/year, or a 24% reduction in bacteria loading every year. The reduction target of 20% will likely be met when about 83% of the BMPs have been installed.

- *Milestone #5: Meet 12.5% reduction target for phosphorus, install 100% of prescribed BMPs.* The current amount of phosphorus loading from land uses and stream erosion is at a baseline loading of 10,570 pounds per year. If all top six prioritized BMPs are implemented at the recommended amounts listed above, then the watershed will experience a phosphorous loading reduction of 1,321 pounds per year, or a 12.5% reduction in total phosphorus loading every year, meeting the reduction target. Because it will require installing all prescribed BMPs to meet this reduction target, it will be the last milestone reached.

The results of pollutant load reductions reached once all milestones are met are exhibited in *Table 4.5*.

Table 4.5 Baseline Pollutant Loading & Pollutant Loading Post BMP Implementation

Pollutant	Current Pollutant Loading from Land Use	Current Pollutant Loading from Stream Erosion	Current Total Pollutant Loading (Baseline)	Pollutant Reduction After Top 6 BMP Implementaiton	Pollutant Loading After Top 6 BMP Implementation
Nitrogen (lbs/yr)	36,250	13,489	49,739	7,933	41,806
Phosphorous (lbs/yr)	3,826	6,744	10,570	1,321	9,249
TSS (lbs/yr)	1,424,300	N/A	1,424,300	474,309	949,991
Sediment (tons/yr)	N/A	7,384	7,384	360	7,024
Bacteria (billion counts/yr)	218,980	59,072	278,052	66,844	211,208

Sizing & Cost Estimates for Top Six Prioritized BMPs

Two of the many factors that the watershed planning group considered when selecting the top six prioritized BMPs are size and cost of BMP. The size of BMP must be defined because the size of a BMP is associated with the size of the drainage area feeding it, and it affects cost as well as function and pollutant load reduction efficiency. To identify costs and assure the benefits associated with the construction of BMPs needed to treat the drainage areas indicated by the objectives, consultants provide size estimates for each of the top six prioritized BMPs.

BMP Sizes

BMPs at the generalized sizes provided below target rainfall events that deliver the majority of stormwater pollutants (MN Pollution Control Agency, 2017). They are gross estimates that can be used for planning at the watershed scale. The actual sizing of each BMP used must be determined by an engineer based on site-specific variables. Furthermore, pretreatment features are recommended for all BMPs to minimize sedimentation entering the BMP, therefore reducing maintenance requirements, such as filter strips flanking a vegetated swale or at the inlet of a stormwater wetland. (See https://stormwater.pca.state.mn.us/index.php?title=Main_Page).

Consultants interpret sizing generalizations from design criteria for urban BMPs from the Minnesota Stormwater Manual (2017). The chosen BMP sizes reflect the storage volume and correlating surface area needed to capture, treat, and remove pollutants in stormwater runoff. They do not account for side slopes or other design features, so the resulting footprint of the BMP could be larger.

Consultants used soil infiltration rates and percent impervious surface in the drainage area to suggest proper sizing of BMPs. Since silt loam makes up 77.3% of the soil texture of the watershed and loam makes up 14.8% for a total coverage of 92.1% of the watershed, consultants used the correlating design infiltration rate of 0.3 in/hr for loam and silt loam according to the Minnesota Stormwater Manual (MN Pollution Control Agency, 2017), which can be found at https://stormwater.pca.state.mn.us/index.php?title=Design_infiltration_rates. Consultants determined percent impervious surface per land use below, also reported in Table 11 of Section 1: Watershed Resource Inventory Resource.

High Density Development (HDD):	85% impervious
Medium Density Development (MDD):	72% impervious
Low Density development (LDD):	38% impervious
Open Space (OS):	9% impervious
(incl. Turf, Cemetery, and Golf course)	
Agricultural (AG):	2% impervious
(incl. High Residue Till, Low Residue Till, Orchard, Pasture, and Mulch Yard)	

Stormwater Wetlands

Stormwater Wetlands are constructed stormwater management practices, not natural wetlands. They are similar to stormwater ponds, as they can contain a permanent pool and temporary storage of water for water quality and runoff quantity control when constructed in Hydrologic Soil Group C and D soils that can hold water. Unlike stormwater ponds, stormwater wetlands have a variety of water depths and an associated vegetative complex, which require slightly more surface area for the same contributing drainage area. They are best suited for drainage areas of at least 10 acres to ensure an input of water sufficient to maintain a permanent pool. The wetland footprint is recommended to be approximately 2% to 4% of the drainage area. For more sizing information, see Minnesota Stormwater Manual at https://stormwater.pca.state.mn.us/index.php?title=Design_criteria_for_stormwater_wetlands (MN Pollution Control Agency, 2017).

	For All Drainage Area Imperviousness
Surface Area of BMP Treatment Area:	2 ac – 4 ac (2% - 4% of drainage area)
Drainage Area:	100 acres

Vegetated Filter Strips

Grassed and forested filter strips are sized using the same guidelines, although grassed filter strips are more effective for shorter strips because of their denser vegetation. Filter strips are most effective for sheet flow (not concentrated flow) during smaller storms (less than 1 in. rainfall and 0.5 feet per second flow velocity) on 5% slopes or flatter (MN Pollution Control Agency, 2017). The drainage area flow lengths and filter strip widths are correlated. To generalize, stormwater should sheet flow over 75 feet or less of impervious surfaces like parking lots into a filter strip at least 25 feet wide. Stormwater should sheet flow over 150 feet or less of pervious areas like lawns and agricultural fields before entering a filter strip that is at least 18 feet wide. These sizes may vary depending on drainage area slope. For a sizing chart, see the Minnesota Stormwater Manual at https://stormwater.pca.state.mn.us/index.php?title=Vegetated_filter_strips (Minnesota Pollution Control Agency, 2017).

However, consultants report the pollution load reduction efficiencies from the STEPL model (Tetra Tech, 2018) which is correlated with a 35-foot wide filter strip. Therefore, consultants assume the following drainage area and filter strip flow lengths for our watershed planning purposes:

Drainage Area Flow Lengths:
75 feet of Impervious Drainage Area (e.g. parking lots)
150 feet of Pervious Drainage Area (e.g. lawns and agricultural fields)

Filter Strip Flow Length:
35 feet

Steps to determine BMP and drainage area size:

- To determine size of BMP, take length times a 35-foot width.
- To determine size of drainage area, take length times drainage area run (either 75 feet for impervious area or 150 feet for pervious area).

For Impervious Drainage Area (per 100 ft of filter strip)

Surface Area of BMP Treatment Area:	3,500 sf
Dimensions of BMP:	100 ft long x 35 ft wide
Drainage Area:	7,500 sf
Dimensions of Drainage Area:	100 ft long (run) x 75 ft wide

For Pervious Drainage Area (per 100 ft of filter strip)

Surface Area of BMP Treatment Area:	3,500 sf
Dimensions of BMP:	100 ft long x 35 ft wide
Drainage Area:	15,000 sf
Dimensions of Drainage Area:	100 ft long (run) x 150 ft wide

Vegetated Swale and Infiltration Features

A vegetated swale is a linear BMP that a concentrated flow of stormwater runs through, densely vegetated swales and fitted with rock check dams, creating a series of stormwater retention cells. The cells encourage infiltration of stormwater into the ground, just like rain gardens, bioretention basins and trenches, and other infiltration features. The dense vegetation and retention cells make the vegetated swale very effective at reducing runoff velocities and trapping pollutants. This BMP differs from a ditch planted in turf grass, also called a grass swale, which does not employ check dams and does not reduce pollutants adequately enough to act as a stand-alone BMP (MNDNR, 2020). Vegetated swales can be either dry or wet, depending on the underlying soils. In Hydrologic Soil Groups A and B, water percolates more quickly through the soil and the swale will dry out between storms. In Hydrologic Soil Groups C and D, water may stand in the bottom of the swale because it percolates through the soil very slowly and the groundwater level can be close to the surface. The wet bottom may not be desirable in populated areas as the standing water may increase mosquito issues.

Consultants recommend retrofitting ditches planted in turf grass as predominantly dry swales with dense vegetation and check dams that temporarily retain water within its series of cells. Although the ideal soil medium is sandy loam to a depth of 30 inches (MNDNR, 2020) and the watershed is made up of mostly silty loam and loam, the consultants recommend utilizing the natural soils considering cost and ease of installation. When constructed as a dry swale in HSG A or B soils, the vegetative swale is similar in function to a bioretention cell but is configured as a shallow, linear channel. Installing check dams within the swale is important for slowing water velocity, detaining stormwater, and realizing the water quality benefits (MN Pollution Control Agency, 2017). It is preferred for the swale to have a meandering, naturalized design when space allows but can be a straight channel if space is limited (MNDNR, 2020).

To generalize the size of dry vegetated swales needed for the purposes of watershed planning, consultants used the same calculation as for bioretention cells. Therefore, the minimum size to treat a 5-acre drainage area varies by impervious surface in the drainage area. The surface area for the water quality treatment area is again squared off, creating additional headspace within the swale above the treatment area. The appropriate drainage area to be treated by a vegetated swale is 5 acres or less. The swale should have a bottom width of at least 3 feet and sides with a 3:1 slope or flatter (MN Pollution Control Agency, 2017). These minimum dimensions create a top width of 10.2 feet for the treatment storage area with a treatment storage depth of 1.2 ft. (The swale can be wider to accommodate floodwaters, but the treatment area for water quality purposes has a depth of 1.2 ft according to the Minnesota Pollution Control Agency's calculation for bioretention area.)

Most likely, vegetated swales would be retrofitted with native perennial vegetation in developed areas and along roads, railroad, and trails. Generalized for watershed planning, the minimum sizes of vegetated swales needed for each type of development are as follows:

<u>100% Impervious Area: Roads, Railroads, Trails (R/RR/T)</u>

Surface Area of BMP (bottom of swale):	0.35 ac (7% of 5 ac Drainage Area)
Dimensions of BMP (bottom of swale):	3 ft wide x 5,042 ft long*
Drainage Area:	5 acres

<u>85% Impervious Area: High Density Developed (HDD)</u>

Surface Area of BMP (bottom of swale):	0.3 ac (6% of 5 ac Drainage Area)
Dimensions of BMP (bottom of swale):	3 ft wide x 4,285 ft long*
Drainage Area:	5 acres

<u>72% Impervious Area: Medium Density Developed (MDD)</u>

Surface Area of BMP (bottom of swale):	0.25 ac (5% of 5 ac Drainage Area)
Dimensions of BMP (bottom of swale):	3 ft wide x 3,630 ft long*
Drainage Area:	5 acres

<u>38% Impervious Area: Low Density Developed (LDD)</u>

Surface Area of BMP (bottom of swale):	0.13 ac (2.6% of 5 ac Drainage Area)
Dimensions of BMP (bottom of swale):	3 ft wide x 1,916 ft long*
Drainage Area:	5 acres

* Dimensions of infiltration-type BMPs can vary by length and width, adding up to the surface area noted for each land use type. An infiltration trench would be similar in dimensions to a vegetated swale, but a rain garden or infiltration basin would likely be more squared off or a naturalized shape.

For additional sizing information, see Design Criteria for Vegetated Swale and Bioretention Area in the Minnesota Stormwater Manual at
https://stormwater.pca.state.mn.us/index.php?title=Dry_swale_(Grass_swale) and

https://stormwater.pca.state.mn.us/index.php?title=Design_criteria_for_bioretention (MN Pollution Control Agency, 2017).

Grassed Waterways

Grassed waterways are vegetated swales through crop fields that drain concentrated flows of stormwater from a field without causing erosion. They are most effective on steep slopes but can be installed in most fields. The main water quality benefit of grassed waterways is their ability to prevent erosion from occurring. The vegetation can also filter and reduce volume of runoff. Proper sizing of a grassed waterway typically can carry a 10-year, 24-hour storm (MN DOA, 2017), although stakeholders in this watershed and others have indicated that existing grassed waterways are not wide enough to handle the increase in rainfall documented within the region. Slopes should be 10:1 or flatter. The Natural Resource Conservation Service offers design guidance (MN DOA, 2017). To generalize for the purposes of watershed planning, consultants assign a minimum top width of 27 ft, which allows for a 3-foot bottom width, 1.2 ft storage depth (according to bioretention calculations above), and 10:1 slopes.

Table 4.6 lists the size consideration per BMP, cost estimate per unit of BMP, and for the total low to high cost amount per BMP proposed for implementation during the life of the plan.

Table 4.6 BMP Size Consideration & Treated Drainage Area for Watershed-Wide BMPs

#	Recommended BMPs - Watershed Wide	Total Drainage Area Treated by BMP (Unit)		BMP Size Consideration	Unit
1	41.32 acres of Grassed Waterway (30 ft wide)	1,033	acre	4 acre/100 acre drainage area	acres of grassed waterways
2	21.88 acres of Vegetated Swale (15 ft wide, existing grade w/ rock check dams)	547	acre	4 acre/100 acre drainage area	acres of vegetated swale
3	286.47 acres of Herbaceous Filter Strip (35 ft wide)	1,061	acre	27 acre/100 acre drainage area	acres of herbaceous filter strips
4	18.3 acres of Constructed Stormwater Wetland (Natural grade w/ forebay)	610	acre	3 acre/100 acre drainage area	acres of constructed wetland
		Total Area Converted into BMP			**Units of BMP**
5	328 acres of Conversion to Natural Area (Herbaceous)	328	acre	total area	acres of natural area
6	5,145 feet of Streambank Stabilization (Very Severe & Severe Banks)	5,145	ft	total area	feet of streambank

Each BMP will treat a certain amount of area that drains into the BMP. Consultants consider sizes based on 100 acres of drainage area to compare the amount of BMP needed to treat the same amount of drainage area for each BMP. For instance, stormwater runoff coming from 100 acres could be treated by a 3-acre constructed stormwater wetland or 27 acres of herbaceous filter strips. Conversion to natural area and streambank stabilization operate a little differently in terms of drainage area treatment. The sizing for these two BMPs do not consider the amount of runoff from a drainage area. Rather, these BMPs treat the precipitation that directly falls onto the natural area and the erosion that occurs immediately along the shoreline.

BMP Unit Cost & Total Installation Cost for Watershed-Wide BMPs

Valuation for BMPs installed on agricultural land is based on the Stephenson County NRCS Illinois Conservation Practices Physical Effects (NRCS 2015). Valuation for BMPs installed on developed land is based off of numerous sources, including the Minnesota Stormwater Manual (MN Pollution Control Agency, 2017), EPA Stormwater Technical Fact Sheets (1999), Overlake Supply (2020), Forestry Suppliers (2020), A.M. Leonard (2020), and personal communication with Tallgrass Restoration, Rockford Park District, and Olson Ecological Solutions. *Table 4.7* lists the cost estimate per unit of BMP and the total low to high cost amount per BMP proposed for implementation during the life of the plan. BMPs implemented on agricultural land are generally less expensive than implementation on developed land. Therefore, the cost of implementation ranges from $1.6 million to $3.5 million depending on where the BMPs are implemented. It is important to note that although this cost seems very large, this assumption is that the cost will be spread out of 5 years while the plan is being implemented progressively.

Table 4.7 Per Unit BMP Cost & Total Cost Estimates for Watershed-Wide BMPs

#	Recommended BMPs - Watershed Wide	Recommended BMP Amount Watershed-Wide	Unit	Installation Cost/Unit		Total Low End Installation Cost for BMP Size	Total High End Installation Cost for BMP Size
1	Grassed Waterway (30 ft wide)	41.32	acres of grassed waterways	$ 5,495.00		$ 227,053.40	
2	Vegetated Swale (15 ft wide, existing grade w/ rock check dams)	21.88	acres of vegetated swale	$ 17,460.00		$ 382,024.80	
3	Herbaceous Filter Strip (35 ft wide)	286.47	acres of herbaceous filter strips	$ 830.00	$ 3,290.00	$ 237,770.10	$ 942,486.30
4	Constructed Stormwater Wetland (Natural grade w/ forebay)	18.30	acres of constructed wetland	$14,275.00	$15,900.00	$ 261,232.50	290,970.00
5	Conversion to Natural Area (Herbaceous)	328.00	acres of natural area	$ 675.00	$ 3,290.00	$ 221,400.00	$ 1,079,120.00
6	Streambank Stabilization (Very Severe & Severe Banks)	5,145	feet of streambank	$ 70.00	$ 120.00	$ 360,150.00	$ 617,400.00
TOTAL COST (Low End & High End)						**$ 1,689,630.80**	**$ 3,539,054.50**

Cost per Unit of Reduced Pollutants

Some of the projects have significant cost when compared to others. This may be that they are more expensive, but more likely there is better opportunity for implementation within the watershed and therefore more of this type of BMP is slated for implementation. Another way to look at costs is dollars per pound of pollutant removed. The charts below in *Tables 4.8* and *4.9* present cost per pound of each pollutant removed, i.e. cost: benefit ratio. The cost: benefit ratio is calculated over a 10-year span, which includes the cost of implementation in year 1 and the cost of maintenance for 10 years. The reason why this is calculated for a 10-year span is most funding sources, such as the USDA and the Illinois EPA, require 10-15 years of BMP maintenance to receive funding. These charts present similar information with one exception: pollutant reductions, i.e. the benefit, based on each BMP treating runoff from drainage areas of agricultural land use only, developed land use only, or a mix of agricultural and developed land uses. Because agricultural lands produce a different amount of pollutant loading than developed lands, a BMP that treats runoff from 100 acres of farmland will have different pollutant load reductions, or different benefits, than if it was treating runoff from 100 acres of developed land or 100 acres of farmland and developed land interspersed. *Table 4.8* keeps the land uses of drainage areas separated. *Table 4.9* blends the land uses of drainage areas for a BMP that is likely to treat larger, more diverse drainage areas; this BMP is a constructed stormwater wetland. Constructing a stormwater wetland that has a drainage area with blended land uses increases the cost benefit: ratio.

Since *Table 4.8* is a tool to help compare the costs of the six prioritized BMPs and their efficiencies in removing pollutants, streambank stabilization is expressed in cost per pound of sediment removed in comparison to the other BMPs cost to remove a pound of TSS. Throughout this chapter, we have referred to sediment in tons. To convert pollutant load reduction from tons to pounds, consultants multiplied 360 tons by 2,000 pounds per ton of sediment.

Table 4.8 Cost: Benefit Ratio for Implementing BMPs with Agricultural or Developed Drainage Areas*

Cost: Benefit Ratio per BMP*

BMPs for Agricultural Areas	Grassed Waterway (412)	Riparian Filter Strip - Forested (391)	Riparian Filter Strip - Herbaceous (390)	Constructed Stormwater Wetlands (656)	Convert to Natural Area - Herbaceous (342)	Streambank Stabilization (580)
Averaged by Drainage Area Dominated by Agricultural Land Use						
Avg $/lb TSS per BMP	$ 1.38	$ 0.98	$ 0.92	$ 1.36	$ 2.12	$ 0.11
Avg $/lb TP per BMP	$ 966.33	$ 486.45	$ 455.40	$ 887.25	$ 986.11	$ 221.43
Avg $/lb TN per BMP	$ 67.42	$ 42.30	$ 39.60	$ 87.85	$ 68.80	$ 119.23
Avg $/bill. counts Bacteria per BMP	$ 9.95	$ 13.90	$ 13.01	$ 9.76	$ 25.36	$ 27.68
*Calculated over 10-yr span						
BMP Cost Estimate Sources	NRCS. 2015. Illinois Conservation Practices Physical Effects (CPPE). Provided by Terry Kirchner, Stephenson County NRCS on June 30, 2015.					

BMPs for Developed Areas	Vegetated Swale (15' top width, existing grade, check dams, 1 ac = 15'x2904')	Vegetated Filter Strip (Herbaceous)	Constructed Stormwater Wetlands (Natural grade w/ forebay)	Constructed Stormwater Wetlands (6" depth w/forebay)	Convert to Natural Area	Streambank Stabilization
Averaged by Drainage Area dominated by Agricultural Land Use						
Avg $/lb TSS per BMP	$ 0.36	$ 1.27	$ 0.23	$ 0.58	$ 2.54	$ 0.17
Avg $/lb TP per BMP	$ 216.62	$ 675.57	$ 169.09	$ 429.05	$ 1,302.94	$ 342.86
Avg $/lb TN per BMP	$ 124.40	$ 97.23	$ 26.42	$ 67.04	$ 146.37	$ 184.62
Avg $/bill. counts Bacteria per BMP	$ 11.27	$ 35.14	$ 3.21	$ 8.14	$ 59.60	$ 42.86
*Calculated over 10-yr span						
BMP Cost Estimate Sources	MN Stormwater Manual, Overlake Supply, Forestry Supply, Tallgrass Restoration, Rockford Park District, Olson Ecological Solutions, EPA SW Tech Fact Sheets					

Table 4.9 Cost: Benefit Ratio for Implementing BMPs with Blended Land Use Drainage Areas

	BMPs for Agricultural Areas						BMPs for Developed Areas					
	Grassed Waterway (412)	Riparian Filter Strip - Forested (391)	Riparian Filter Strip - Herbaceous (390)	Constructed Stormwater Wetlands (656)	Convert to Natural Area - Herbaceous (342)	Streambank Stabilization (580)	Vegetated Swale (15' top width, existing grade, check dams, 1 ac = 15'x2904')	Vegetated Filter Strip (Herbaceous)	Constructed Stormwater Wetlands (Natural grade w/ forebay)	Constructed Stormwater Wetlands (6" depth w/forebay)	Convert to Natural Area	Streambank Stabilization
Cost: Benefit Ratio per BMP*												
Blended LU Drainage Area							**Blended LU Drainage Area**					
Avg $/lb TSS per BMP	N/A	N/A	N/A	$ 0.29	N/A	N/A	N/A	N/A	$ 0.31	$ 0.78	N/A	N/A
Avg $/lb TP per BMP	N/A	N/A	N/A	$ 216.40	N/A	N/A	N/A	N/A	$ 226.83	$ 575.56	N/A	N/A
Avg $/lb TN per BMP	N/A	N/A	N/A	$ 32.26	N/A	N/A	N/A	N/A	$ 33.82	$ 85.81	N/A	N/A
Avg $/bill. counts Bacteria per BMP	N/A	N/A	N/A	$ 3.88	N/A	N/A	N/A	N/A	$ 4.07	$ 10.32	N/A	N/A
*Calculated over 10-yr span							*Calculated over 10-yr span					
BMP Cost Estimate Sources	NRCS. 2015. Illinois Conservation Practices Physical Effects (CPPE). Provided by Terry Kirchner, Stephenson County NRCS on June 30, 2015.						MN Stormwater Manual, Overlake Supply, Forestry Supply, Tallgrass Restoration, Rockford Park District, Olson Ecological Solutions, EPA SW Tech Fact Sheets					

Nitrogen Removal Cost

Looking at projects and practices in terms of the cost to remove one lb of nutrient, one lb of TSS, or one billion counts of bacteria provides stakeholders with a different perspective regarding the cost of pollutant removal. Focusing on nitrogen, installing riparian filter strips that treat agricultural drainage areas is the most cost-effective solution, ranging from $39.60 to $42.30 per lb of nitrogen. Constructing stormwater wetlands that treat developed drainage areas is the most cost-effective solution, ranging from $26.42 to $67.04 per lb of nitrogen depending on if the project requires no excavation or six inches of excavation.

Grassed waterways, conversion to natural area, and constructed stormwater wetlands all have moderate costs when treating runoff from agricultural areas ranging from of $67.42-$87.85 per lb of nitrogen. Installing herbaceous filter strips that treat developed drainage areas has a moderate cost, at $97.23 per lb of nitrogen removal.

Streambank stabilization near agricultural drainage areas is the priciest BMP for removing nitrogen at $119.23 per lb of nitrogen removal. Vegetated swales, conversion to natural area, and streambank stabilization near developed drainage areas are the priciest BMPs for removing nitrogen, ranging from $124.40-$184.62 per lb of nitrogen removal.

Phosphorus Removal Cost

Phosphorus removal is the priciest out of all four pollutants considered. Constructing stormwater wetlands (using the existing grade) and installing vegetated swales that treat developed drainage areas are the most cost-effective solutions, ranging from $169.09-216.62 per lb of phosphorus. Stabilizing streambanks near agricultural drainage areas is also a cost-effective solution, at $221.43 per lb of phosphorus removal.

Riparian filter strips have moderate costs when treating runoff from agricultural areas ranging from of $455.40-$486.45 per lb of phosphorus. Streambank stabilization, constructed wetlands with six inches of excavation, and herbaceous filter strips that treat developed drainage areas have moderate costs, ranging from $342.86-$675.57 per lb of phosphorus removal.

Constructed stormwater wetlands, grassed waterways, and conversion to natural area are the priciest BMPs when treating agricultural drainage areas, ranging from $887.25-$986.11 per lb of phosphorus removal. Conversion to natural area near developed drainage areas is the priciest BMP for removing phosphorus, at $1,302.94 per lb of phosphorus removal.

TSS and Sediment Removal Cost

TSS and sediment removal is the least expensive out of all four pollutants considered. Streambank stabilization and riparian filter strips that treat agricultural drainage areas are the most cost-effective solutions, ranging from $0.11-$0.98 per lb of TSS or sediment removal. Streambank stabilization, constructed stormwater wetlands (using the existing grade and with six-inch excavation), and vegetated swales that treat developed drainage areas are the most cost-effective, ranging from $0.17-$0.58 per lb of TSS or sediment. Sediment applies when talking about streambank stabilization, while TSS applies for all other BMPs being compared.

Constructed stormwater wetlands and grassed waterways have moderate costs when treating runoff from agricultural areas ranging from of $1.36-$1.38 per lb of TSS. Herbaceous filter strips that treat developed drainage areas have a moderate cost, at $1.27 per lb of TSS removal.
Conversion to natural area is the priciest BMP, albeit still below $3.00 per lb of removal, when treating agricultural drainage areas and developed drainage areas, ranging from $2.12 per lb of TSS removal for agricultural drainage areas and $2.54 per lb of TSS removal for developed drainage areas.

Bacteria Removal Cost

Bacteria removal is the second least expensive out of all four pollutants considered. Constructed stormwater wetlands (using the existing grade or with six-inch excavation) and vegetated swales that treat developed drainage areas are the most cost-effective, ranging from $3.21-$11.27 per billion counts of bacteria removal. Constructed stormwater wetlands, grassed waterways, and riparian filter strips that treat agricultural drainage areas are also the most cost-effective solutions, ranging from $9.76-$13.90 per billion counts of bacteria removal.

Conversion to natural area and streambank stabilization near agricultural drainage areas have moderate costs ranging from of $25.36-$27.68 per lb billion counts of bacteria. Herbaceous filter strips, streambank stabilization, and conversion to natural area that treat developed drainage areas have a moderate cost, ranging from $35.14-$59.60 per billion counts of bacteria.

Schedule of Implementation of Watershed-Wide Practices

To implement the proposed projects and practices over a five-year time frame, the plan spreads BMP implementation costs evenly at a low-end cost of $337,926.16 to a high-end cost of $707,810.90 per year. The wide range of potential cost is due to the large variation in cost depending on if the project is implemented on developed or agricultural land. Grants and financial assistance organizations usually will require match, although amounts vary. One grant may require 40% match, which would require local sources to spend 40% of the total project cost either through volunteer time, cash, or volunteered labor. Another may require 20% or 50%, creating a range of match needed per year. The schedule of implementation for watershed-wide practices is presented in *Table 4.10*. More detail about abbreviated funding and technical support is offered in Chapter 6.

The schedule of implementation is simple, implementing an equal area or size of each best management practice and keeping the same budget every year for five years. It may take longer to set up such a schedule in the first place, but it then becomes routine each year. Doing so would allow landowners a consistent variety of options for participation each year. This may be optimum, as factors may affect a landowner's ability and interest to participate in the implementation of a particular program each year. It is important to recognize that the actual schedule will depend on many factors including leadership, community interest, and financial and technical support opportunities. This schedule should be reviewed and revised annually.

Table 4.10 Schedule of Implementation of Watershed-Wide Practices

Years	Interim Milestones	Potential Funding/Technical Support	Annual Low End Installation Cost	Annual High End Installation Cost
1 to 5	Install 8.26 acres of 30 ft-wide grassed waterways in waterways that are currently bare throughout the watershed.	NRCS, SWCD, IEPA, USFWS, IDOA, NWTF, PF	$ 45,410.68	
1 to 5	Install vegetated swales into 2.10% of existing roadway ditches throughout the watershed (4.38 acres).	NRCS, TU, IEPA	$ 76,404.96	
1 to 5	Install 57.29 acres of 35 ft-wide herbaceous filter strips along streambanks, ponds, basins, roadways, etc.	NRCS, SWCD, Trees Forever, TU, IEPA	$ 47,554.02	$ 188,497.26
1 to 5	Install 3.66 acres of constructed stormwater wetlands on existing hydric soils.	NRCS, SWCD, IEPA, IDNR, USFWS, Trees Forever, PF	$ 52,246.50	58,194.00
1 to 5	Convert 65.6 acres of land into natural areas.	IEPA, IDNR, USFWs, Trees Forever, Grand Victoria, AmeriCorps, PF	$ 44,280.00	$ 215,824.00
1 to 5	Stabilize 367 feet of very severely eroded streambanks and 662 feet of severely eroded streambanks throughout watershed.	IEPA, Patagonia	$ 72,030.00	$ 123,480.00
TOTAL ANNUAL COST (Low End & High End)			**$ 337,926.16**	**$ 707,810.90**

Responsible Parties

All stakeholders are asked to do what they can to help implement the plan. In addition to private homeowners and landowners, this watershed has structure, organization, and financial resources offered by local organizations. The following entities have expressed a willingness to help implement the plan:

The Winnebago County SWCD (District) already provides and is willing to continue providing technical and financial assistance and financial assistance to implement the certain BMPs. For instance, there are state and federal cost-share programs for implementing grassed waterways. If an agricultural producer is interested in filter strips, they could utilize the existing CRP program; however the District acknowledges that while there are some CRP filter strips already existing in the watershed, it may be a challenge to fund a substantial amount more. If an agricultural producer is interested in constructed stormwater wetlands, they could again utilize the existing CRP wetland restoration program.

The RPD has spear headed this watershed planning effort and desires to help where they can in implementing the recommendations within this plan. The RPD is open to funding any of the top six priority BMPs on RPD property. The amount would need to be determined on a project by project basis. The RPD is also open to providing a RPD staff member to participate in continuing the watershed planning group effort to work towards implementation.

The Winnebago County Highway Department is open to assisting partial funding of BMP projects near roadways within their jurisdiction and within their easements.

The Winnebago-Boone Farm Bureau, the local Farm Bureau within this watershed, and Illinois Farm Bureau are possible partners for agricultural BMP implementation projects and educational efforts (publications, communication pieces, and mailings) recommended in this watershed plan. Local County Farm Bureaus' select nutrient stewardship projects and submit projects to the Illinois Farm Bureau through the IFB's Nutrient Stewardship grant application for funding. This program is meant to support farmers in their efforts to address water quality challenges facing Illinois.

The Rock River Water Reclamation District has graciously offered to provide a specified amount of pro bono lab processing work for fecal coliform water sampling to be conducted during the Fall of 2020 by students and faculty from Rock Valley College. They are also willing to financially contribute to projects that reduce the amount of nitrogen and phosphorus loading in the South Fork Kent Creek.

The Region 1 Planning Council (RPC) is willing to assist stakeholders interested in applying for larger grants, i.e. the Illinois EPA Section 319 grants, for projects with potential for implementation in multiple areas watershed wide. Since EPA Section 319 grants require a lot of administration, it is recommended that multiple watershed-wide projects be considered in one grant application. For example, if five separate landowners have an interest in streambank stabilization, then all five projects could be grouped into a watershed-wide project and can together apply for EPA Section 319 grant funding. The RPC can provide South Fork Kent Creek watershed residents with grant writing and administration for a fee. The Region 1 Planning Council (RPC) maintains an Environmental Planning Committee (EPC) that meets bi-monthly. The RPC has agreed to take on the following watershed planning efforts as their focus project for the next year or two. Participation in this implementation effort through the RPC is strictly voluntary; this is not mandatory or regulatory in nature. The EPC consists of many local, environmental professionals, many of whom have also been involved in the planning of the South Fork Kent Creek watershed plan via participation as technical advisors. In this way, this group will provide a cohesive transition from planning to implementation of the watershed plan.

Section 2, Chapter 5
Implementation of Site-Specific Projects

Introduction

Chapter 4 detailed the priorities, considerations, and steps needed to implement the watershed-wide practices. This chapter similarly provides necessary details about site-specific projects selected by landowners. These projects contain recommendations for implementing specific BMPs described in Chapter 2. Financial and technical resources for implementing these projects and practices are found in the next chapter.

This chapter discusses site-specific projects by detailing the location, potential concerns or water quality issues on-site, recommendations given by consultants, BMP size estimates, estimated pollutant reductions per project, and priority per project. These projects are detailed at the conceptual level and may require engineer or other design specialists to develop finer details based on site conditions.

Further education and awareness of the plan and the recommendations here within will help increase the amount of interest in implementing recommended BMPs. Only projects fleshed out to a conceptual level that received landowner permission to be included in this plan are contained in this chapter. As stakeholders implement projects recommended in this plan, the hope is to inspire and involve surrounding landowners to consider implementing BMPs on their properties as well. Any implementation of a site-specific project described in this chapter will contribute to and help accomplish the watershed-wide recommendations and their estimated reduction targets discussed in Chapter 4.

Summary of Site-Specific Projects

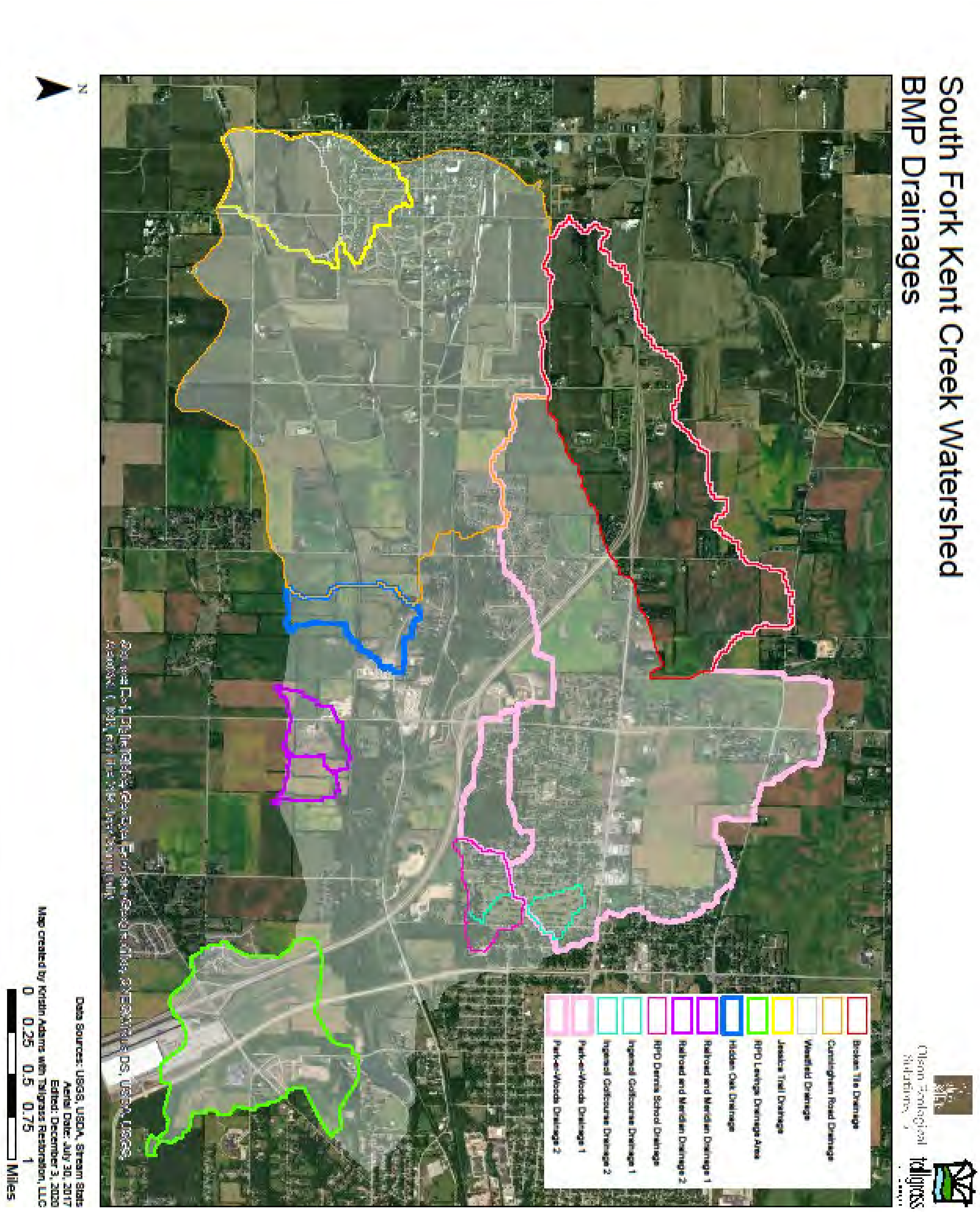
Ten site-specific projects with willing landowners are referenced and detailed below. These projects are high priority, and their implementation should be explored prior to or at the same time as the implementation of watershed-wide BMPs without identified locations and landowners. When possible, these projects may serve upon which to build a larger project within the same drainage area. *Table 5.1* summarizes the BMP types, sizes, locations, drainage areas, benefits in terms of pollutant load reductions, and costs for ten site-specific project areas and provides their cumulative effect. *Figure 5.1* outlines the drainage areas leading to each site-specific BMP location. Please keep in mind that the recommended BMPs can only filter stormwater runoff from smaller drainages within these large, overall drainages. The smaller drainages that more accurately predict pollutant load reductions per BMP are used in *Tables 5.1* through *5.11*. Also, these drainages overlap; therefore, they are difficult to illustrate. *Table 5.6* below refers to a recommended project that is not included in the summary *Table 5.1.* The excluded project is the repair of failing drain tile that is brining stormwater normally destined for a different watershed into this watershed. Once the tile is repaired, this water will be rerouted north into the North Branch Kent Creek Watershed. The pollutant loads do not originate within the South Fork Kent Creek Watershed; therefore, they were not included in the baseline pollutant loading calculations for South Fork Kent Creek. We exclude it from summary table because it would otherwise inflate the percent pollutant load reductions were occurring when compared to baseline levels.

Table 5.1 Summary of Site-Specific BMPs

BMP Information				Pollutant Load Reductions by BMP				Cost
Location				TN	TP	TSS	Bacteria	Cost
Table #	Name	Latitude	Longitude	(lb/yr)	(lb/yr)	(lb/yr)	(billion counts/yr)	$
5.2	Park-er-Woods Ponds & Creek Area	42°16'13.07"N	89°10'4.30"W	33	3.5	1010	296	$ 7,103
5.3	Ingersoll Golf Course & Memorial Park	42°16'23.21"N	89° 9'10.35"W	35	7.5	1222	95	$ 20,471
5.4	Dennis School Woods	42°16'6.80"N	89° 8'56.26"W	19	2.5	407	41	$ 137,522
5.4	Memorial Hall Woods	42°16'4.99"N	89° 9'45.32"W					
5.5	Levings Park	42°15'28.49"N	89° 8'1.37"W	2080	275	112747	33655	$ 289,458
5.7	Park-er-Woods Neighborhood	42°16'3.63"N	89°10'10.75"W	981	196	59343	15353	$ 222,870
5.8	Westfield Farm	42°15'5.71"N	89°13'53.70"W	351.5	25	19165	1132	$ 58,201
5.9	Railroad & Meridian Farm	42°15'15.57"N	89°10'0.59"W	49.5	5.5	2328	73	$ 8,780
5.10	Hidden Oak Trail Drainage Swale	42°15'42.98"N	89°11'2.79"W	1.5	1	26	7	$ 1,182
5.11	Cunningham Rd. Stormwater Wetland	42°15'47.23"N	89°11'44.09"W	1129	129	51548	29147	$ 1,087,905
Summary of Site-Specific BMPs Total				**4679.5**	**645.03**	**247796**	**79799**	**$ 1,833,491**

*This table omits North Branch Kent Creek Failed Drain Tile (see *Table 5.6.*)

Figure 5.1 Drainages for Recommended Site-Specific BMPs



Rockford Park District Properties

The RPD is the key player that began this watershed planning effort. They would like to improve water quality in Levings Lake, at other RPD properties, and throughout the entire watershed. Along those ends, they are interested in implementing BMPs on RPD property where appropriate and when funding allows. Below is a list of identified projects on RPD property.

Park-er-Woods Ponds

The RPD owns and maintains the Park-er-Woods north and south ponds, as well as the land surrounding these ponds and an unnamed tributary located in the Park-er-Woods residential neighborhood. Some existing concerns include pond shoreline erosion, pond algae, north pond pipe clog, and homeowner lawn care, such as fertilizer, pesticides, pet waste, and leaf litter/grass clippings of neighbors close to the ponds.

The ponds are directly impacted by the amount of stormwater and potential contamination of stormwater flowing from the residential neighborhood across the land that surrounds the ponds and potentially from observed drain tiles emptying into the ponds. This plan recommends raising awareness to homeowners near the ponds that the ponds will experience erosion, sedimentation, and algae if precautions are not taken to reduce the amount of contaminated runoff entering the ponds. Riparian filter strips, lawn care practices, and stormwater storage BMPs, such as rain barrels and rain gardens, can help alleviate these concerns.

Although most of the benefit to the pond would be accomplished within the residential subdivision, there are a few BMPs that RPD can install on their property to offer some relief. This plan recommends drainage repair and filter strips at 35-foot widths on RPD property, but any width is encouraged because not all areas of the Park-er-Woods ponds have enough allotted space to create 35-foot wide filter strips. However, the filter strips along the pond shorelines are currently 10-15 feet at the widest, and there is enough room on some sides the south and north pond for 35-foot wide filter strips.

The RPD currently maintains the ponds and RPD property surrounding the ponds. RPD maintenance efforts include invasive species control of cattail, teasel, and loosestrife, annual meeting with Park-er-Woods Association mainly to discuss maintenance concerns for the south pond and access to the trail, maintenance of the 10 to 15-foot filter strips along the north portion of the creek (near the north pond), maintenance of the 35-foot wide filter strips along the south portion of the creek (near south pond to Highway-20), maintenance of the naturalized shorelines along north pond and south pond, and maintenance of a recreational trail along the creek, which runs the entire length of the RPD property.

After viewing aerial imagery, conducting a site visit, and having conversations with RPD staff that directly oversee the Park-er-Woods ponds, filter strips, and trail, consultants recommend the following BMPs for RPD property in Park-er-Woods:

North Pond

- Filter Strip: Widen existing riparian filter strip along the west side of the north pond. This filter strip will expand upon the existing naturalized shorelines of the north pond and ranges in widths depending on space availability. In total this widened filter strips will encompass about 0.5 acres. Leave an 8-foot maintenance/recreational trail along the

RPD property line and extend the filter strip to 35 feet where space allows, such as at the southern end of the pond.

- Repair drain: Repair the clogged and eroded drainpipe on the east side of the north pond. Once repair is complete, regrade and reseed the area. The area of repair is estimated at about 0.15 acres. Leave an 8-foot wide trail of turf grass and seed with native grasses and forbs on either side of the trail.
- North Creek Filter Strip: Widen the existing riparian filter strip along the east side of the north creek. In total this widened filter strip will encompass about 0.33 acres. Leave at least an 8-foot maintenance/recreational trail and extend the filter strip to 35 feet where space allows.

South Pond

- Pond Filter Strip: Widen the existing riparian filter strip along the northeast side of the south pond. In total this widened filter strip will encompass about 0.33 acres. Leave at least an 8-foot maintenance and recreational trail and extend the filter strip to 35 feet where space allows.
- Vegetated Swale: Install a vegetated swale just south of the south pond. This area currently contains a turf grass-covered wet channel that drains straight to the creek. In total this vegetated swale and native seeded area will encompass about 0.33 acres.
- South Creek Filter Strips: Install a series of four filter strips, compiling about 1 acre in total, along the west side of the creek starting from the south pond and extending to Highway-20. This series of filter strips will connect the existing natural areas located between residential properties and the creek. A 35-foot filter strip is designed for a 150-foot run of flow over permeable land. There is a longer than 150-foot run between the Donelda Lane and the creek. Therefore, this filter strip in addition to the existing filter strip next to the creek will help to filter runoff before it enters the creek. After the water passes through this recommended series of filter strips on its way to the creek, there is another roughly 50 to 135 feet of run through pervious surface, depending on where one measures. Therefore, maintaining the existing filter strip directly adjacent to the creek will effectively filter this additional runoff.

Table 5.2 indicates the details of the BMP installations. *Figures 5.2* and *5.3* depict these recommendations for the north pond, south pond, and creek. Photographs of existing conditions at the ponds and creek in Park-er-Woods are found after these figures. Please note the figures are conceptual and the actual shapes and sizes of each BMP will need to be detailed further by an engineer or BMP designer.

Table 5.2 Park-er-Woods Ponds and Creek Area

BMP Information					Pollutant Load Reductions by BMP				Cost	
Location	BMP	Size of	Dimensions of	Size of	TN	TP	TSS	Bacteria	Cost	Unit Cost
Name	Type	BMP (ac)	BMP (ft x ft)	Drainage Area (ac)	(lb/yr)	(lb/yr)	(lb/yr)	(billion counts/yr)	$	$/ac
Park-er-Woods North Pond	Filter Strip	0.50	35 x 622	2.64	8	0.82	234	69	$ 1,644	$ 3,290
Park-er-Woods North Creek	Filter Strip	0.33	35 x 410	1.74	5	0.54	154	45	$ 1,084	$ 3,290
Park-er-Woods South Pond	Filter Strip	0.33	35 x 410	1.74	5	0.54	154	45	$ 1,084	$ 3,290
Park-er-Woods South Creek	Filter Strip	1.00	35 x 1245	5.29	15	1.63	468	137	$ 3,291	$ 3,290
Park-er-Woods Ponds and Creek Area Total		**2.16**	**35 x 2687**	**11.41**	**33**	**3.53**	**1010**	**296**	**$ 7,103**	**N/A**

Figure 5.2 Park-er-Woods North Pond Recommendations

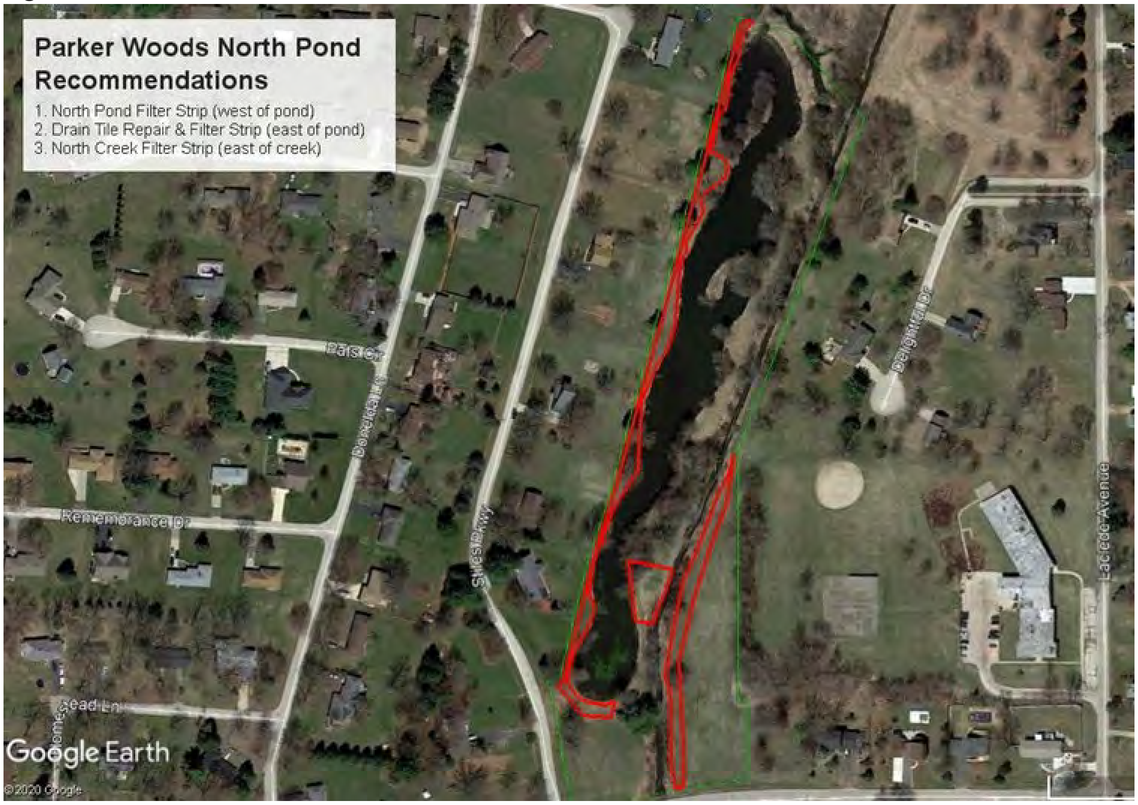


Figure 5.3 Park-er-Woods South Pond Recommendations

Photographs

North pond pipe clogged in with mud. Photo credit Lou Ann Johnson, Park-er-Woods Drainage Commissioner

Spring algae in Park-er-Woods pond. Photo credit Lou Ann Johnson, Park-er-Woods Drainage Commissioner

Park-er-Woods south pond. Photo credit Rebecca Olson, OES

South Fork Kent Creek in Park-er-Woods. Photo credit Rebecca Olson, OES

Ingersoll Golf Course

The Ingersoll Golf course is owned by the RPD and is located at 101 Daisyfield Road, #1300, Rockford, IL, just southwest of the intersection of Daisyfield Rd. and Business 20. Consultants recommend installing vegetated swales with filter strips along either side of the swales in wet and eroded areas that are out of play so as to not interfere with golf operations. Consultants recommend utilizing native plants within these vegetated swales and filter strips. The golf course Superintendent is open to these recommendations for installation in certain areas. The specific areas for installation have not yet been identified. *Figure 5.4* shows an aerial image of the golf course boundaries. *Table 5.3* provides details.

Figure 5.4 Ingersoll Golf Course Boundaries

Ingersoll Memorial Park

Ingersoll Memorial Park is located just south of the golf course. This area is primarily used as a disc golf course. The RPD is working to restore some natural areas in the Memorial Park, including a savanna approximately one acre in size on the southwest corner of the park and two rectangular native planted areas approximately 0.26 acres. *Figure 5.5* shows the location of these restoration natural areas. The property boundary is shown in green and natural areas in yellow. *Table 5.3* provides details.

Figure 5.5 Ingersoll Memorial Park Recommendations

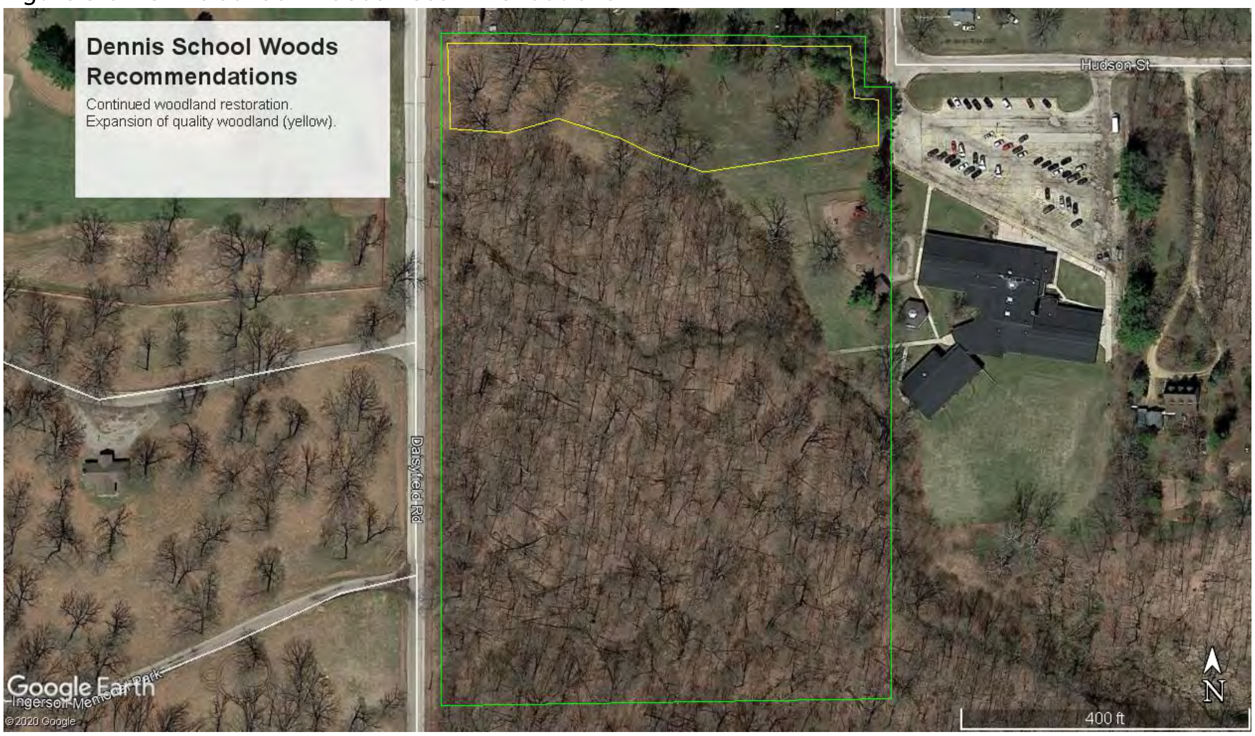
Table 5.3 Ingersoll Golf Course and Memorial Park

BMP Information					Pollutant Load Reductions by BMP				Cost	
Location	BMP	Size of	Dimensions of	Size of	TN	TP	TSS	Bacteria	Cost	Unit Cost
Name	Type	BMP (ac)	BMP (ft x ft)	Drainage Area (ac)	(lb/yr)	(lb/yr)	(lb/yr)	(billion counts/yr)	$	$/ac
Ingersoll Golf Course	Filter Strip	4.2	35 x 5227	22.20	30	6	933	74	$ 13,818	$ 3,290
Ingersoll Golf Course	Vegetated Swale	0.14	3 x 2085	5.40	2	1	257	18	$ 2,507	$ 17,460
Ingersoll Memorial Park	Natural Area	1.26	N/A	1.26	3	0.5	32	3	$ 4,145	$ 3,290
Ingersoll Golf Course and Memorial Park Area Total		**5.60**	**N/A**	**28.86**	**35**	**7.5**	**1222**	**95**	**$ 20,471**	**N/A**

Dennis School Woods

Dennis School Woods is a woodland located across Daisyfield Rd. directly east of the Ingersoll Memorial Park. The RPD acquired this property and has been working to restore the woodland by removing invasive woody species and expanding the woodland on the north side of the parcel. *Figure 5.6* depicts this area and BMP recommendations. The property boundary is outlined in green. Consultants recommend continued woodland restoration and expansion of quality native species woodland. The area of woodland expansion is outlined in yellow and is approximately 1.8 acres. *Table 5.4* provides details.

Figure 5.6 Dennis School Woods Recommendations



Hall Memorial Woods

Hall Memorial Woods is a 40-acre high quality woodland. This woodland is located north of Highway 20 and just east of Park-er-Woods. The RPD would like to invest in this high-quality natural area by managing the woodland for invasive and weedy plant species removal. *Figure 5.7* depicts the woodland boundary and location. *Table 5.4* provides details.

Figure 5.7 Hall Memorial Woods Recommendations

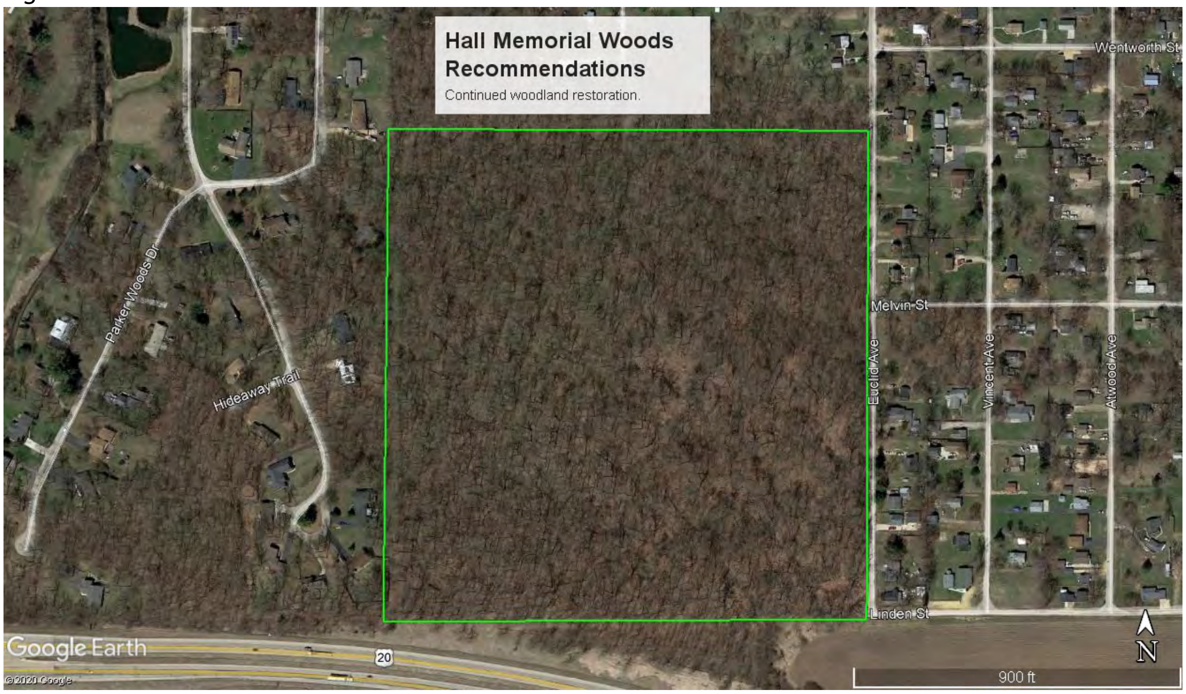


Table 5.4 Dennis School and Memorial Hall Woods

BMP Information					Pollutant Load Reductions by BMP				Cost	
Location	BMP	Size of	Dimensions of	Size of	TN	TP	TSS	Bacteria	Cost	Unit Cost
Name	Type	BMP (ac)	BMP (ft x ft)	Drainage Area (ac)	(lb/yr)	(lb/yr)	(lb/yr)	(billion counts/yr)	$	$/ac
Dennis School Woods	Natural Area	1.8	N/A	1.80	1	0.5	18	2	$ 5,922	$ 3,290
Memorial Hall Woods	Natural Area	40	N/A	40.00	18	2	389	39	$ 131,600	$ 3,290
Dennis School and Memorial Hall Woods Area Total		**41.8**	**N/A**	**41.8**	**19**	**2.5**	**407**	**41**	**$ 137,522**	**N/A**

Levings Park

As described in Chapter 2, the RPD has already implemented conservation efforts at Levings Park to improve water quality within Levings Lake. The RPD is interested in implementing additional conservation efforts on-site to further filter runoff flowing into Levings Lake. Consultants recommended projects including bioswales with check dams, constructed stormwater wetlands, filter strips surrounding the lake shoreline, and bioislands just inside the lake's two inlets to improve water quality and relieve flooding in Levings Lake and South Fork Kent Creek. The recommended projects will be designed to slow stormwater velocity and retain, infiltrate, and filter stormwater. *Figures 5.8 and 5.9* depict these recommendations. *Table 5.5* provides details. (See also *Exhibit E*.)

- Along the south catchment in an area within Levings Park that is now a swale and low are in mowed turf grass receiving stormwater runoff from Subbasin A, the plan recommends installing the bioswales, one of the constructed stormwater wetlands, and ten bioislands. Consultants recommend grading 160 linear feet of swale, installing check dams, and restoring native vegetation within the disturbed area by broadcasting seed & planting plugs. To retrofit the 2.4-acre wetland, consultants recommend slightly grading the area surrounding the existing 0.4-acre wetland planted in 2018, grading abandoned courts to match surrounding elevations, replacing aggregate with soil, and converting turf to native vegetation via seed and plugs. After exposing 148 linear feet of underground pipe, consultants recommend in its place grading an open bioswale, installing check dams, and then vegetating the bioswale with native species using seed and plugs.

- Near where Kent Creek flows into Levings Lake, a concept plan created by Olson Ecological Solutions in 2017 titled *A Cleaner Levings Lake* recommends constructing a 5.6-acre stormwater wetland and lining the inlet and shoreline with 21 bioislands about 50 feet from the shoreline to filter nutrients and sediment and guide suspended solids and debris away from the active recreation areas within the lake, creating a maintenance area within the lake.

- Along the shoreline of Levings Lake, RPD is installing a filter strip approximately 2.1 acres in size with the dimensions of 2,614 feet long and 35 feet wide. The dam, regulated by the Army Corps of Engineers, must remain mowed. The filter strip is not installed along the dam and a few other active shoreline areas.

Table 5.5 Levings Park

BMP Information					Pollutant Load Reductions by BMP				Cost	
Location	BMP	Size of	Dimensions of	Size of	TN	TP	TSS	Bacteria	Cost	Unit Cost
Name	Type	BMP (ac)	BMP (ft x ft)	Drainage Area (ac)	(lb/yr)	(lb/yr)	(lb/yr)	(billion counts/yr)	$	$/ac
Levings Park - South Catchment	Vegetated Swale	0.01	160 x 3	0.40	0.5	0.5	49	13	$ 175	$ 17,460
Levings Park - South Catchment	Stormwater Wetland	2.4	N/A	120.00	379	44	17314	9982	$ 38,160	$ 15,900
Levings Park - South Catchment	Vegetated Swale (Expose Pipe)	0.01	148 x 3	0.40	0.5	0.5	49	13	$ 175	$ 17,460
Levings Park - South Catchment	Bioislands	0.02	100 sf x 10 islands	N/A	250	40	17330	Unk.	$ 50,000	$50/sf
Levings Park - Lake Shoreline	Filter Strip	2.1	35 x 2614	11.10	40	4	1213	355	$ 6,909	$ 3,290
Levings Park - Kent Cr. Inlet	Stormwater Wetland	5.6	N/A	280.00	885	102	40399	23292	$ 89,040	$ 15,900
Levings Park - Kent Cr. Inlet	Bioislands	0.05	100 sf x 21 islands	N/A	525	84	36393	Unk.	$ 105,000	$50/sf
Levings Park Area Total		**10.19**	**N/A**	**411.90**	**2080.00**	**275.00**	**112747.00**	**33655.00**	**$ 289,458**	**N/A**

Figure 5.8 Levings Park BMP Recommendations

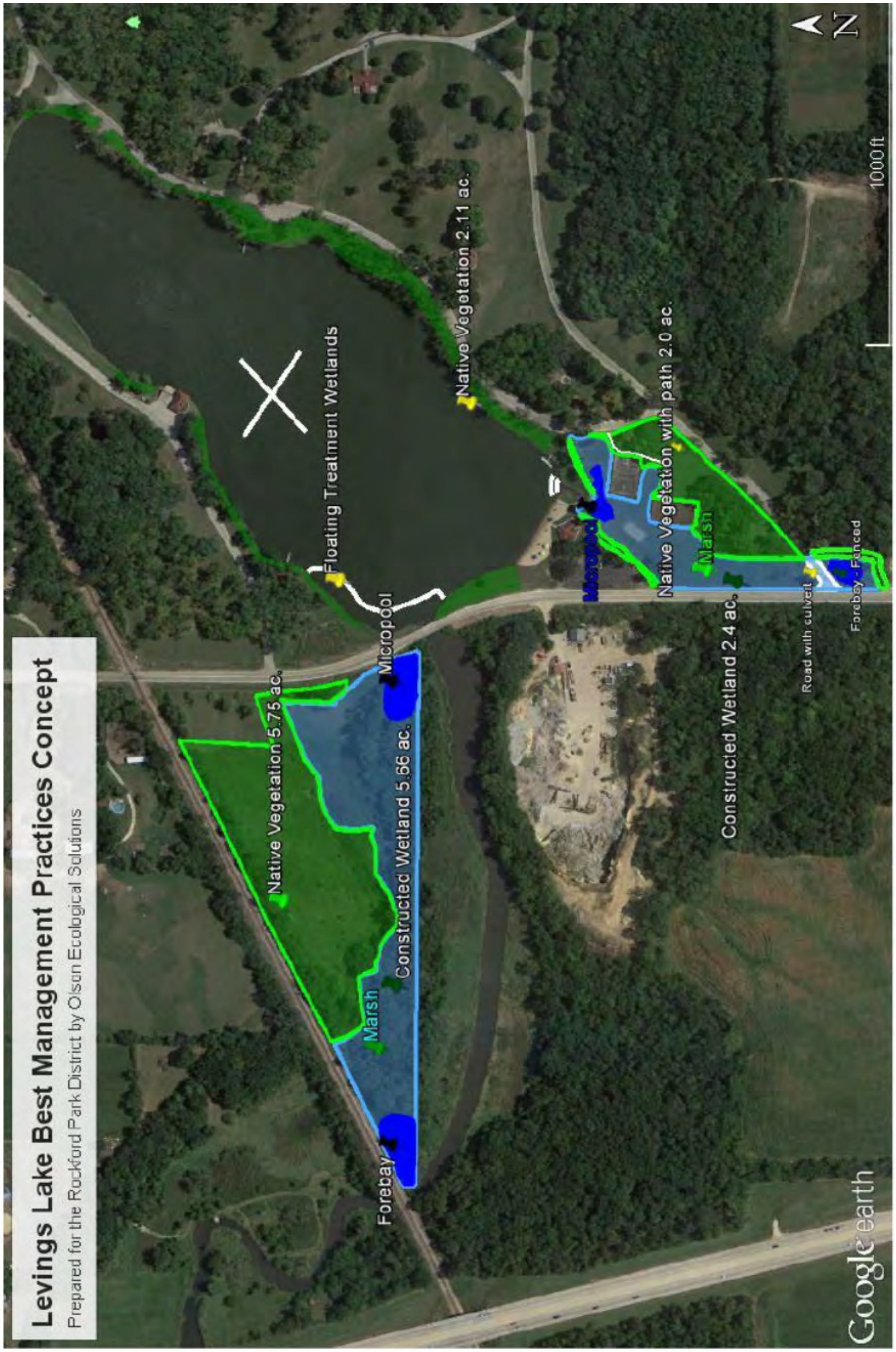
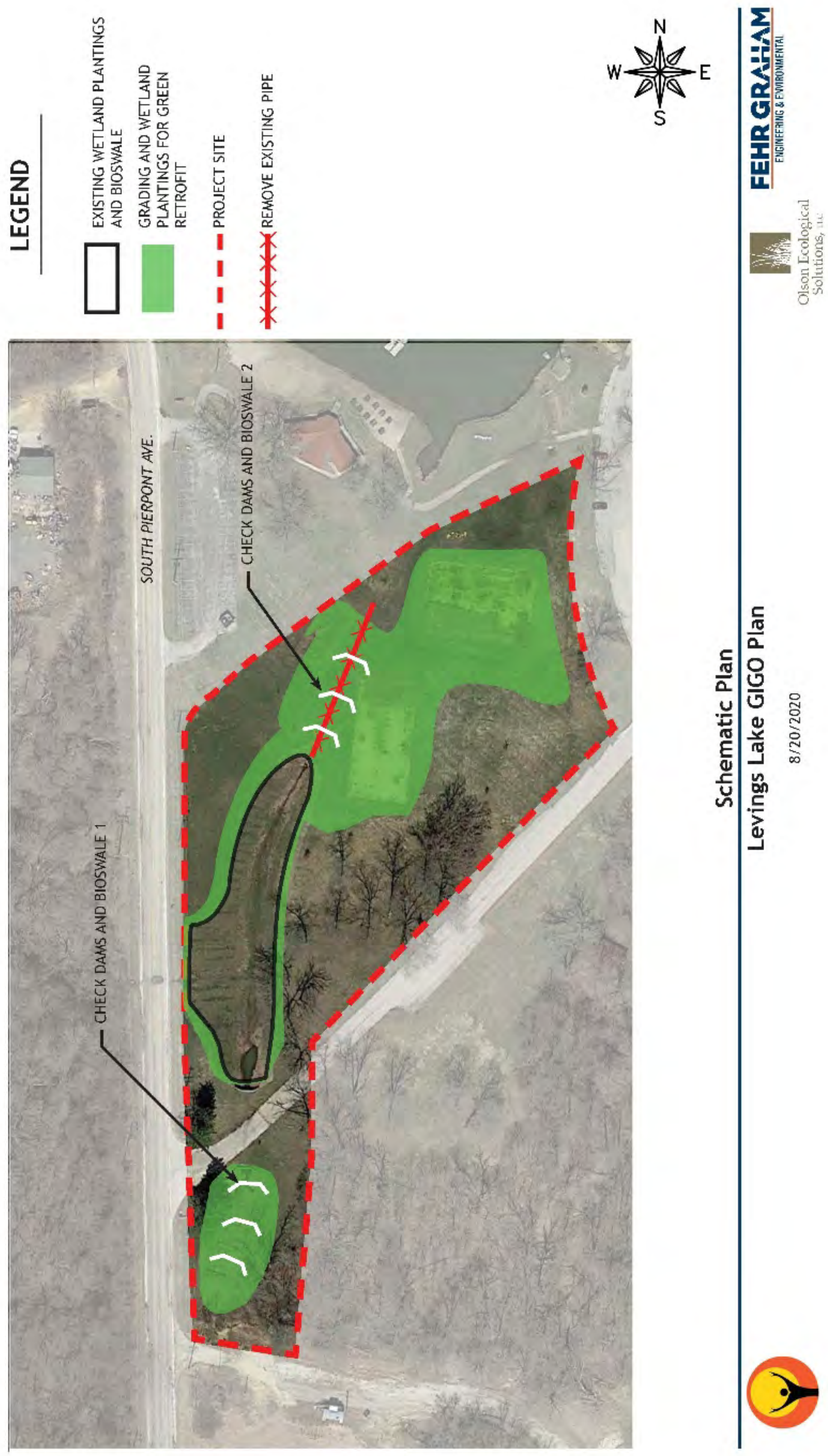


Figure 5.9 Levings Park BMP Recommendations - South Catchment Detail



North Branch Kent Creek Failed Drain Tiles

Stakeholders from Park-er-Woods have expressed concerns about water quality in the neighborhood. Algae, sedimentation, and shoreline erosion afflicts the ponds in Park-er-Woods while failed drain tiles, streambank erosion, and sedimentation affect the creek flowing through the neighborhood. Old, failing ceramic drain tiles north of the residential area carry sediment laden water into the neighborhood and cause erosion and sedimentation build-up problems throughout Park-er-Woods and other areas north of Park-er-Woods. The image below depicts one area where the failed drain tile has blown out and caused sedimentation build-up downstream. Photo credit to Jeff Wishop, of Wishop Tile & Drainage. The Park-er-Woods Drainage Commission is working to repair or remove portions of the failed drain tile, but funding has proven as a roadblock. The Drainage Commission is looking for a long term-solution to this issue that consistently degrades water quality in the ponds and stream and erodes streambanks. Between the age of the tile and tree root pressure, this has become a reoccurring problem that many landowners are interested in correcting. The vast majority of landowners near the failed drain tiles have issues and concerns about the failed drain tile. Below are images from Jeff Wishop demonstrating ponding, channelization, and sedimentation from the failed drain tile and the condition of the drain tile. *Figure 5.10* depicts the approximate location of the drain tile.

Many of the breaks within the drain tile lie just outside the delineated watershed boundary. However, since these drain tiles are so degraded, they have allowed surface water from a different watershed, namely the North Fork Kent Creek watershed, to enter these tiles and then carry the surface water south to the South Fork Kent Creek watershed. There is an Army Corps diversion dike that starts just north of West State street and west of Meridian Road roughly in line with the watershed boundary. This dike diverts water from south to north. The tiles flow under the dike. If the tiles were not breached and openly taking surface water, this water would be diverted north along the Army Corps dike to Anna Page Park's detention structure and ultimately released into North Fork Kent Creek. In other words, additional surface water from a different watershed is being diverted into the South Fork Kent Creek watershed because of these failed drain tiles. This additional water is not only sediment laden but also causes water quality and flooding issues downstream where the tiles empty. The tiles empty just north of Park-er-Woods. *Figure 5.11* depicts the current watershed boundary along with the approximate boundary of the two extra drainage areas (north drainage area and south drainage area) added to the watershed due to the drain tile failure. These extra drainage areas are approximately 1,126 acres in total and consist predominantly of farmland with a scattering of low density residential. *Table 5.6* provides known details.

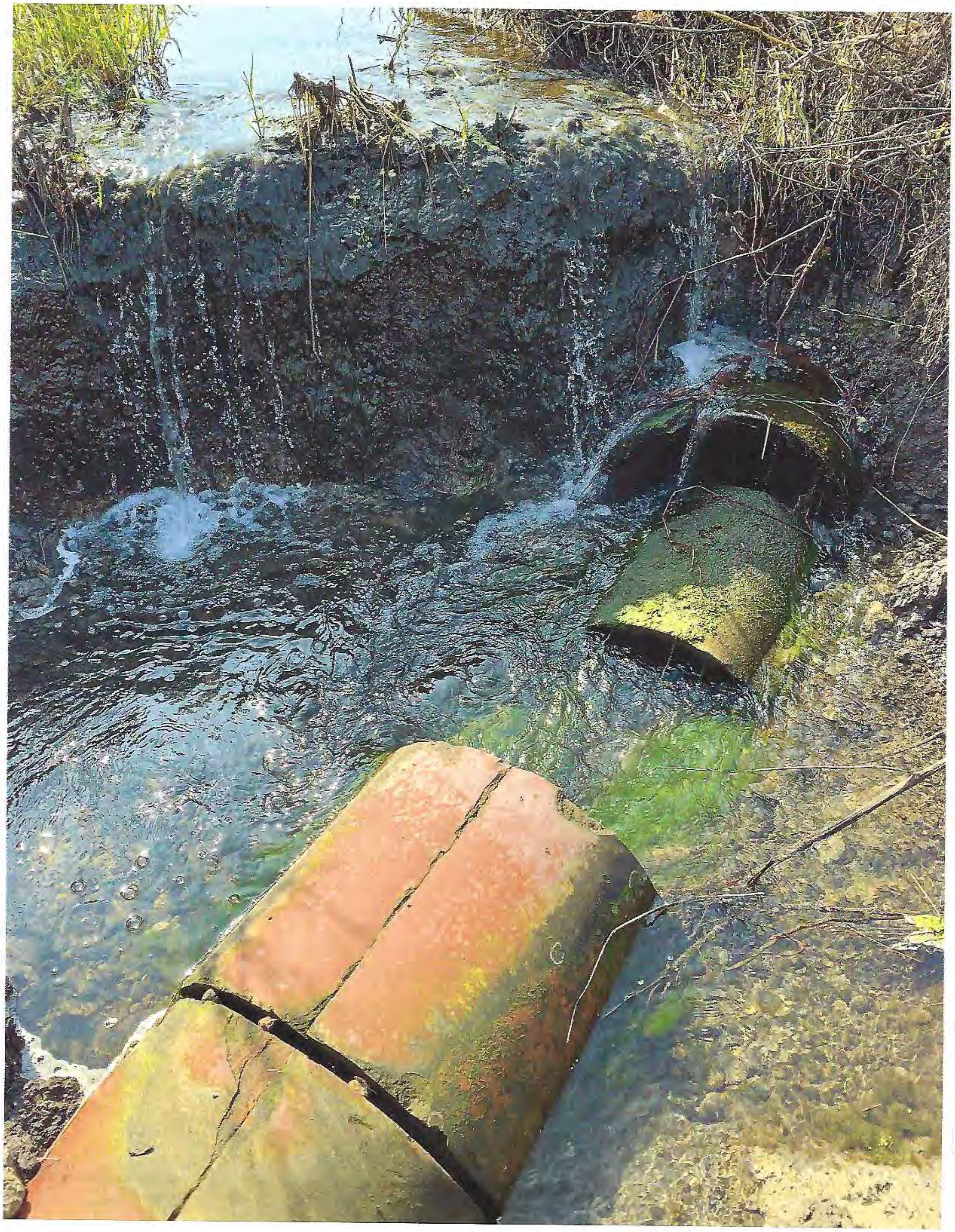


Table 5.6 North Branch Kent Creek Failed Drain Tile

BMP Information					Pollutant Load Reductions by BMP*				Cost	
Location	BMP	Size of	Dimensions of	Size of	TN	TP	TSS	Bacteria	Cost	Unit Cost
Name	Type	BMP (ac)	BMP (ft x ft)	Drainage Area (ac)	(lb/yr)	(lb/yr)	(lb/yr)	(billion counts/yr)	$	$/ac
N. Branch Kent Cr. Failed Drain Tile	Repair Drain Tile	Unk.	Unk.	1126	3309	276	120595	6525	Unk.	Unk.
North Branch Kent Creek Failed Drain Tile Total		**Unk.**	**Unk.**	**1126**	**3309**	**276**	**120595**	**6525**	**Unk.**	**Unk.**

* Used 100% efficiency for all pollutant reductions

Figure 5.10 Approximate Location of Failed Drain Tile

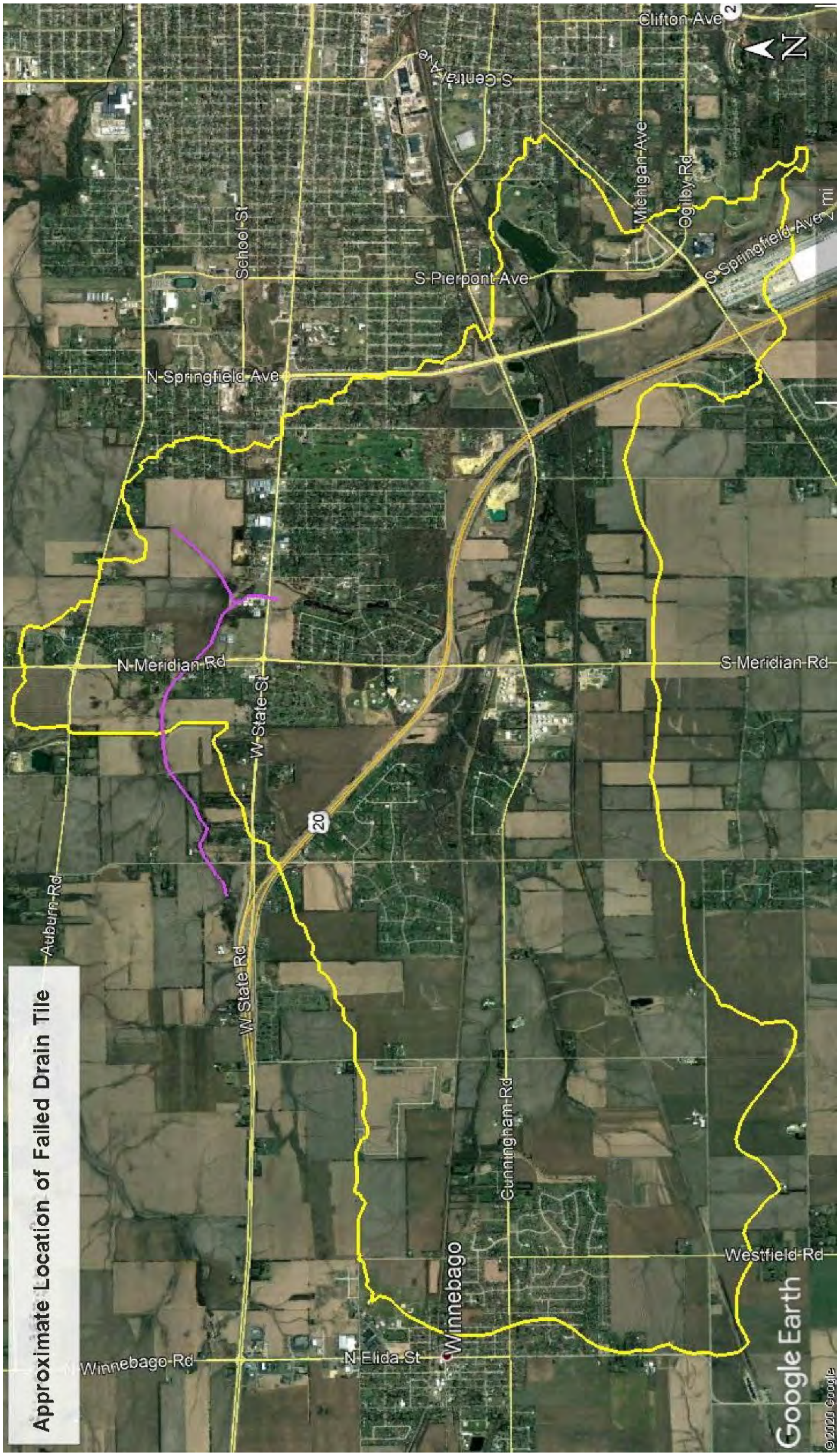
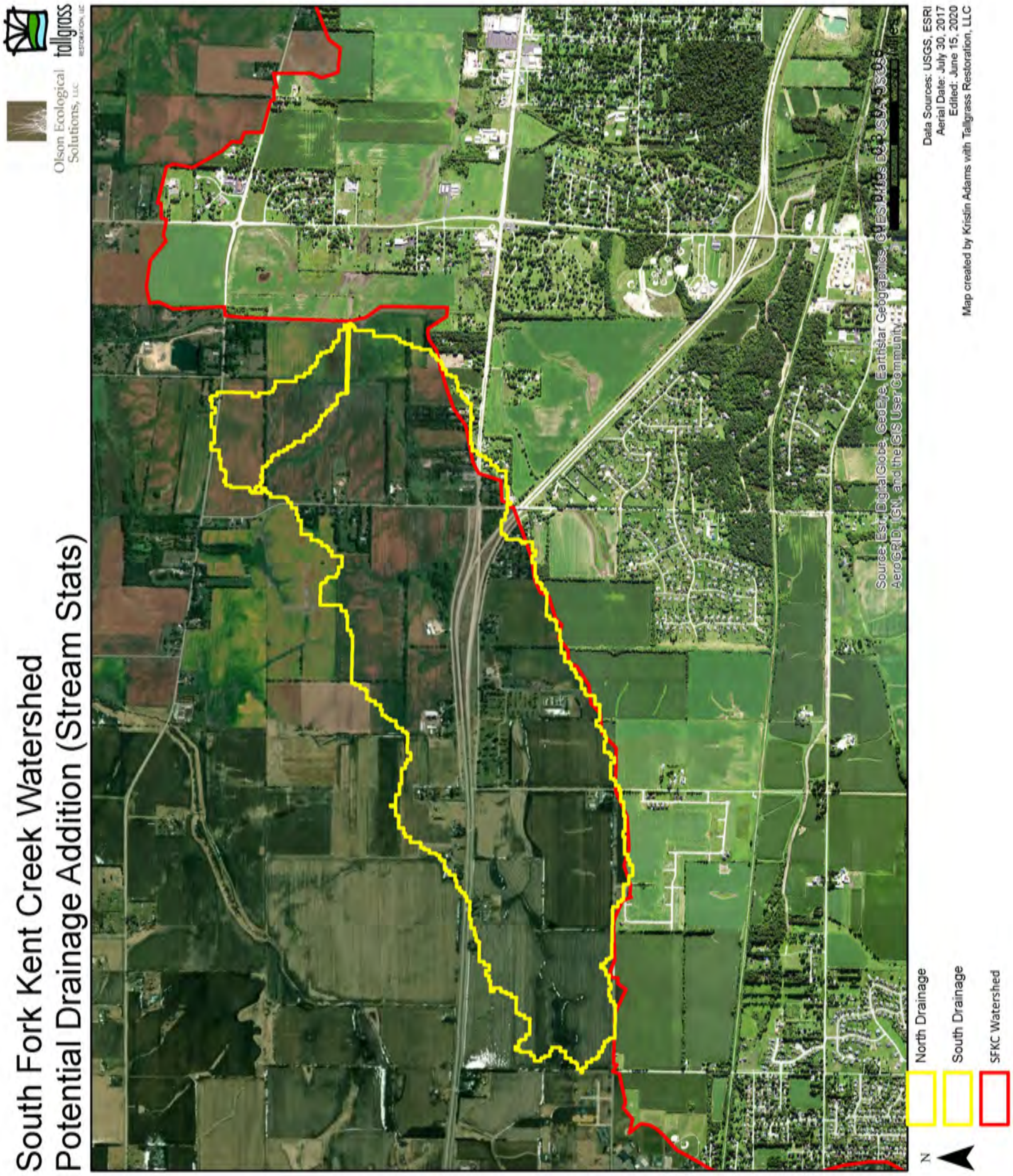


Figure 5.11 Approximate Area of Extra Drainage Area Due to Tile Failures



Park-er-Woods Neighborhood

Within Park-er-Woods, there are many BMPs that residents could implement to address pollutants close to the source on their own properties. Doing so would improve water quality in the ponds and creek and to reduce flooding issues near homes and in roadways. Consultants recommend the installation of native vegetated swales within the roadway ditches on Meridian Road to slow down and store water before flooding Park-er-Woods. Vegetated swales would also benefit the area if installed along roadways within Park-er-Woods. These vegetated swales could not only filter pollutants out of stormwater runoff from roadways and lawns before they enter the ponds and creek, but they can also assist in runoff capture and infiltration to reduce velocity of runoff and potential flooding along roadways. Homeowners may also consider installing rain barrels, rain gardens, or infiltration trenches to capture runoff from roofs and lawns. Another recommendation to greatly improve the clarity and quality of the ponds is homeowner lawn care practices, such as responsible fertilizer and pesticide lawn application, pet waste cleanup, and leaf litter and grass clipping collection. To learn more about responsible lawn care, please see Chapter 3. Another way to reduce excess nutrients, fecal coliform, and sediment from entering the ponds and creek is to install riparian filter strips along the pond shorelines and streambanks. The RPD is considering expanding existing riparian filter strips on their property, but all homeowners and especially those with land near the creek or ponds may also consider installing filter strips between their lawns and the surface water. *Table 5.7* provides detail assuming 25% participation by residents.

Table 5.7 Park-er-Woods Neighborhood

BMP Information					Pollutant Load Reductions by BMP				Cost	
Location	BMP	Size of	Dimensions of	Size of	TN	TP	TSS	Bacteria	Cost	Unit Cost
Name	Type	BMP (ac)	BMP (ft x ft)	Drainage Area (ac)	(lb/yr)	(lb/yr)	(lb/yr)	(billion counts/yr)	$	$/ac
Park-er-Woods Neighborhood - Meridian Rd. Roadside (25%)	Vegetated Swale	0.48	(3 x 3450) x 2	18.50	17	7	2288	592	$ 8,297	$ 17,460
Park-er-Woods Neighborhood - Subdivision Roadsides (25%)	Vegetated Swale	7.22	(3 x 52413) x 2	277.70	251	106	34343	8885	$ 126,051	$ 17,460
Park-er-Woods Neighborhood Lawns (25%)	Rain Gardens / Infiltration Trenches	2.14	N/A	82.23	416	52	13729	3245	$ 37,329	$ 17,460
Park-er-Woods Neighborhood - Lawns (25%)	Filter Strip	15.56	35 X 19362	82.23	297	31	8983	2631	$ 51,192	$ 3,290
Park-er-Woods Neighborhood Total		**25.39**	**N/A**	**460.66**	**981**	**196**	**59343**	**15353**	**$ 222,870**	**N/A**

Westfield Farm

A property owner with a crop field near the southwest corner of Hawkins Drive and Westfield Road is interested in improving water quality and conservation efforts on site. The parcel is a 106-acre family-owned property. The agricultural producer currently practices no till or minimal till, crop rotation between soybeans and corn, and some contouring when appropriate. The north border is a tree line. Periodically woody invasive species have been removed from the north tree line. The landowner is interested in removing more of the woody brush from that border. In the past, two grassed waterways were on site, but in some years, they are planted over and require repair and widening to reach proper function. There is an area that ponds on the southwest side of the field near S. Winnebago Road. This area is outlined in light blue on *Figure 5.10*. The water from the field drains from the west side of the field to the east towards Westfield Road. There are two spillways where the water from the field empties on the west side of Westfield Road. These spillways take water from the field into the county ditch, then under Westfield Road to the farm field to the east. The landowner has seen water flow into these spillways like a waterfall after a big storm. Gravel lines these culverts on both sides of Westfield Road.

After speaking with the landowner, viewing aerial imagery, and discussing some ideas with an engineer, consultants came up with the following recommendations for BMPs:

1. Filter strip and selective clearing of invasive woody species on the Northwest border.
2. Filter strip along the east property line located on the west side of Westfield Road.
3. Repairing and widening two grassed waterways to convey water from the west to the east.
4. Constructed stormwater wetland on the southwest edge of the field to help filter ponding water and allow for infiltration.

Filter Strips

Consultants recommend installing two filter strips: one along the northwest tree line and another along the east edge of the property line. Each filter strip should ideally be 35 feet or wider. If space does not allow for 35 feet, then 18 feet will suffice. The landowner could consider putting these filter strips into CRP field borders.

North Filter Strip

The north filter strip along the tree line on the north edge of the property is depicted in the map as being approximately 860 feet by 35 feet, or 0.7 acres. Consultants recommend selective clearing of invasive shrubs/trees within the tree line. Once invasive woody species are removed, native grasses and forbs can be seeded to form a filter strip along that edge. It is estimated that within the proposed filter strip two water conveyances carry water from the farm field to Hawkins Drive. The proposed filter strip will filter water from the farm field as it sheet flows across it and into the residential area.

East Filter Strip

The east filter strip running adjacent to the west side of Westfield Road is depicted in the map as being approximately 1,900 feet by 35 feet, or 1.5 acres. Two specific areas within the filter strips have proposed widths larger than 35 feet to help slow and filter water from the two grassed waterways. If the landowner decided to extend the filter strip into the right-of-way, then he/she must contact the Winnebago Township to receive approval before starting construction of filter strip. The landowner may also consider shortening the proposed filter strip lengths so that they only extend 50 feet from either side of each spillway.

Grassed Waterways

The grassed waterways are likely to follow remnants of previous grassed waterways that have been planted over with crops. It is likely that the old grassed waterways are not as extensive as the newly proposed ones. Therefore, the project would consist of widening, repairing, and perhaps extending existing grassed waterways. The grassed waterways proposed size vary in width, but consultants recommend a minimum width of 30 feet.

Constructed Stormwater Wetland

There is an area on the southwest edge of the proposed grassed waterway that ponds most years and is described by the landowner as a chronic problem. Consultants and the landowner have discussed the possibility of creating a constructed stormwater wetland in that area to address the chronic ponding issue. The area outlined in light blue in *Figure 5.10* is approximately 0.1 acres. This area could simply be taken out of production and planted with wetland or emergent vegetation depending on site conditions. The wetland vegetation would help draw down the water and reduce the amount of ponding in the area along South Winnebago Road. The area with lighter-colored soil that is a bit east of the light blue outline also ponds but not as often as the light blue outlined area. The landowner may consider expanding the constructed wetland to the lighter area, or secondary ponding area. If the landowner elects to keep the constructed wetland size as outlined in *Figure 5.10*, then the landowner could regrade the west portion of the southernmost grassed waterway to reduce ponding in the secondary ponding area.

Table 5.8 provides detail. *Figure 5.12* depicts each recommended BMP. The filter strips are shown in pink, grassed waterways in orange, and constructed stormwater wetland in light blue. Please note the figure is conceptual and the actual shapes and sizes of each BMP will need to be detailed further by an engineer or BMP designer.

Table 5.8 Westfield Farm

BMP Information					Pollutant Load Reductions by BMP				Cost	
Location	BMP	Size of	Dimensions of	Size of	TN	TP	TSS	Bacteria	Cost	Unit Cost
Name	Type	BMP (ac)	BMP (ft x ft)	Drainage Area (ac)	(lb/yr)	(lb/yr)	(lb/yr)	(billion counts/yr)	$	$/ac
Westfield Farm Crop Field	Repair, Widen 2 Grassed Waterways	9.97	30 x 14476	383.46	338	23	18481	1111	$ 54,785	$ 5,495
Westfield Farm Crop Field	Stormwater Wetland	0.1	N/A	0.25	0.5	0.5	19	1	$ 1,590	$ 15,900
Westfield Farm Northwest Field Border	Filter Strip	0.7	35 X 860	3.65	4	0.5	207	6	$ 581	$ 830
Westfield Farm West Field Border	Filter Strip	1.5	35 X 1900	8.07	9	1	458	14	$ 1,245	$ 830
Westfield Farm Total		**12.27**	**N/A**	**395.43**	**351.5**	**25**	**19165**	**1132**	**$ 58,201**	**N/A**

Figure 5.12 Westfield Farm Site-Specific Recommendations

Railroad & Meridian Farm

An agricultural producer with a crop field near the southeast corner of the old railroad tracks and S. Meridian Road is interested in improving water quality and conservation efforts on his property. The parcel is located directly south of the old railroad tracks and just east of the old composting facility parcel. The agricultural producer currently practices no till or minimal till, crop rotation between soybeans and corn, and some use of cover crops. The north, west, and east field borders are in CRP, and the producer has periodically removed some of the invasive brush in the field borders. There are currently no grassed waterways on the property. The producer does not see any need for them, as it is not practical with how small the field is and none of the areas wash out. The field is tiled and drains into the forested ravine on the northeast end of the field. The wooded ravine on the northeast side generally has a year-round trickle feeding the ravine. In the past, scrap metal and other materials have accumulated in or near the ravine, and it is crowded with invasive honeysuckle and buckthorn. A grass buffer surrounds the forested ravine. The agricultural producer would like to clean this area up and remove some of the invasive understory. There is a sharp slope on the northwest side of this farm field in the woods down to the stream. This area appears to have two eroded gullies. Consultants considered grassed waterways as a possible BMP recommendation, but they decided to not pursue it due to lack of landowner interest, the small size of the field, and lack of erosion in the crop field. *Figure 5.11* depicts each recommended BMP. The woodland restoration of the forested ravine is shown in green, continued maintenance of the CRP border is shown in yellow, continued maintenance of the grass filter strip surrounding the forested ravine is shown in pink, and the area surrounding the two eroded gullies is shown in red. Please note the figure is conceptual and the actual shapes and sizes of each BMP will need to be detailed further by an engineer or BMP designer.

After speaking with the agricultural producer, viewing aerial imagery, and using information from previous site surveys, consultants came up with the following recommendations for BMPs:

1. Woodland restoration and stabilization of the forested ravine
2. Continue maintenance of the CRP field borders and the grass filter strip surrounding the forested ravine and crop fields
3. Stabilize two eroded gullies in the northwest corner of the property

Woodland Restoration and Stabilization

Consultants recommend restoring the forested ravine located on the north east side of the crop field. Woodland restoration would include about 1.88 acres of selective clearing of invasive shrubs/trees. Once the woodland is restored to natives and the canopy/woody understory is thinned, then the ravine may self-heal itself and stabilize the banks. If it does not self-heal, streambank stabilization, riparian filter strips along the ravine, and a series of check dams within the gully may be recommended.

CRP Continued Progress

The producer periodically removes invasive woody species from the CRP field buffers lining the west, north, and east edges of the field and from the tree line in the center of the crop field. Consultants recommend continued progress towards removing invasive shrubs from CRP field borders and any other tree line. Once most invasive woody species are removed, consultants recommend seeding these areas with native CRP seed mixes.

Stabilize Eroded Gullies

In the northwest corner of the farm field, two eroded gullies guide stormwater from the field at the top of the hill down a steep slope to the creek below. Several gullies have started to form, two of which are substantial, each at least three feet wide at the top of the gully and 1.5 feet deep. The filter strip surrounding the farm field is wooded at the point where the gullies begin. Consultants recommend removing invasive species within the woodlands to allow more sunlight that will encourage herbaceous growth on the forest floor, protecting the area from further erosion. In addition to removing invasive species, consultants recommend repairing the gullies and planting them with a native grass and wildflower mix to allow for stormwater to travel to the creek through a stabilized area. Rock check dams will likely be needed. These recommendations are conceptual and require further investigation by an engineer.

Figure 5.13 illustrates the BMP recommendations and *Table 5.9* provides details.

Table 5.9 Railroad and Meridian Farm

BMP Information					Pollutant Load Reductions by BMP				Cost	
Location	**BMP**	**Size of**	**Dimensions of**	**Size of**	**TN**	**TP**	**TSS**	**Bacteria**	**Cost**	**Unit Cost**
Name	**Type**	**BMP (ac)**	**BMP (ft x ft)**	**Drainage Area (ac)**	**(lb/yr)**	**(lb/yr)**	**(lb/yr)**	**(billion counts/yr)**	**$**	**$/ac**
RR and Meridian Farm Wooded Ravine	Natural Area	1.88	N/A	1.88	1	0.5	18	2	$ 1,269	$ 675
RR & Meridian Farm Wooded Ravine Border	Filter Strip	1.86	35 x 2315	9.83	12	1	558	17	$ 1,544	$ 830
RR & Meridian Farm Field Borders	Filter Strip	5.63	35 x 7007	29.76	35	3	1689	52	$ 4,673	$ 830
RR & Meridian Farm Gully	Natural Area	1.4	247 x 247	1.40	1	0.5	14	1	$ 945	$ 675
RR & Meridian Farm Gully	Vegetated Swale	0.02	3 x 247	0.77	0.5	0.5	49	1	$ 349	$ 17,460
Railroad & Meridian Farm Total		**10.79**	**N/A**	**43.64**	**49.5**	**5.5**	**2328**	**73**	**$ 8,780**	**N/A**

Figure 5.13 Railroad & Meridian Farm Site-Specific Recommendations

Hidden Oak Trail Drainage Swale

A homeowner has an eroded drainage easement swale on the south side of his property. The drainage swale conveys water to a tributary of South Fork Kent Creek. The landowner is concerned about the erosion within the swale that has now eroded enough soil to expose his utility lines. Over time, this drainage easement has channelized into a two-foot steep ravine without measures for soil stabilization. The photographs below depict the eroded swale. The third photograph shows exposed utility lines.

After speaking with the landowner, viewing aerial imagery, inspecting site photographs, and working with a Winnebago County Highway Department engineer, consultants and the engineer came up with the following recommendations for converting the eroded drainage easement swale into a vegetated swale:

1. Grading ravine banks back and reducing steepness of ravine slope.
2. Armoring the inlet with rock.
3. Selectively clearing of woody invasive and/or weedy species within 1/3rd acre surrounding the ravine.
4. Vegetating the swale bed, slope, and surrounding woodland restoration area with native vegetation.

Consultants recommend pulling the banks of the channelized ravine back and leveling the slopes to a 4 to 1 or lesser slope. To reinforce the swale bed where water enters, it is recommended to install a rock apron near the inlet for armoring. The area is overgrown with some weedy and invasive woody species. Consultants recommend selective clearing of all invasive and some weedy woody species to open the canopy and allow sunlight to the forest floor. *Figure 5.12* below estimated an area of about 0.2 acres (green outline) that could be selectively cleared, but more or less is acceptable depending on budget. This process will allow herbaceous plants to become established. These plants will help stabilize the slopes of the swale and filter the runoff. Once selective tree clearing is completed, the swale and selectively cleared area should be vegetated with native plants. *Figure 5.12* below estimates an area of about 0.2 acres to be seeded with native species within the swale and the woodland restoration area. The width of the swale is likely to be 15-20 feet depending on what portion of the swale is measured. Native plants' intensive root structure will further reinforce and stabilize the bed and slopes of the swale. Native vegetation will also filter out total suspends solids, excess nutrients, and bacteria that may have accumulated in the stormwater runoff. It is recommended to use native plant species with rigid stems and high stem density that are suited to current site conditions and intended uses (NRCS eFOTG). In doing so, once the native vegetation is established it will hold up to the volume and velocity of water flowing through the swale. Consultants recommend regular maintenance and inspection of the drainage swale to ensure proper function. Homeowner should inspect the swale regularly to ensure the following: no debris, such as litter, downed trees, or landscape waste, enters the swale, rock armoring remains in place and is functioning properly, and installed native vegetation is established after about 3 years. The homeowner should maintain the swale by removing collected debris from swale, ensuring no one dumps litter or landscape waste in the swale, mow and remove vegetative old growth to help new year's vegetative growth and rigor, spread native seed in bare areas of swale, and remove invasive and weedy plant species from swale before they go to seed. For more information about Illinois invasive plant species please see https://www.invasive.org/illinois/speciesofconcern.html

Figure 5.14 depicts the location and estimated size of the vegetated swale and woodland restoration area. Please note the figure is conceptual and the actual shape and size of the BMPs will need to be detailed further by an engineer or BMP designer. *Table 5.10* provides details.

Figure 5.14 Hidden Oak Trail Site-Specific Recommendations

Table 5.10 Hidden Oak Trail Drainage Swale

BMP Information					Pollutant Load Reductions by BMP				Cost	
Location	BMP	Size of	Dimensions of	Size of	TN	TP	TSS	Bacteria	Cost	Unit Cost
Name	Type	BMP (ac)	BMP (ft x ft)	Drainage Area (ac)	(lb/yr)	(lb/yr)	(lb/yr)	(billion counts/yr)	$	$/ac
Hidden Oak Drainage Swale	Filter Strip	0.2	20 x 436	1.85	1	0.5	22	6	$ 658	$ 3,290
Hidden Oak Drainage Swale	Vegetated Swale	0.03	3 x 436	1.15	0.5	0.5	4	1	$ 524	$ 17,460
Hidden Oak Trail Drainage Swale Total		**0.23**	**20 X 436**	**1.15**	**1.5**	**1**	**26**	**7**	**$ 1,182**	**N/A**

Cunningham Road Constructed Stormwater Wetland

A property owner with cropland and a residence on the northwest corner of Cunningham Road and S. Weldon Road may be interested in installing a constructed stormwater wetland at the southeast corner of his cropland near South Fork Kent Creek. The parcel is a 39-acre plot with a home on the northeast corner and cropland on the remainder of the property. Part of the property is within the flood zone; therefore, the property owner wishes for the constructed wetland to remove the residence from the flood zone. The proposed wetland is approximated to be 14 acres for planning purposes; the final size and shape is to be determined. The area could be taken out of agricultural production. Approximately 25,000 cubic yards of existing soil would need to be excavated during the installation; however, around half (13,000 cubic yards) of the excavated soils would be reused on-site to create a berm on the south and east sides. An inflow could be placed on the southwest corner of the parcel to take in water from the creek while the outlet could be directed towards the current culvert structure that carries water from the field under S. Weldon Rd into the creek on the east side of S. Weldon Road. An overflow structure could be placed on the southeast corner of the property to overflow into the creek. The area could be planted with wetland or emergent vegetation depending on site conditions. The emergent vegetation would help draw down the water and reduce the amount of ponding in the area along Cunningham Road.

Possible benefits from this constructed stormwater wetland range from removal of residence from floodplain, temporary storage of stormwater, filtration and infiltration of stormwater from drainage area, and alleviation of flooding near the stream, the intersection of Cunningham Rd. and S. Weldon Rd., and the property owner's cropland and residence.

Figure 5.15 depicts the property boundaries according to WinGIS. *Figures 5.16* and *5.17* depict a potential boundary for the proposed constructed wetland and other details, including potential locations for an inflow, outlet, overflow, and outflow. Sean Von Bergen of the Winnebago County Highway Department created the sketch depicted in *Figure 5.16* to give a conceptual understanding of the potential for a BMP at this location. *Figure 5.18* illustrates the overlap of this potential wetland boundary with hydric soils. *Figure 5.19* depicts the approximate drainage area that would bring stormwater into the proposed constructed wetland. Please note these figures depicting approximate wetland boundary and drainage area are conceptual and the actual shape, size, and overall design of the constructed wetland will need to be detailed further by an engineer or BMP designer. *Table 5.11* provides details.

Figure 5.15 Cunningham Rd. Wetland Property Boundary

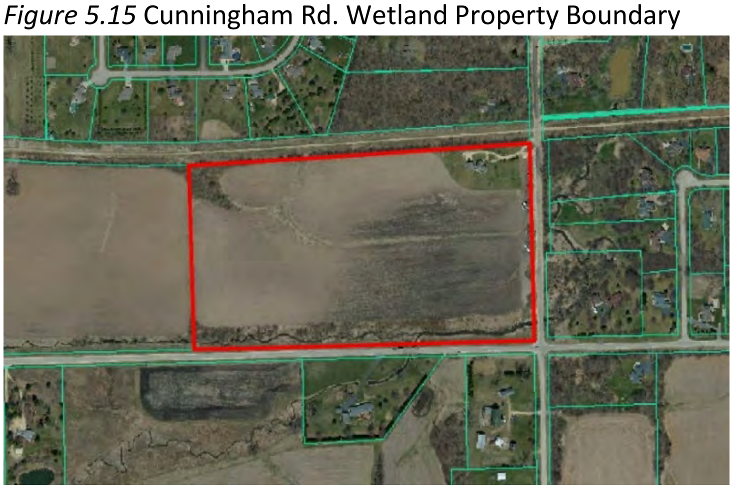


Figure 5.16 Cunningham Rd. Constructed Wetland Conceptual Detail

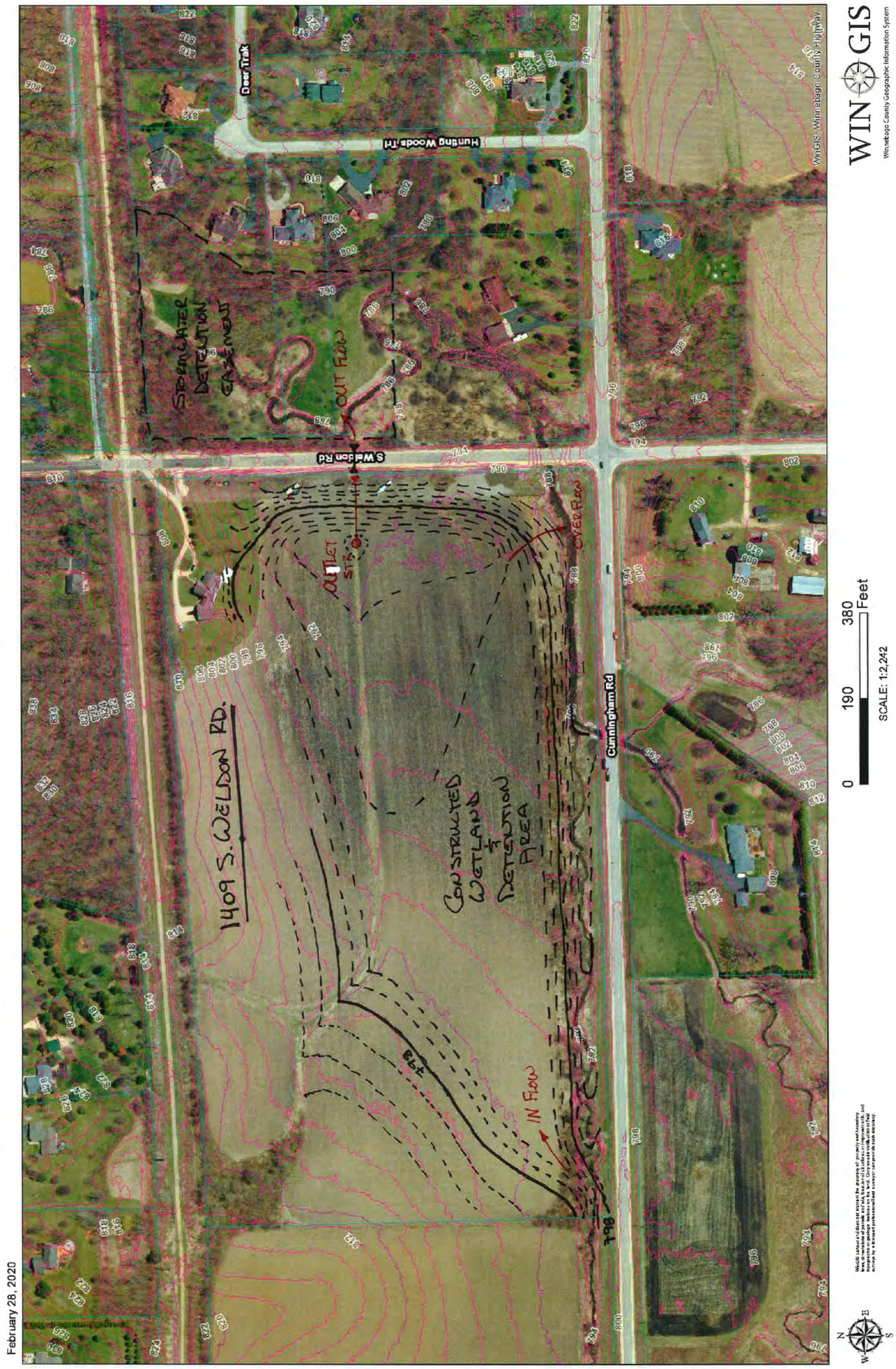


Figure 5.17 Cunningham Rd. Constructed Wetland Boundary

Figure 5.18 Cunningham Rd. Wetland Hydric Soils

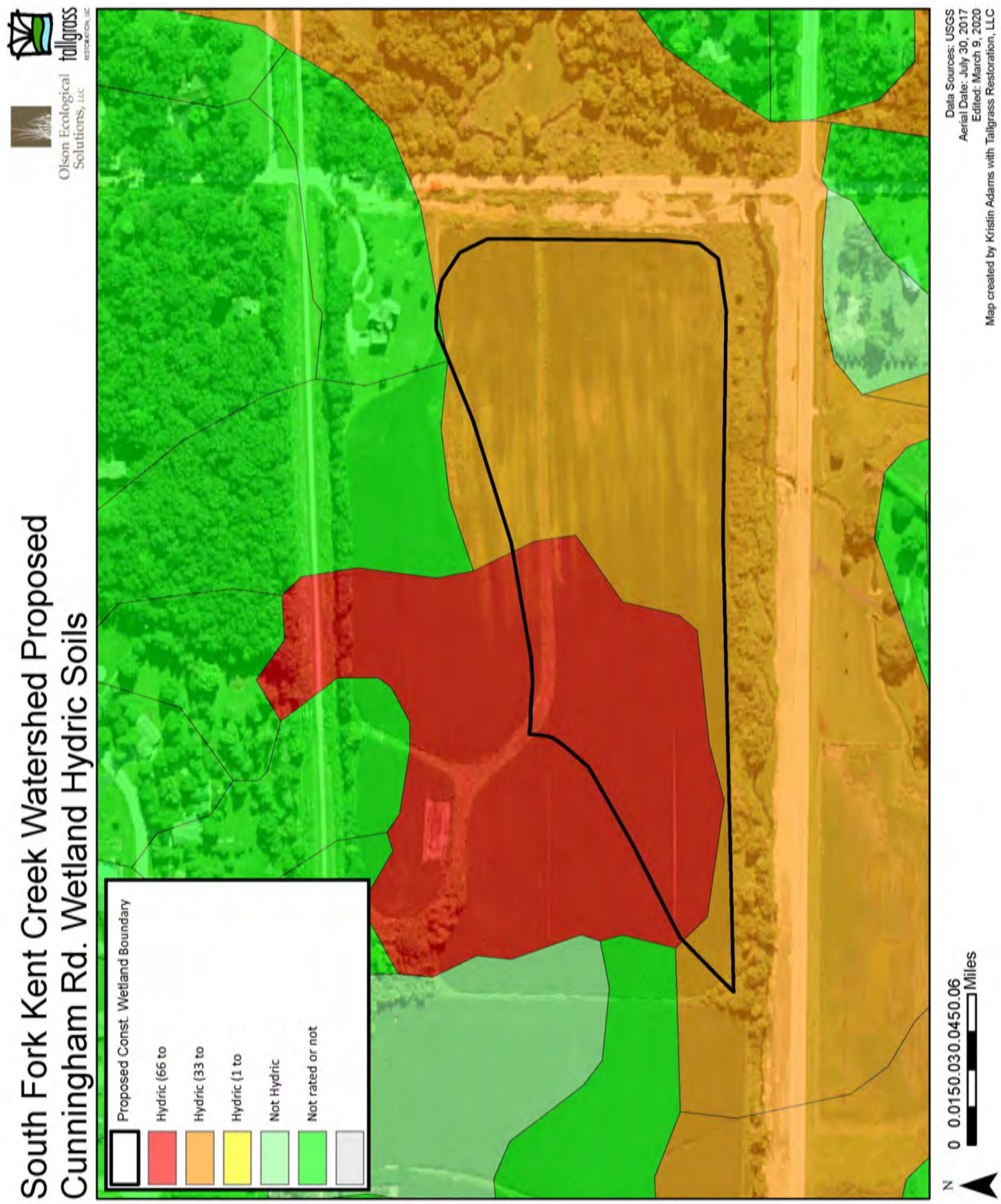


Figure 5.19 Cunningham Rd. Wetland Drainage Area

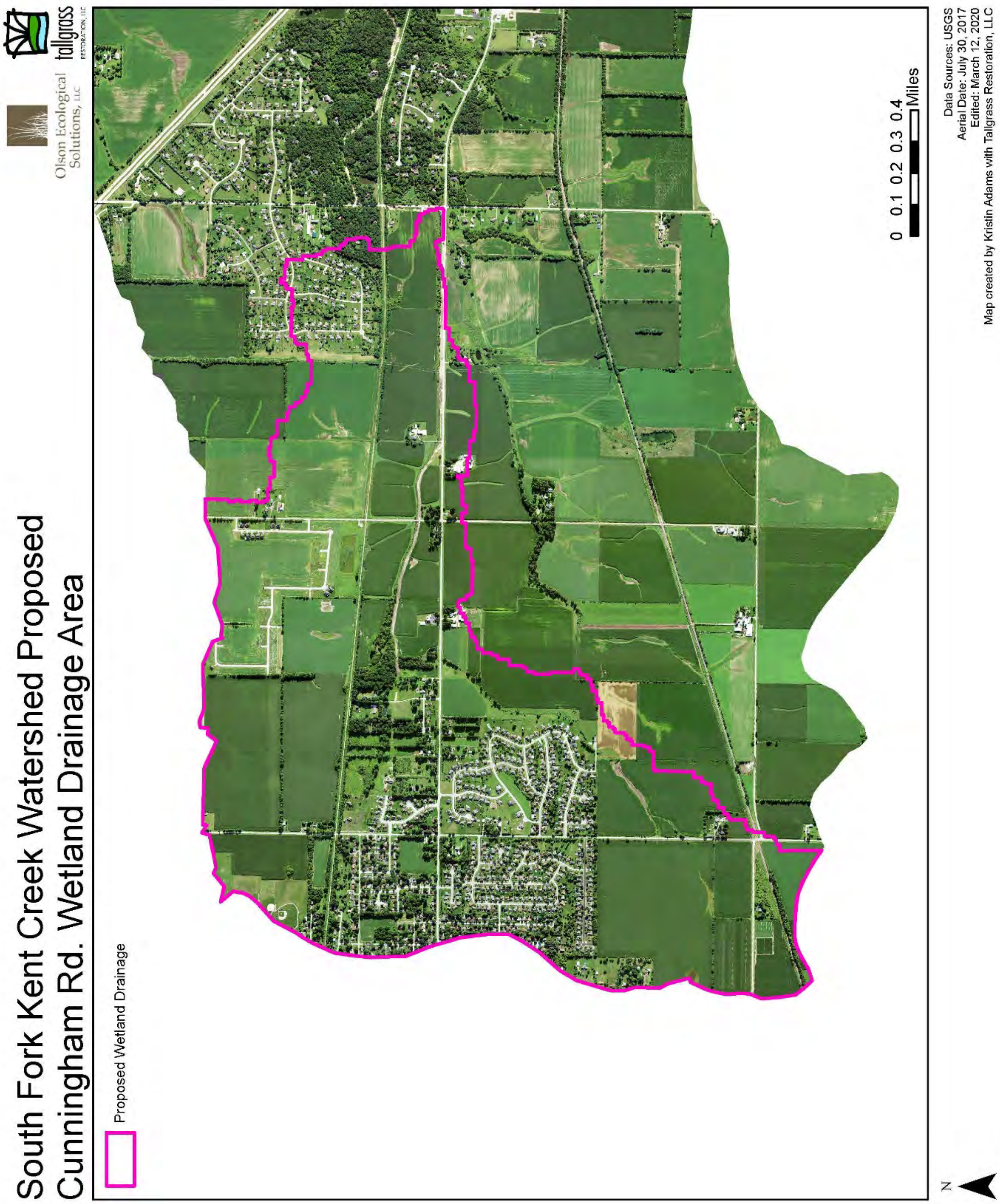


*Table 5.11*Cunningham Road Constructed Stormwater Wetland

BMP Information					Pollutant Load Reductions by BMP				Cost	
Location	**BMP**	**Size of**	**Dimensions of**	**Size of**	**TN**	**TP**	**TSS**	**Bacteria**	**Cost**	**Unit Cost**
Name	**Type**	**BMP (ac)**	**BMP (ft x ft)**	**Drainage Area (ac)**	**(lb/yr)**	**(lb/yr)**	**(lb/yr)**	**(billion counts/yr)**	**$**	**$/ac**
Cunningham Rd. Field	Filter Strip	3.5	35 x 4356	18.50	22	2	1050	32	$ 2,905	$ 830
Cunningham Rd. Field	Stormwater Wetland	14	N/A	350.00	1107	127	50498	29115	$ 1,085,000	$ 77,500
Cunningham Road Stormwater Wetland Total		**17.5**	**N/A**	**368.5**	**1129**	**129**	**51548**	**29147**	**$ 1,087,905**	**N/A**

* Cost of stormwater wetland calculated for additional grading.

Conclusion

All site-specific projects and practices are highly prioritized by stakeholders, and they would collectively add significant value to the efforts of reducing excess nutrients, sediment, and fecal coliform in nearby surface waters. This chapter focuses on site-specific projects identified by stakeholders who are interested in implementing these projects on their land. Many serve as examples of situations that likely exist throughout the watershed. These projects can give other stakeholders an idea of how BMPs are selected for certain properties based on the on-site conditions and concerns of the landowner. The more BMP implementation and education awareness that occurs within the watershed, the more successful the community will be at reducing pollutant loading in the creek and waterbodies. The following chapter details technical resources and financial assistance available to watershed stakeholders interested in implementing BMPs to improve water quality.

Section 2, Chapter 6
Financial and Technical Resources

Introduction

Potential funding and technical assistance are available through various grant agencies and local environmental organizations suggested in this chapter. Costs can be deferred by organizing volunteer efforts, as grant agencies typically recognize the value of volunteer time and allow that value to provide matching funds for their grant dollars. For example, if a grant is secured to support 60% of the cost of implementing a $100,000 project, then the financial assistance would be $60,000 from the grant agency and the local community would need to budget $40,000 in cash and value of volunteer time to match the other 40%.

Local sources of matching funds are recommended and usually required to qualify for grant funding. Local match can come from several sources, including local environmental organizations and associations, businesses, developers, municipalities, and private citizens. Funds can be in the form of cash or the value of volunteer time. The national average for the estimated value of volunteer time in 2018 was $25.43 per hour according to the Independent Sector. It is important to recognize this value, as many projects that benefit water quality rely on dedication and many hours spent by volunteers. Stakeholders thoughts of specific groups that might be capable of providing volunteer hours: Boy Scouts #705, who are sponsored by First Presbyterian Church, and the local high schools, which are Winnebago High School and Boylan High School.

There are many potential funding and technical assistance resources for the planning and implementation of conservation practices. *Table 6.1* lists potential agencies that provide funding and/or technical support for implementing these types of conservation projects and practices. The pages that follow provide more detail on each organization and the programs or assistance they offer. The first section describes financial and technical assistance for agricultural producers. The next section details financial and technical assistance offered to a combination of governmental bodies, non-profits, businesses, residents, and/or agricultural producers. The third section describes financial assistance for non-profits & community organizations. The last section lists non-profit organizations that provide technical assistance to anyone in need.

Financial and Technical Assistance for Agricultural Producers

Programs funded through Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) provides financial and technical assistance as well as easement programs to assist agricultural producers and landowners implement and maintain conservations practices that help protect agricultural land and natural resources. Applying for grant funding, organizing and planning for the workload, and implementing the specific conservation practices is completely left to the willingness of the farmer. Information about guidelines and specifications for conservation practices can be found online in the State of Illinois Old Section IV of the NRCS electronic Field Office Technical Guide (FOTG).

Environmental Quality Incentives Program (EQIP): Through EQIP, NRCS and grant recipients finance solutions that conserve natural resources while also improving agricultural operation. NRCS assists agricultural producers with financial resources, the development of a unique conservation plan, and implementation of conservation practices. With NRCS acting as a co-funder for conservation practice implementation, the participating agricultural producer voluntarily implements these practices. The best way to learn if EQIP is a good fit for you is by contacting your local NRCS office. The NRCS District Conservationist that represents Winnebago County is currently Josh Franks, josh.franks@usda.gov https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/

One of EQIP's Water-Based Landscape Initiatives is the *Mississippi River Basin Healthy Watershed Initiative,* which utilizes Farm Bill programs including the Environmental Quality Incentives Program and the Agricultural Conservation Easement Program to aid landowners in conserving natural resources by voluntarily implementing conservation practices. The overall goals of MRBI are to improve water quality, restore wetlands and enhance wildlife habitat while ensuring economic viability of agricultural lands. https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/initiatives/?cid=stelprdb1048200

Conservation Stewardship Program (CSP): The Conservation Stewardship Program partners qualifying farmers with NRCS to maintain and improve existing conservation plans and fund conservation practices, including brush management, residue and till management, conservation cover, cover crop, critical area planting, filter strips, grade stabilization structures, grassed waterways, streambank and shoreline protection, and more. This program helps to build on your existing conservation efforts while strengthening your operation. Funding is based off the conservation performance, i.e. the higher the conservation performance results in increased funding. Applications are accepted throughout the year. CSP contracts last 5 years, with the option to renew if participant has reached contract goals and agrees to implement additional conservation objectives. CSP contracts have a $1,500 minimum annual payment. To be eligible, one must have current farm records with USDA Farm Service Agency and must be in compliance with highly erodible land and wetland conservation requirements. https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/financial/csp/?cid=nrcseprd1288620

Regional Conservation Partnership Program (RCPP): Through RCPP, NRCS provides funding to landowners and agricultural producers via RCPP contracts and RCPP easements. Funding projects are allocated for effective, innovative solutions to natural resource challenges. https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/rcpp/

***Emergency Watershed Protection - Recovery (EWPP-Recovery)*:** This program provides financial assistance to communities responding to emergencies created by natural disasters. These emergencies can be imminent hazard to life or property from floods, fires, windstorms, or other natural disasters. Public and private landowners are eligible for assistance, but a project sponsor must represent them. Project sponsors must be a legal subdivision of the state, such as a city, county, township or conservation district, and American Indian tribes or tribal governments. NRCS may pay up to 75% of the construction cost of emergency measures. Local sources, in the form of cash or in-kind services, must provide the remaining 25% of funding. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/landscape/ewpp/?cid=nrcseprd1381472

Emergency Watershed Protection - Floodplain Easement (EWPP-FPE): EWPP-FPE provides floodplain easements to land that has been damaged or inundated by flooding.
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/landscape/ewpp/?cid=nrcs143_008216

Agricultural Conservation Easement Programs (ACEP) ACEP protects wetlands and agricultural lands from being developed and converted to alternative uses via agricultural land easements and wetland reserve easements. Agricultural Land Easements protect the nation's long-term food supply by protecting productive agricultural land from conversion to non-agricultural uses. NRCS may fund up to 50% of the fair market value of the agricultural land easement. If NCRS determines that grasslands with environmental significance are protected, then additional funding may be provided. Through Wetland Reserve Easements, NRCS offers technical and financial assistance to private landowners who protect, restore, and improve wetlands with the procurement of a wetland reserve easement.
https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/acep/

Program funded through United States Department of Agriculture (USDA) Farm Service Agency

Conservation Reserve Program (CRP): Through the USDA Farm Service Agency, the Conservation Reserve Program provides a yearly rental payment to farmers who remove environmentally sensitive land from agricultural production and convert it to native plantings in order to improve water quality, reduce soil erosion, and increase wildlife habitat. Generally, USDA Farm Service Agency opens the signup period from June to August. All applicants must have owned their land for at least 12 months before submitting applications. Through this program, the farmer is offered annual rental payments based on acreage and cost-share assistance up to 50% of the cost of implementing the conservation practice.
https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/index
https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/crp-continuous-enrollment/index

Programs funded through the Illinois Department of Agriculture, Partners for Conservation Program

https://www2.illinois.gov/sites/agr/Resources/Conservation/Pages/default.aspx
Sustainable Agriculture Grants Program provides funding to organizations, educational institutions, nonprofits, governmental agencies, and individuals who demonstrate comprehension of sustainable agriculture systems and implement conservation practice projects. Illinois' soil and water conservation districts prioritize and select projects that will receive cost-share funding. To be eligible, the land for which the conservation practice is to be applied must have erosion rates greater than one and one-half times the tolerable soil loss level.
Streambank Stabilization and Restoration Program (SSRP) provides cost-share assistance or demonstration project funding to landowners who implement streambank stabilization projects that demonstrate effective and inexpensive solutions to soil and stream bank erosion. Funding partners for this program are the Illinois Department of Agriculture, Illinois' Soil and Water Conservation Districts

(SWCDs), and Natural Resources Conservation Service (NRCS) of the USDA. Recipients must maintain the selected bank stabilization practices for at least 10 years.

Soil and Water Conservation District Grants Program, administered by the Illinois Department of Agriculture, offers assistance to Illinois' Soil and Water Conservation Districts (SWCDs). In turn the SWCDs provide technical assistance to landowners in natural resource management. All Illinois districts are eligible and encouraged to contact the Illinois Department of Agriculture for information about receiving grants.
https://www2.illinois.gov/sites/agr/Resources/Conservation/Pages/default.aspx
http://www.iira.org/rdrg/partners-for-conservation-streambank-stabilization-and-restoration-program-ssrp/

Programs funded through the Winnebago County Soil and Water Conservation District

The Winnebago County Soil and Water Conservation District provides technical and financial assistance primarily to agricultural producers. However, the District provides cost-share to all Winnebago County residents for some urban practices like rain gardens, pollinator plantings, and well sealings. Other public bodies, e.g. the Park District, could be eligible for these same funds, if there are funds available after all private projects are funded. The District also has potential funding for streambank stabilization projects. Currently, these streambank stabilization funds have a maximum cost-share of $30/foot (SWCD 2020).

Partners for Conservation Fund Program offers cost-share opportunities for Winnebago County residents, organization, and businesses to complete conservation projects on their property. The District covers 75% of the cost to install the certain practice components; although, funding is dependent on the Annual Appropriations from the State of Illinois. Popular cost-share projects include grassed waterways, cover crops, pollinator plantings, well sealing, and rain gardens. Applications are due by April 10th. Applications are found online at http://winnebagoswcd.org/swcd/ or at their office located at 4833 Owen Center Rd. Rockford, IL 61101.

Pollinator Habitat Planting Program provides cost-share opportunities and tips for pollinator habitat plantings. Average costs for these plantings vary depending on if the entire area needs to be converted to a natural area or if the project involves interseeding an existing prairie with a Monarch species seed mix to encourage pollinator habitat. http://winnebagoswcd.org/swcd/?attachment_id=2192

Rain Garden Program offers cost-share for rain garden projects in Winnebago County. On average, the SWCD covers about $7 per square foot of the rain garden. Technical assistance is also available in the planning process of the rain garden. Individual county residents, groups, or corporations are eligible to apply. Contact the office at 815-965-2392 x3 for more information.

Saving Tomorrow's Agricultural Resources (S.T.A.R.) is a state-wide program developed by the Champaign County SWCD, but locally offered through the Winnebago County SWCD. This free tool assists in assessing nutrient and soil loss management practices and encourages producers to use management practices that reduce nutrient and soil losses on their fields. In turn, producers are recognized for their level of commitment to conservation. https://starfreetool.com/about
http://winnebagoswcd.org/swcd/?page_id=2241

Programs funded through the Illinois Farm Bureau and administered by and through the Winnebago-Boone Farm Bureau

The Illinois Farm Bureau (IFB) has grant opportunities for county Farm Bureaus to apply for nutrient stewardship funds each year for local projects. The grant application traditionally comes out during August-September and is usually due the end of October. The Illinois Farm Bureau has also assisted with EPA Section 319 watershed plan funding and funding to update plans.

Illinois Farm Bureau and the Winnebago-Boone Farm Bureau work hard to share the message of the Nutrient Loss Reduction Strategy to agricultural producers, landowners, and agricultural partners. The IFB funds three important initiatives to help Illinois agricultural producers implement the NLRS, study new best management practices, and work towards stewardship:

Nutrient Stewardship Grant Program supports the County Farm Bureaus and helps members demonstrate and study a variety of best management practices for reducing nutrient losses. Winnebago-Boone Farm Bureaus can strengthen local partnerships and provide additional funding with partner in-kind and financial support. This program may also fund farmer/landowner meetings within each county to determine stakeholder interest.

4R4U Program is a partnership between IFB, county Farm Bureaus, Farm Service agricultural suppliers, and GROWMARK that highlights and evaluates on-farm nutrient management practices, such as the 4Rs (Right source, Right rate, Right time, Right place) and cover crops. The program goal is to optimize crop yield while also reducing environmental impact.

Edge-of-Field Partnership Program with the Illinois Land Improvement Contractors of America evaluates woodchip bioreactors and other edge-of-field practices by considering the engineering, construction, data-collection, and research with the agricultural producers. The partnership also includes the USDA Natural Resources Conservation Service and the University of Illinois Extension. Through this program, the partners have committed to installing one edge-of-field practice each year for four more years and studying those sites through university researchers (Illinois Farm Bureau, 2020).
http://www.ilfb.org/take-action/current-priorities/protecting-our-environment/
https://www.winnebagoboonefarmbureau.org/home.html

Technical Assistance provided by the University of Illinois- Extension

University of Illinois Extension endeavors to enable people to improve their lives and communities through learning partnerships that put knowledge to work. The University of Illinois Extension provides technical resources and holds educational seminars for Jo Davies, Stephenson, and Winnebago counties. They also provide soil testing resources. https://extension.illinois.edu/jsw https://extension.illinois.edu/soiltest/

Programs funded through American Farmland Trust

American Farmland Trust (AFT) provides technical assistance by detailing and promoting sound agricultural practices and other technical expertise, hosting regional events and national conferences, and conducting research. https://farmland.org/

AFT Farm Legacy Initiative works to ensure that land remains as farmland or ranchland as it transitions to the next generation. An agricultural producer or rancher worried that their land will be developed can donate their farmland or ranchland to AFT. In return the producer or rancher will not have to pay large federal and state capital gains taxes, may receive an income tax deduction depending on their tax bracket, and the assurance that their land will be stewarded wisely. Their Midwest regional office is located in Sycamore, Illinois. https://farmland.org/project/farm-legacy/

Financial and Technical Assistance for Governments, Non-Profits, Businesses, Residents and/or Producers

Program funded through Illinois Environmental Protection Agency (Illinois EPA)

Section 319 Program: Through the Clean Water Act, the United States EPA provides Section 319 grants to state environmental protection agencies in order to attain and preserve the beneficial use of water. Section 319 provides watershed project funding for planning grants and implementation grants. States are required to use at least 50% of the annual appropriation of Section 319 funds to implement watershed projects that focus on restoring impaired waters and are guided by watershed-based plans. The federal contribution may not exceed 60% of the entire implementation cost. The grantee must provide 40% of the remaining cost through cash or in-kind services, e.g. volunteer time. Administrative costs may not exceed 10% of the funding. Cost-sharing is available, but only for costs related to implementing demonstration projects. Demonstration projects are used to show the effectiveness of an approach as it applies to solving a water-quality issue in a specific area and its unique hydrogeological and sociological features. States can allow these grant funds to be made available via subgrants to both public and private entities. Subgrants to individuals are limited to demonstration projects.
https://www.epa.gov/nps/319-grant-current-guidance
https://www.epa.gov/nps/funding-resources-watershed-protection-and-restoration

Green Infrastructure Grant Opportunities (GIGO): This new program offered by the Illinois EPA funds projects that construct green infrastructure best management practices that prevent, eliminate, or reduce water quality impairments by decreasing stormwater runoff into Illinois' streams and lakes. Projects that implement multiple BMPs in the same watershed may prove to be more efficient. Applications due on August 21, 2020. The maximum total grant award is $2,500,000 with a minimum of $75,000. Funds are available to any Grant Accountability and Transparency Act (GATA) Pre-Qualified entity that has legal status to accept funds from the State of Illinois, including watershed planning groups, land trusts, public and private profit and nonprofit organizations, units of government, park districts, and soil and water conservations districts. GIGO may provide up to 75% of the approved project cost, while the grantee must match at least 25% via money spent or in-kind services.
https://www2.illinois.gov/epa/topics/grants-loans/water-financial-assistance/Pages/gigo.aspx

Wastewater and Drinking Water Loan Programs provide low-interest loans to eligible public or private applicants through the State Revolving Fund (SRF). The SRF has two loan programs: the Water Pollution Control Loan Program (WPCLP), which funds wastewater and stormwater projects, and the Public Water Supply Loan Program (PWSLP), which funds drinking water projects. These programs provide funding for the design and construction of projects that protect or improve water quality and address human health and failing water infrastructure. https://www2.illinois.gov/epa/topics/grants-loans/state-revolving-fund/Pages/default.aspx

Farmer to Farmer funding opportunity is offered through the EPA's Gulf of Mexico Division. This program funds projects that improve water quality, habitat, resilience, and environmental education in the Gulf of Mexico watershed. This funding is available to develop innovative practices within farming communities, measure the results of those practices, and identify how the practices will be incorporated into farming operations. Examples of fundable project activities include surveys, studies, research, investigation, experimentation, education, training, and/or demonstrations. EPA anticipates awarding seven to twelve assistance agreements with awards ranging from $250,000 to $1,000,000 with a typical project period of three years. https://www.epa.gov/sites/production/files/2020-08/documents/epa_gmd_2020_farmer_final_rfa_0.pdf

Programs funded through Illinois Department of Natural Resources (IDNR)

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Open Space Lands Acquisition & Development (OSLAD) and Land & Water Conservation Programs (LWCF) allow local units of government to apply for funding when acquiring or developing land for open space or public parks. Applications must be submitted between May 1 and July 1. Types of projects funded through this program include the creation of water quality basins with native plantings and the preservation or improvement of permanent wetlands. The OSLAD program focuses on assistance with recreation amenities (playgrounds, ballfields, etc.), but wetland and natural area can be included in the overall cost. This grant program awards up to $750,000 for acquisition projects or up to $400,000 for development/renovation projects. Under both OSLAD and LWCF, funding is available for up to 50% of total approved projects costs. https://www.dnr.illinois.gov/AEG/Pages/OpenSpaceLandsAquisitionDevelopment-Grant.aspx

Park and Recreational Facility Construction Act (PARC) provides grants to eligible local governments for park and recreation unit construction projects and land acquisition. This grant has a 2-year grant period and amounts awarded can range from $25,000 to $2,500,000. The grant covers 75% of capital project cost for most applicants, and 90% of capital project cost for Disadvantaged Communities. Eligible land acquisition projects for recreation and conservation may include frontage on public surface waters for recreation use and open space acquisition to protect floodplains, wetlands, natural areas, wildlife habitat, and unique geological and biological features, and additions to such areas. https://www2.illinois.gov/dnr/grants/Pages/PARC-Grant.aspx

Conservation Stewardship Program (CSP) encourages landowners to manage their land in a way that protects Illinois' limited environmental resources. Landowners with at least five acres of unimproved land can commit to developing and implementing a habitat management plan for their property. If they do this, they can apply to CSP in exchange for a reduced valuation of property taxes. This program could be used for landowners interested in converting land into natural areas with native plantings and managing it properly. This program could also be used for those interested in restoring a woodland overgrown with invasive plant species. The NRCS has a financial assistance program called Conservation

Stewardship Program (described above on page 6-2); however, aside from having the same name these two programs are different. https://www2.illinois.gov/dnr/conservation/CSP/Pages/default.aspx

Urban and Community Forestry Program assists municipalities and local units of government in developing, maintaining, and sustaining local community forestry programs. Local citizens benefit from maintained, high-quality, and diverse forests. Some benefits of managing diverse forests include shade, protection from winter winds/summer heat, energy cost reduction, air quality improvement, noise pollution protection, carbon dioxide reduction, reduction of stormwater infiltration rate, and property value increase (IDNR). According to the Illinois Department of Natural Resources, for every local dollar spent on trees, taxpayers receive $4.00 in public benefits.
https://www2.illinois.gov/dnr/conservation/Forestry/UrbanForestry/Pages/default.aspx
For a more comprehensive list of programs please visit
https://www2.illinois.gov/dnr/grants/Documents/IDNRGrantOpportunitiesListing.pdf

Program funded through U.S. Fish & Wildlife Service (FWS)

https://www.fws.gov/grants/programs.html
Partners for Fish and Wildlife provides technical and financial assistance to private landowners who voluntarily implement habitat restoration and improvement programs. Typically, Partners will provide assistance for projects that conserve and restore native vegetation, hydrology, and soils.
https://www.fws.gov/partners/

Program funded through Illinois Department of Commerce and Economic Opportunity (DCEO)

Rebuild Illinois Public Infrastructure (RIPI) Grant Program funds public infrastructure improvements that can provide an improved foundation for economic growth in Illinois communities. A wide range of public infrastructure projects qualify for this funding: flood and drainage, dredging of waterways, water and sewer line extensions, and other public infrastructure capital improvements. Local governments only are eligible to apply for projects on government-owned land. Applications are due June 30, 2020. Grant applications are evaluated in order of importance by project impact, community need, project readiness, job creation, and community support.
https://www2.illinois.gov/dceo/AboutDCEO/GrantOpportunities/23731362/NOFO%20Supplement-Rebuild%20Illinois%20Public%20Infrastructure.pdf

Program funded through the Illinois General Assembly

Build Illinois Bond Act is an Illinois State Bond designated for planning, engineering, acquisition, construction, reconstruction, development, improvement, and extension of the public infrastructure in the State of Illinois. Through this bond, the State of Illinois may issue, sell, or provide bonds to units of government for the planning, engineering, acquisition, construction, reconstruction, and improvement of watersheds, drainage, flood control, recreation and related improvements and facilities, including expenses related to land and easement acquisition, relocation, control structures, channel work and clearing and appurtenant work. The Build Illinois Bond Act may also cover the making of Park and Recreational Facilities Construction (PARC) grants and the creation of loans or grants to local governments for waste disposal systems, water and sewer line extensions, and water distribution and purification facilities. https://www.ilga.gov/legislation/ilcs/ilcs3.asp?ActID=529&ChapterID=7

Program funded through Trees Forever, Sygenta, Operation Pollinator, and FS Growmark

Illinois Buffer Partnership is a water quality program funded by Trees Forever, Syngenta, Operation Pollinator, and Growmark. These funding partners desire to highlight the voluntary efforts of farmers and rural landowners in planting, maintaining, and enhancing conservation practices and buffers. The mission of this Partnership is to showcase the actions taking place to restore Illinois flood plains and to raise awareness of potential for streamside buffers to enhance water quality and pollinator habitat. Cost-share funding is available for various water quality projects including, but not limited to, streamside buffers, wildlife/pollinator habitat, wetland or pond project, rain garden/bioswale, field windbreak, livestock confinement buffer planting, organic crop buffer, nut or fruit production, and agroforestry projects. After all federal, state, and local funding has been applied, recipients will be reimbursed for 50% of their remaining expenses, up to $2,000. Applications are available in August and must be submitted by December 31st. Recipients agree to allow their projects to serve as demonstration sites for education. Projects are expected to be completed within the same year that the funding is awarded. If extensions are needed, then they must be requested in writing and will be approved on a case-by-case basis. http://www.treesforever.org/Illinois_Buffer_Partnership

Programs funded through Illinois Clean Energy Community Foundation

Illinois Clean Energy Community Foundation has seven categories within their Natural Areas Program for funding. Five of the seven categories could potentially be applicable to watershed planning and the broader mission of conservation:

Capacity Building is for projects that focus on increasing the organizational capacity of conservation groups active in protecting natural areas and wildlife habitat. This program is primarily for 501(c)(3) nonprofit organizations. Funding rarely covers the entire costs of the project. Applicants may apply for up to $40,000 for a two-year grant project.

Community Stewardship Challenge Grant is geared toward increasing community participation in the protection and care of natural areas that are managed by nonprofit organizations. This program can provide funding via 1) a cash donation match ($3 provided: $1 raised, not exceeding donation of $21,000), 2) volunteer labor ($4,000 awarded for stewardship activities upon verification of 400 stewardship volunteer hours logged), or 3) equipment purchase (reimburse up to 80% or $5,000 for capital cost of stewardship equipment). This program is for 501(c)(3) nonprofit organizations that have active volunteer participation in the stewardship of publicly accessible natural areas that are owned by a non-profit, local government, or government agency. Grants awarded up to $32,000 for natural area sites owned by a nonprofit and $27,000 for sites owned by the government.

Land Acquisition aids non-profits that purchase land outright with the purpose of protecting and enhancing wildlife habitat. Eligible applicants include nonprofit organizations and local government agencies that serve Illinois residents. Priority is given to projects that purchase natural habitat, as opposed to open space or parks, utilize all the funds for the direct purchase of the natural habitat, and meet specified transactional requirements for payment. The program funds up to 80% of the direct cost in purchasing the land and up to $10,000 for restoration completed within the first year of purchase.

Planning for Land Acquisition provides some financial assistance to nonprofit conservation groups who are planning the management and protection of natural areas. Grants under this program are awarded to individual organizations, but project action can include the participation of multiple organizations, including public and private. Majority of applicants are nonprofit organizations; however, if a local government agency, college, or university desires to seek grant funding through this program, they may contact the Foundation before application submission.

Pollinator Meadows Pilot Program focuses on assisting local governments and non-profits change turf grass areas into pollinator habitat. There is a minimum requirement of two acres. Applicant must be able to fund at least 50% of the installation cost and agree to maintain the pollinator habitat for five years according to specified criteria.

Program funded through ComEd & Openlands

ComEd Green Region Program: Openlands partners with ComEd to administer the ComEd Green Region Program. Through this program ComEd supports municipalities, townships, counties, park districts, conservation districts and forest preserve districts in northern Illinois and within ComEd's service territory with efforts to protect or improve public spaces for the benefit of all. Non-profit organizations and all other units of government not listed above (such as schools, school districts, and housing authorities) are not eligible to apply but are strongly encouraged to partner on joint projects with an Eligible Applicant. This watershed is located within the ComEd's service territory. The application deadline is usually mid-March each year. In order to apply, one must create an account and start an application through https://openlands.submittable.com/submit. Funding of up to $10,000 finance open space projects that emphasis the planning, acquisition, and improvement of natural areas, recreation resources, and local parks. Green Region grant recipients may pool funds from other grant/funding sources that are associated with their open space projects. https://www.openlands.org/livability/greenregion/

Program funded through The Funders' Network & Urban Sustainability Directors Network

Partners for Places: Through Partners for Places, the Funders' Network (TFN) and Urban Sustainability Directors Network (USDN) invests in local projects that build partnerships and promote a healthy environment, robust economy, and the well-being of local residents. They offer Mini Grants and General

Grants to help local governments, local foundations, and frontline community-led group(s) build relationships, align around project ideas. Mini Grants range from $7,00-$10,000. General Grants range from $25,000-$75,000 (for one-year projects) or $50,000-$100,000 (for two-year projects). A 1:1 match is required by one or more local foundations. Cities and counties in the United States and Canada are eligible for funding. Eligible applicants for the Mini Grant must be a partnership between three entities: 1) a community-led group (i.e. non-profit), 2) a local government sustainability director or water manager for green stormwater infrastructure projects, and 3) a local, place-based foundation. Eligible applicants for the General Grant must be a partnership between two entities: 1) a local government sustainability director or local government water manager (for green stormwater infrastructure projects) and 2) a local or regional place-based foundation. Eligible grant recipients can be a local, place-based community foundation, a public charity, or a partnering nonprofit. https://www.fundersnetwork.org/partners-for-places/

Financial and Technical Assistance for Non-Profits & Community Organizations

Smith Charitable Foundation funds projects in Rockford, IL, or the surrounding community. Applicants must be a 501(c)3 certified organization or a registered charitable organization serving people in Rockford or a nearby community, with a project addressing either the environment, education, or arts & culture. Applicants can submit an initial application at any time, but final full applications are due September 15th. https://smithcharitable.org/

Community Foundation of Northern Illinois, Neighborhood Grants encourage and support neighborhood -based groups working to improve the quality of life in their communities. Applicants must be a 501(c)3 tax-exempt not-for-profit organization or a neighborhood group with at least 3 active leaders, the capacity to manage grants, an implementation plan to benefit the residents in the defined geographic region, and a project that can be completed within one year. The geographical location for this funding is a neighborhood-based organization in Boone, Ogle, Stephenson or Winnebago County. Examples projects for this grant include resident-focused seminars, community gardens, organizing and newsletter, reforestation projects, neighborhood clean-ups, neighborhood activities and surveys, and beautification projects.
https://www.cfnil.org/sites/default/files/2020-02/Neighborhood_Grant_Guidelines_2020.pdf

Grand Victoria Foundation–Vital Lands funds land acquisition projects that pursue permanent protection and long-term stewardship of Illinois' vital lands. While criteria for proposed projects is flexible, the minimum standards are set high. Eligible applicants must be well-managed, fiscally healthy 501(c)(3) public charities or certified public institutions registered in Illinois and in good standing. 501(c)(3) organizations seeking land acquisition funding must have conservation programs in Illinois and have adopted the Land Trust Alliance's Standards and Practices. Grand Victoria Foundation will only provide up to 30% of total dedicated funds calculated for long-term stewardship. In the application process, organizations will be asked to describe and document how they responsibly invest, manage, and use financial assets and build and maintain dedicated funds for stewardship and defense. Applications may be submitted at any time, as grants are awarded on a rolling basis. https://grandvictoriafdn.org/

Patagonia Corporate Grants Program donates funds to non-profit, community-based groups working towards a positive change for the planet in their own backyards and have a demonstrated strong support base. Eligible community-based groups/projects must fit the following criteria: be a non-profit organization; focus on the root cause of the problem; have distinct action competent with measurable goals and objectives; and NOT be solely for environmental education, involve land acquisitions, land trusts, or conservation easements, be primarily research based, for an endowment fund, for a political candidate campaign, for a green building project, nor for a conference. They provide grants ranging between $5000- $20,000 for projects like taking down dams, restoring forest and rivers, protecting critical land and marine habitat, and supporting local, organic, and sustainable agriculture. One proposal is accepted per group per fiscal year (May 1-April 30). There are two annual deadlines: April 30 (receive response by August 30) or August 31 (receive response by end of January). To find out if your group is eligible go to https://www.patagonia.com/how-we-fund/corporate-grant/

Illinois American Water Environmental Grant Program offers funding to local community-based organizations for projects that either protect or improve the community's public drinking water supply OR improve, restore, or protect one or more watersheds. Some example projects include watershed cleanup, reforestation, habitat restoration, streamside buffer restoration, and surface water education. Applications deadlines are March 31. Applications are evaluated and receive feedback by April 30.

To qualify for Environmental Grant funding, a proposed project must be:

- Located within an American Water service area
- Completed between May and November of the grant funding year
- A new, innovative community initiative or a significant expansion to an existing program
- Carried out by a partnership between two or more organizations
- Economically sustainable after grant funding year

https://amwater.com/ilaw/news-community/environmental-grant-program

The Coca-Cola Foundation, a registered 501(c)(3) charitable organization, is Coca-Cola's primary international philanthropic arm. The Foundation awards grants throughout the year based on three priority areas, tax requirements, legal compliance and approval by the Foundation's Board of Directors. The three priority areas for funding include the following:

- Empowering women: economic empowerment and entrepreneurship
- Protecting the environment: access to clean water, water conservation and recycling

- Enhancing communities: education, youth development and other community and civic initiatives

https://www.coca-colacompany.com/shared-future/communities/the-coca-cola-foundation

Waste Management Charitable Giving (WM) strives to give back to the community to ensure it is a cleaner and better place to live. Eligible recipients are 501(c)(3) organization or public organizations where any donations requested will be used exclusively for public purposes. WM gives preference to organizations that have a broad variety of funders, community partners, and volunteers.

Waste Management is most motivated to support:

- organizations and programs that preserve and/or enhance natural resources.
- environmental education programs targeted at middle and high school students, i.e. environmental and science related projects, science fairs, Earth Day projects, etc.
- charities located in the immediate community that they serve.

https://www.wm.com/about/community/charitable-giving.jsp

Technical Assistance for All Parties from Non-profit Organizations

Illinois Rural Community Assistance Program (RCAP) helps small communities throughout Illinois with utility, financials, asset management, wastewater projects, and other projects. The non-profit offers services nationally, including training and technical assistance to address wastewater treatment and disposal issues in small, rural, and tribal communities. Illinois RCAP is part of Great Lakes RCAP, administered by the Great Lakes Community Partnership. The state of Illinois has Illinois RCAP services, including decentralized wastewater treatment and grant writing.

https://www.glcap.org/programs/community-rural-development/rural-community-assistance-program-rcap/rcap-services-in-illinois/

Natural Land Institute (NLI), a 501(c)(3) nonprofit organization, works in the Mississippi River Bluffs and the Rock River Watershed. NLI advocates for land preservation, land use planning, and direct action to preserve areas by acquisition, either on its own or in conjunction with other organizations and agencies. Specific assistance to landowners includes support with native planting, invasive species removal, and advice on improved mowing practices. naturalland.org

AmeriCorps is a voluntary civil society program that aims to help others by addressing critical needs of the community. In the past AmeriCorps groups have helped remove invasive plants in 9 acres next to hatcheries and helped in a savanna restoration project. https://www.nationalservice.gov/programs/americorps

Pheasants Forever is a 501(c)(3) nonprofit organization that is dedicated to the conservation of pheasants, quail and other wildlife through habitat improvements, public awareness, education, and land management policies and programs. Over 91% of their dollars are spent on habitat projects, public awareness, and education. pheasantsforever.org https://pheasantsforever.org/Habitat/Why-Habitat.aspx

National Wildlife Turkey Federation is a nonprofit organization dedicated to the conservation of the wild turkey and the preservation of our hunting heritage. nwtf.org

Trout Unlimited, a 501(c)(3) nonprofit organization, endeavors to conserve, protect and restore North America's cold-water fisheries and their watersheds. tu.org

Ducks Unlimited, a 501(c)(3) nonprofit organization, conserves, restores, and manages wetlands and associated habitats for North America's waterfowl. Ducks Unlimited and along with numerous partners invested $1.1 million across 14 Illinois project sites by enhancing or restoring 3,204 acres of wetland and grassland habitat in 2019. The benefit of these project is not only for enhancing waterfowl habitat but also for improving water quality. ducks.org

Northwest Illinois Stewardship Co-op (NISC) Invasive Species Strike Team works to eradicate invasive species in conservation areas located in Jo Daviess, Carroll, Ogle, Stephenson, and Winnebago counties. The NISC consists of nine organizations, including the Jo Daviess Conservation Foundation. To learn more, please contact the Jo Daviess Conservation Foundation at info@jdcf.org.

Flood Mitigation Resource

This plan does not provide recommendations for practices solely geared towards flood mitigation. Moreover, Illinois EPA Section 319, which partially funds the creation of this plan, does not fund projects for the purpose of flood mitigation. This plan is intended to improve water quality. However, some practices that improves water quality could have confounding benefits of flood mitigation or flood storage. For stakeholders interested in learning more about funding specific to flood mitigation please visit FEMA's website at www.fema.gov

The Federal Emergency Management Agency (FEMA) has several grant programs for acquisition, retrofitting, and small drainage improvement projects for flood-prone areas. Three state-managed FEMA programs can fund acquisition of floodplain properties: ***Hazard Mitigation Grant Program***, ***Flood Mitigation Assistance***, and the ***Pre-Disaster Mitigation Program***. Contact your local FEMA administrator for current grant requirements. For more information, contact the FEMA Regional Office. FEMA Region V serves Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin.

Conclusion

Table 6.1 summarizes these financial and technical resources and can be found on the following page. For more information about these and other state and non-governmental organization programs that support the nutrient loss reduction strategy, please view the 2019 Illinois NLRS Biennial Report, particularly pages 70-92: https://www2.illinois.gov/epa/topics/water-quality/watershed-management/excess-nutrients/Documents/NLRS-Biennial-Report-2019-Final.pdf

The following chapter details potential monitoring efforts to track the implementation and progress of this plan.

Table 6.1 Financial & Technical Resources Summary

	Agency	Abbr.	Funding/Technical Support	Provides Support for Who?	Organization Mission or Program Goal	Website
Financial/Technical Support for Agricultural Producers	Winnebago County Natural Resources Conservation Service	NRCS	Technical, Funding	Agricultural Producers	Reducing runoff of pollution from agricultural areas into streams and lakes.	No direct website. Go to: http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/water/
	U.S. Department of Agriculture, Farm Service Agency	USDA	Funding	Agricultural Producers	Provides yearly rental payment to farmers who convert environmentally sensitive land from agricultural production to native plantings.	https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/crp-continuous-enrollment/index
	Illinois Department of Agriculture, Partners for Conservation	IDOA	Funding	Agricultural Producers	Provides funding, cost-share assistance and technical assistance for natural resource management projects.	https://www2.illinois.gov/sites/agr/Resources/Conservation/Pages/default.aspx
	Winnebago County Soil and Water Conservation District	SWCD	Technical, Funding	Agricultural Producers, Residents, Businesess, Organizations	Provides conservation cost-share opportunities for Winnebago County residents, organizations, and businesses.	http://winnebagoswcd.org/swcd/
	Illinois Farm Bureau	IFB	Technical, provides funding to county farm bureaus	Agricultural Producers	"Works to improve the econonmic well-being of agrciluture and enrich the quality of farm family life."	http://www.ilfb.org/
	Winnebago-Boone Farm Bureau		Technical, Funding	Agricultural Producers	"Be the voice, resource, and advocate for farm families and agriculture, while promoting stewardhsip for today and future generations."	https://www.winnebagoboonefarmbureau.org/
	University of Illinois Extension Soil Testing	UofI - Extension	Technical	Agricultural Producers	Offers soil testing assistance, agricultural research, and local seminars.	https://extension.illinois.edu/soiltest/ https://extension.illinois.edu/jsw
	American Farmland Trust	AFT	Technical, Funding	Agricultural Producers	"Working to save the land that sustains us by protecting farmland, promoting sound farming practices, and keeping farmers on the land."	https://farmland.org/
Financial/Technical Support for Government, Business, Non-profit, Resident, and/or Agricultural Producer	Illinois Environmental Protection Agency, Bureau of Water	Illinois EPA	Funding	Governmental Units, Businesess, Organizations, Agricultural Producers, Residents	"Ensure that Illinois' rivers, streams, and lakes will support all uses for which they are designated including protection of aquatic life, recreation, and drinking water supplies."	https://www2.illinois.gov/epa/topics/water-quality/Pages/default.aspx
	Illinois Department of Natural Resources	IDNR	Funding	Governmental Units, Businesses, Organizations	Recreation facilities and trails, wildlife habitat, water quality, open space protection, etc.	http://www.dnr.illinois.gov/Pages/default.aspx
	U.S. Fish and Wildlife Service	USFWS	Funding	Residents, Governmental Units, Organizations	Protects waterfowl and migratory birds and their habitat.	http://www.fws.gov/grants/
	Illinois Department of Commerce & Economic Opportunity	IDCEO	Funding	Governmental Units	Funds public infrastructure improvements that can provide an improved foundation for economic growth in Illinois communities, including flood and drainage projects.	https://www2.illinois.gov/dceo/CommunityServices/CommunityInfrastructure/Pages/RebuildIllinois_Programs.aspx
	Illinois General Assembly		Funding	Governmental Units	Provides bonds to units of government for improving public infrastructure, including watershed, drainage, flood control, and recreational improvements.	https://www.ilga.gov/legislation/ilcs/ilcs3.asp?ActID=529&ChapterID=7
	Trees Forever: Illinois Buffer Partnership		Funding	Agricultural Producers, Residents	Funds voluntary efforts of farmers and rural landowners in planting, maintaining, and enhancing conservation practices and buffers.	http://www.treesforever.org/Illinois_Buffer_Partnership
	Illinois Clean Energy Community Foundation, Natural Areas Program		Funding	Non-profit Organizations, Governmental Units	Offers funding for conservation group organization capacity, community stewardship engagement, land acquisition, and planning for land acquisition.	https://www.illinoiscleanenergy.org/natural-areas-program
	ComEd & Openlands		Funding	Governmental Units	Provides funding to protect or improve public space.	https://www.openlands.org/livability/greenregion/
	Funder's Network & Urban Sustainability Directors Network	TFN & USDN	Funding	Community Group, Government, and Place-based Foundation	"Inspire & strengthen funding and philanthropic leadership that yield environmentally sustainable, socially equitable, and economically prosperous regions and communities."	https://www.fundersnetwork.org/partners-for-places/
	Federal Emergency Management Agency	FEMA	Technical, Funding	Governmental Units, Residents, Agricultural Producers	"Helping people before, during, and after disasters."	https://www.fema.gov/
Financial Support for Non-profits & Community Organizations	Smith Charitable Foundation		Funding	Non-profit Organizations	Funds evironmental projects in Rockford or a nearby community.	https://smithcharitable.org/
	Community Foundation of Northern Illinois		Funding	Not-profit Organizations, Neighborhood groups	Funds projects that improve the quality of life for communiteis in Boone, Ogle, Stephenson, or Winnebago County.	https://www.cfnil.org/
	Grand Victoria Foundation, Vital Funds		Funding	Non-profit Organizations	Provides land acquisition funds to assist projects that pursue permanent protection and long-term stewardship of Illinois' vital lands.	https://grandvictoriafdn.org/what-we-fund/environment/
	Patagonia Corporate Grants Program		Funding	Non-profit Organizations	Donates funds to non-profit, community-based groups working towards a positive change for the planet.	https://www.patagonia.com/grant-guidelines.html
	Illinois American Water	IAW	Funding	Community Organizations	Offers funding to community-based organizations for projects that improve, restore, or protect the community's public drinking water supply or one or more watersheds.	https://amwater.com/ilaw/news-community/environmental-grant-program
	The Coca-Cola Foundation		Funding	Non-profits, Community Organizations	Provides funding for environmental/water conservation projects.	https://www.coca-colacompany.com/shared-future/communities/the-coca-cola-foundation
	Waste Management	WM	Funding	Non-profits, Community Organizations, Charities	Provides funding for natural resource conservation and environmental education.	https://www.wm.com/about/community/charitable-giving.jsp

Table 6.1 Financial & Technical Resources Summary

	Agency	Abbr.	Funding/Technical Support	Provides Support for Who?	Organization Mission or Program Goal	Website
Technical Support for All	Illinois Rural Community Assistance Program	IL RCAP	Technical	Small, rural communities in Illinois	Helps small communities throughout Illinois with utility, financials, asset management, wastewater projects, grant writing, and other projects.	https://www.glcap.org/programs/community-rural-development/rural-community-assistance-program-rcap/rcap-services-in-illinois/
	Natural Land Institute	NLI	Technical	Agricultural Producers, Residents	Assists landowners and groups with native planting, invasive species removal, and advice on improved mowing practices.	naturalland.org
	AmeriCorps		Technical	All	Restore natural areas by treating a removing invasive plant species.	https://www.nationalservice.gov/programs/americorps
	Pheasants Forever		Technical	All	Conserves pheasants, quail and other wildlife through habitat improvements, public awareness, and land management policies and programs.	pheasantsforever.org
	National Wildlife Turkey Federation	NWTF	Technical	All	Conserves wild turkey and preserves our hunting heritage.	nwtf.org
	Trout Unlimited	TU	Technical	All	Conserves, protects, and restores North America's coldwater fisheries and their watersheds.	tu.org
	Ducks Unlimited	Ducks	Technical	All	Conserves, restores, and manages wetlands and associated habitats for North America's waterfowl.	ducks.org
	Northwest Illinois Stewardship Co-op Invasive Species Strike Team	NISC	Technical	Conservation groups and areas	Eradicates invasive species in conservation areas of Jo Daviess, Carroll, Ogle, Stephenson, and Winnebago counties.	http://jdcf.org/

Section 2, Chapter 7
Monitoring and Evaluation Strategy

Introduction
To track watershed improvements and effectiveness of the plan, it is important to develop a simple, realistic system for monitoring and evaluation. This chapter outlines the monitoring focuses, criteria to measure success, and schedule with responsible parties. It presents the selected strategies that will monitor and evaluate the effects of adopting and implementing the plan, which prioritize the promotion of watershed goals and progress of plan implementation. The Region 1 Planning Council (RPC) has agreed to take on the following watershed planning efforts as their focus project for the next year or two, with input from their Environmental Planning Committee (EPC) that meets bi-monthly. The RPC may coordinate with or delegate to stakeholders and other interested organizations in tracking, evaluating, and enacting these monitoring actions.

Monitoring Focus
Monitoring efforts will focus on bacteria, nutrient, and sediment levels in the watershed's surface water. This will be tracked with observations, water sampling for fecal coliform, and monitoring worksheets distributed to stakeholders who are implementing BMPs. Observations include water quality after storms, land use changes, and wildlife and their habitat. These monitoring efforts are further detailed below.

Observations
Water Quality Observations
After rainfall events, designated stakeholders could perform visual observations of the presence of sediment plumes and water clarity. It is vital for the designated stakeholders to establish consistent mechanisms for their on-site monitoring prior to the implementation of best management practices to understand the baseline conditions. In order to establish some consistency, the designated stakeholders should select a specific hour after the termination of the storm to perform visual observations. These monitoring actions will aid to address Goals 1, 2, and 3 to reduce bacteria, nutrient, and sediment loading from all sources in the watershed.

Land Use Change Observations
Land use changes that would negatively affect water quality should also be tracked. Designated stakeholders can record acreages of changes that affect water quality such as the addition of impervious surfaces through farmland conversion to residential, commercial, or industrial uses. Tracking both positive and negative land use changes in the watershed will keep our understanding of pollutant loading and the watershed plan current as a working document, and it will help us make sense of results of other monitoring efforts such as water sampling and observations after storms.

Wildlife Observations
The watershed plan prioritizes the protection, enhancement, and management of wildlife habitat through Goal 4. Designated stakeholders could monitor wildlife activity on a regular basis to establish an understanding of the effect of habitat improvements for species that live on land and in the water.

- For land-based animals, unless large habitat blocks are added and a specific species is likely to benefit, focus on the endangered Rusty patched bumble bee and Hine's emerald dragonfly, plus count the variety of types of migratory birds and insects, especially pollinators like butterflies and bees.
- For species that live in the water, count the variety of invertebrates found in the bundles of decaying leavers that collect in eddies and on fallen logs, or use mesh bags filled with leaves left in the water for a few days.

The species named above are easily observed and can be found in small scale restoration efforts, such as those occurring with naturalized vegetated swales, filter strips, constructed stormwater wetlands, and streambank stabilization. The designated stakeholder will need to possess proper identification skills and tools for monitoring efforts related to specific species while monitoring the variety of birds, insects, and invertebrates involves being able to distinguish differences between species and counting the number of species. A monitoring schedule and data sheet should be developed for best comparison of changes over time. The schedule should reflect spring and/or fall migration of birds and hotter summer months when flowers are in bloom for both terrestrial insect and aquatic invertebrate counts.

Water Sampling for Fecal Coliform

Sampling the water of tributaries throughout the watershed will help to determine levels of fecal coliform and attempt to pinpoint potential sources. Continuing to test for fecal coliform or other parameters in the waterways can aid in establishing whether implemented projects and practices are efficient and if more conservation efforts need to be undertaken. Monitoring fecal coliform levels regularly can help to evaluate the success of BMP implementation at addressing Goals 1, 2, and 3. Rock River Water Reclamation District has graciously offered to provide a specified amount of pro bono lab processing work for fecal coliform water sampling to be conducted by students and faculty from the Rock Valley College. A professor from Rock Valley College plans to take the lead on water sampling and hopes to use the water sampling as an opportunity for students to learn and become involved in this watershed planning process.

General recommendations for water sampling of fecal coliform include:

- Conduct dry weather sampling to establish the baseline fecal coliform counts of the tributaries and South Fork Kent Creek.
- Decide whether to use dry weather sampling to establish the fecal coliform counts in the base flow or wet weather sampling to better understand fecal coliform levels introduced to the streams from surrounding land use practices during storms.
- Repeat dry and wet weather sampling as frequently as possible to increase confidence in conclusions, as fecal coliform counts can vary greatly from one day to the next depending on a variety of environmental conditions. Continue to conduct water sampling for fecal coliform at least annually. Decide when during the year the monitoring should occur and keep it consistent every year, as the time of year can reflect different land use practices.
- Continue sampling at the established sampling points over time to collect more comprehensive data.
- Analyze the samples to identify potential sources. Study pairs of samples located above and below potential sources including subdivisions on septic systems and open areas that attract nuisance geese populations.

- If a potential source demonstrates elevated levels of fecal coliform at the downstream sampling point compared to the upstream point, analyze the potential source's tributary more closely by taking more samples at strategic locations along the tributary to further pinpoint specific locations of potential sources of fecal coliform.

Robert Kay with the United States Geologic Survey has recommended the following approaches in finding the source(s) of fecal coliform in the water (personal communication):

- Consider sampling groundwater for fecal coliform. If detected, coliform in groundwater would indicate either a septic source or possibly land based manure applications. If not detected, this would indicate a source in the surface water, such as geese or cattle.
- Consider sampling surface water for an expanded list of analytes. For instance, there is surface water sampling available for analytes typically found in human waste, e.g. caffeine and pharmaceuticals could indicate fecal coliform from septic systems whereas hormones used in cattle could indicate fecal coliform from livestock.

If there are still questions about the source of the fecal coliform after conducting these samples, consider performing microbial source tracking of fecal coliform in order to identify what specific animal (e.g. human, dogs, cows, horses, chickens, geese, deer, etc.) the fecal coliform is coming from.

Consultants recommend sampling at locations illustrated in *Figure 7.1* below. Numbered points in green represent prioritized sampling points located above and below potential sources of fecal coliform. Lettered points in red are of secondary priority. They are located near confluences of tributaries and other strategic locations throughout the watershed to show fecal coliform contributions as tributaries converge.

Lake Sediment Depths

The Rockford Park District surveys sediment depths at least every few years to better understand the sedimentation rates and dredging needs of Levings Lake. This plan recommends that these efforts continue at least once every five years. A similar effort may be undertaken for the north and south ponds at Park-er-Woods and any other waterbody of interest by the landowner of the waterbody.

Septic System Maintenance Surveys

Designated stakeholders should survey homeowners to ensure that septic system inspections are occurring at least every 3 years. Details for the survey techniques are to be determined.

BMP Implementation Monitoring Worksheets

The stakeholders designated to perform and oversee monitoring will utilize standardized monitoring worksheets to track BMP implementation and effectiveness throughout the watershed. The designated stakeholders will be responsible for distribution, retrieval, and compilation of worksheet data. The South Fork Kent Creek Watershed Monitoring Worksheet can be found on pages 7-6 and 7-7 of this chapter.

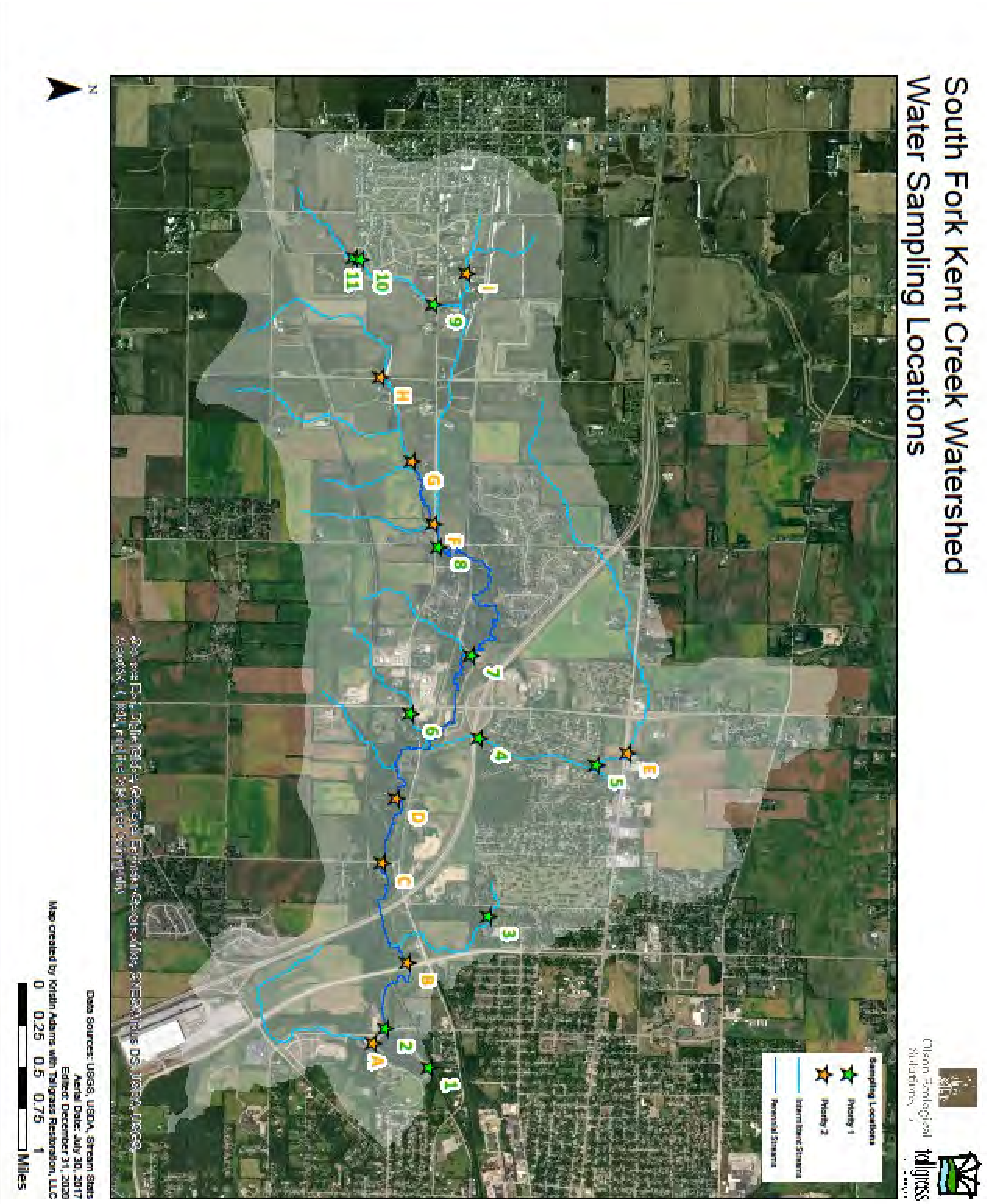
These monitoring worksheets will:

- Quantify BMPs over time
- Track maintenance
- Ensure follow-up
- Reiterate the goals of the South Fork Kent Creek Watershed though annual distribution

- Consolidate information in a cohesive manner

By utilizing these worksheets to consolidate data and show active enthusiasm and participation in BMP implementation, potential for funding opportunities will likely increase. These monitoring worksheets also provide feedback to the RPC and designated stakeholders for them to evaluate effectives of BMPs and for progress towards the selected goals of this watershed plan.
Figure 7.1 Water Sampling Locations

Figure 7.1 Water Sampling Locations



South Fork Kent Creek Watershed Monitoring Worksheet

The Region 1 Planning Council (RPC) asks that landowners and stakeholders use this worksheet to track their implementation of best management practices and conservation efforts throughout the watershed. The RPC will utilize the information provided to monitor BMP implementation progress and efficiency towards the goals of the watershed plan. With positive landowner participation in BMP implementation and tracking, funding opportunity potential increases. By showing that landowners and stakeholders are taking initiative and ownership of successful implementation of the watershed plan, grant dollars are more likely to be awarded.

Please return this worksheet to: Region 1 Planning Council
Attn: Shelby Best, Environmental and Sustainability Specialist
127 N. Wyman, Suite 100
Rockford, Illinois 61101-1114
sbest@r1planning.org

1. Name and detailed description of project or best management practice, including area (in feet or acres) affected and location. If more space is needed, please attach an additional sheet to this worksheet:

2. Start date:

3. Completion date:

4. Approximate cost:

5. Unexpected costs or frustrations:

6. Scope of project:

7. Why did you decided to implement this practice?

8. Is the project or practice implemented working?

9. What are your anticipated benefits from implementation of this practice?

10. If applicable, have you observed any changes in erosion, runoff, sedimentation in waterways, flooding, or wildlife using the area after project implementation?

11. Identify which goals you believe your project applies to. Circle all that apply:
    a. Decrease contaminants in the water, including fecal coliform bacteria.
    b. Minimize erosion, sediment, and nutrient loading into surface waters.
    c. Address water volume and velocity to improve water quality and prevent flooding.
    d. Protect, enhance, and manage wildlife habitat.
    e. Sustain and enhance the recreational opportunities of the watershed.
    f. Educate the community about water quality and this plan.
    g. Work with governing and policy-making bodies to protect water quality currently and in future land use planning.
    h. Preserve prime farmland during future land use changes.

12. Please provide a map of your project location and before and after photographic documentation:

13. Did you receive technical assistance in implementing this project or practice? If yes, from whom?

14. Will you be pursuing future best management practices? If so, would you be interested in learning about financial or technical assistance for any of these projects?

15. Are there best management practices you would like to learn more about? If so, please list them here.

16. Are you interested in becoming more involved in the South Fork Kent Creek Watershed conservation efforts?

17. If you answered yes to questions #14, #15, or #16, please provide your name, phone number, mailing address and email address:

Criteria to Measure Success

The RPC and delegated stakeholders will meet annually or biannually to track evaluation milestones.

Measurable milestones with schedule:

1. Compile and evaluate monitoring efforts.
    a. In the first year, designate stakeholders for each monitoring effort. Meet regularly to report monitoring findings.
    b. At the beginning of each year, send standardized Monitoring Worksheets found on pages 7-6 and 7-7 of this chapter to stakeholders who have implemented BMPs and allow them time to send in updates.
    c. By the end of each year, gather and compile worksheets and other monitoring data from stakeholders. Track nutrient, sediment, and bacteria loading reductions, wildlife enhancement, and education/outreach progress based on completed projects.

2. Communicate with stakeholders.
    a. At the end of each year after monitoring results have been compiled, provide updates to stakeholders regarding information learned from compiling monitoring worksheets and other data about education, wildlife enhancement, and reductions in nutrient, sediment, and bacteria loading.
    b. At the end of each year, send plan updates and progress to stakeholders, including examples photos, and supplemental documents.

3. Update the Watershed Plan.
    a. On an ongoing basis, consider the Watershed Plan a working document and make updates and changes as necessary.
    b. After five years, review and update the Watershed Plan as a group. If efforts continue beyond the five-year life of this plan, continue to review and update every five to ten years.

Monitoring Schedule

The basic schedule below in *Table 7.1* provides a framework on which to build a monitoring program. Details are provided above for each monitoring focus, under the heading with the same name.

Table 7.1 Monitoring Schedule

Ref. #	Monitoring Focus	Responsible Party	Schedule
1	Water Quality Observations	Designated Stakeholder	Years 1-5 after rainfall events
2	Land Use Change Observations	Designated Stakeholder	Years 1-5
3	Wildlife Observations (land-based animals)	Designated Stakeholder	Annually during spring and fall migration for birds and hot summer months for insects
4	Wildlife Observations (water-based animals)	Designated Stakeholder	Annually during hot summer months
5	Water Sampling for Fecal Coliform	Rock Valley College and Rock River Water Reclamation Dist.	Years 1-5 during hot summer months or other strategic, consistent time of year
6	Sediment Depth Sampling	Rockford Park District	Year 5
7	Septic System Maintenance Surveys	Designated Stakeholder	Years 1-5
8	BMP Implementation Worksheets	Designated Stakeholder	Years 1-5

Works Cited

Accurate Home Inspections. Septic Systems. Retrieved from https://accuratehomeinspectionofillinois.com/septic-system/

Aero-Stream. Septic System Cost Analysis-Explore Your Options When Your Septic System Fails. Retrieved from https://www.aero-stream.com/septic-system-cost.html

A.M. Leonard. 2020. Silt Fencing. Retrieved on 3/8/2020 from https://www.amleo.com/silt-fencing/p/VP-SILT/

Anderson, Seth and Celine Hyer. Michigan Water Environment Association. Arcadis. “Innovative Methods to Assess Sewer Pipe Risk and Improve Replacement Planning Decisions”.

Arnold, Chester and James Gibbons. “Impervious surface coverage: The emergence of a key environmental indicator.” American Planning Association. Journal of the American Planning Association. Spring 1996: 62, 2; pg. 244

Brooker, M. P. 1985. The Ecological Effects of Channelization. *The Geographical Journal*. The Royal Geographical Society: Vol. 151, No. 1, pp.63-69.

Center for Watershed Protection. 2007. National Pollutant Removal Performance Database. Version 3. http://www.stormwaterok.net/CWP%20Documents/CWP-07%20Natl%20Pollutant%20Removal%20Perform%20Database.pdf

Clark, Robert and Robert Thurnau. 2011. “Evaluating the Risks of Water Distribute System Failure.” American Water Works Association. Retrieved from https://puretechltd.com/wp-content/uploads/Evaluating-the-Risks-of-Distribution-System-Failure_OpflowAug11.pdf

Ducks Unlimited. March 5, 2020. Retrieved from https://www.ducks.org/press-room/news-releases/du-conserves-3-200-acres-in-illinois?poe=illinois-conservation-projects

DuPage County Stormwater Management Committee. 2008. Water Quality Best Management Practices Technical Guidance. Retrieved from https://www.dupageco.org/EDP/Stormwater_Management/Water_Quality/1424/

Environmental and Energy Study Institute. 2017. Fact Sheet – Biogas: Converting Waste to Energy. Retrieved from https://www.eesi.org/papers/view/fact-sheet-biogasconverting-waste-to-energy

FEMA. 2005. Reducing Damage from Localized Flooding: A Guide for Communities. https://www.fema.gov/pdf/fima/FEMA511-complete.pdf

Floating Islands International. Retrieved from https://www.floatingislandinternational.com/

Forestry Suppliers. 2020. Products. Retrieved on 3/8/2020 from https://www.forestry-suppliers.com/Search.php?stext=erosion%20control%20blanket

Friend, Duane and John Church. University of Illinois Extension. 2020. Septic Systems in Illinois. Retrieved from https://web.extension.illinois.edu/septicsystems/

Hastings, J. 2009. Nongame Wildlife Habitat Guide: Complementary Opportunities for Stream Restoration Projects. Trout Unlimited. Retrieved from http://www.darestoration.com/documents/2ndEd_Nongame_Wildlife.pdf.

Illinois Department of Natural Resources. Last revised March 3, 2020. Illinois Wildlife Action Plan. Retrieved from https://www.dnr.illinois.gov/conservation/IWAP/Pages/default.aspx

Illinois Department of Transportation. 2010. Bureau of Design and Environment Manual, Chapter Fifty-nine Landscape Design. Retrieved from http://www.idot.illinois.gov/Assets/uploads/files/Doing-Business/Manuals-Split/Design-And-Environment/BDE-Manual/Chapter%2059%20Landscape%20Design.pdf

Illinois Environmental Protection Agency. 2012. *Appendix B-2. Specific Assessment Information for Streams, 2012*. Retrieved from https://www2.illinois.gov/epa/Documents/epa.state.il.us/water/tmdl/303-appendix/2012/appendix-b2.pdf

Illinois Environmental Protection Agency. 2018. *Illinois Integrated Water Quality Report and Section 303(d) List, 2018.* Retrieved from https://www2.illinois.gov/epa/topics/water-quality/watershed-management/tmdls/Documents/Draft-2018-Integrated-Report-11-14-2018.pdf

Illinois Environmental Protection Agency. 2018. BMP Descriptions for STEPL and Region 5 Model. Retrieved from http://it.tetratechffx.com/steplweb/STEPLmain_files/BestManagementPracticesDefinitions.pdf

Illinois Environmental Protection Agency, Illinois State Geological Survey, University of Illinois, Illinois Department of Natural Resources, and Cyberinfrastructure & Geospatial Information Laboratory (n.d.). *Resource Management Mapping Service.* Retrieved from http://www.rmms.illinois.edu/RMMS-JSAPI/

Illinois Environmental Protection Agency, University of Illinois Extension, Illinois Department of Agriculture. 2019. Illinois Nutrient Loss Reduction Strategy: Biennial Report 2019. Retrieved from https://www2.illinois.gov/epa/topics/water-quality/watershed-management/excess-nutrients/Documents/NLRS-Biennial-Report-2019-Final.pdf

Illinois Environmental Protection Agency. Water Quality, Watershed Management, Nonpoint Sources, FAQs. Retrieved from https://www2.illinois.gov/epa/topics/water-quality/watershed-management/nonpoint-sources/Pages/faqs.aspx

Illinois Farm Bureau. 2020. Water Quality. Retrieved from http://www.ilfb.org/take-action/current-priorities/protecting-our-environment/water-quality/

Illinois Urban Manual. Practice Standards. Retrieved from https://illinoisurbanmanual.org/practice-standards/

Kane County Stormwater Management Committee. 2019. Kane County Stormwater Management Ordinance. Retrieved from https://www.countyofkane.org/FDER/Documents/waterOrdinances/adoptedOrdinance.pdf

Lake County Stormwater Management Commission. 2018. DesPlaines River Watershed Based Plan. Page 7-7. Retrieved from https://www.lakecountyil.gov/DocumentCenter/View/25176/Des-Plaines-River-Watershed-Based-Plan

Lake County Stormwater Management Commission. Retrieved from https://www.lakecountyil.gov/553/Stormwater-Management-Commission

Lee, Brad. 2012. Septic System Failure and Environmental Impacts. Lexington, KY: University of Kentucky College of Agriculture. HENV-502. Retrieved from http://www2.ca.uky.edu/agcomm/pubs/HENV/HENV502/HENV502.pdf

LPELC. 2019. Introduction to Vegetative Treatment Systems. Retrieved from https://lpelc.org/introduction-to-vegetative-treatment-systems/

Manta. Septic Tank Cleaning Costs in Rockford, IL in 2020. Retrieved from https://www.manta.com/cost-septic-tank-cleaning-rockford-il

Marchetti Ponte, Karin. 2001. Land Trust Alliance Fact Sheet. Retrieved from https://conservationtoolsproduction.s3.amazonaws.com/library_item_files/203/243/CE_v_DR.pdf?AWSAccessKeyId=AKIAIQFJLILYGVDR4AMQ&Expires=1586898839&Signature=WDI1mtgR0tlxP9Ppxtt1oO%2F9LmQ%3D

Minnesota Dept. of Natural Resources. 2020. Vegetated Swale. Retrieved on 2/3/2020 from https://www.dnr.state.mn.us/water_access/bmp/vegetated_swale_bmp.html

Minnesota Pollution Control Agency. 2017. Minnesota Stormwater Manual. Retrieved on 2/3/2020 from https://www.pca.state.mn.us/water/minnesotas-stormwater-manual

Minnesota Shoreland Management. 2001. Resource Guide: Naturalizing Your Shoreline. Retrieved from http://www.shorelandmanagement.org/quick/faqpdf/nsfaq.pdf

Murphy, S. 2007, April 23. General Information on Solids. Retrieved October 30, 2019, from http://bcn.boulder.co.us/basin/data/NEW/info/TSS.html.

Natural Resource Conservation Service. 2015. Illinois Conservation Practices Physical Effects (CPPE). Provided by Terry Kirchner, Stephenson County NRCS on June 30, 2015.

Natural Resource Conservation Service. 2018. Field Office Technical Guide. Retrieved from https://efotg.sc.egov.usda.gov/#/details

New York State Stormwater Management Design Manual. Chapter 2: Impacts of New Development, Section 2.1 Declining Water Quality, pg. 2-2.

New York Department of Environmental Conservation (NYDEC) and New York Federation of Lake Associations. 2009. *Diet for a Small Lake: The Expanded Guide to New York State Lake and Watershed Management*. Chapter 9 - Watershed Management: The Big Picture. Retrieved from https://www.dec.ny.gov/docs/water_pdf/dietlakech9.pdf

Olson Ecological Solutions. 2017. *A Cleaner Levings Lake: Putting Nature to Work.* Prepared for the Rockford Park District. Rockford, Illinois.

Oram, B. 2014. Bacterial Testing Fecal Coliform, E. coli., Total Coliform Drinking Water Lakes Streams Ponds Pools. Retrieved October 30, 2019, from https://water-research.net/index.php/water-testing/bacteria-testing/fecal-coliform-bacteria

Overlake Supply. 2020. North American Green. Retrieved on 3/8/2020 from https://www.overlakesupply.com/collections/north-american-green

Prairie Moon Nursery. Eco-Grass. Retrieved from https://www.prairiemoon.com/eco-grass

Regional Planning Council. 2019. Winnebago County, Illinois Multi-Hazard Mitigation Plan. Retrieved from https://wincoil.us/media/274268/2019_winnebago_county_mhmp_final.pdf

Rock River Water Reclamation District. Other Services: Mainline Cleaning & Backup Response. Retrieved from http://www.rrwrd.dst.il.us/?page_id=91

Schueler, T.R. 1992. A Current Assessment of Urban Best Management Practices. Metropolitan Washington Council of Governments.

Tetra Tech, Inc. 2018. Spreadsheet Tool for the Estimation of Pollutant Load (STEPL) Version 4.4. U.S. Environmental Protection Agency. Retrieved from http://it.tetratech-ffx.com/steplweb/models$docs.htm

The Nature Conservancy. 2020. Private Lands Conservation. Retrieved from https://www.nature.org/en-us/about-us/who-we-are/how-we-work/private-lands-conservation/?tab_q=tab_container-tab_element_670

United States Department of Agriculture. National Agricultural Statistics Service. 2017. Census of Agriculture: Winnebago County. Retrieved from https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Illinois/

United States Environmental Protection Agency. 1999. Preliminary Data Summary of Urban Stormwater Best Management Practices: pg. 5-54. Retrieved from https://www.epa.gov/sites/production/files/2015-11/documents/urban-stormwater-bmps_preliminary-study_1999.pdf

United States Environmental Protection Agency. 2009. Stormwater Wet Pond and Wetland Management Guidebook. Retrieved from https://www3.epa.gov/npdes/pubs/pondmgmtguide.pdf

United States Environmental Protection Agency. 2015. A Handbook of Constructed Wetland: A Guide to Creating Wetlands for Agricultural Wastewater, Domestic Wastewater, Coal Mine Drainage, and Stormwater in the Mid-Atlantic Region. Volume 1, General Considerations. Retrieved from https://www.epa.gov/sites/production/files/2015-10/documents/constructed-wetlands-handbook.pdf

United States Environmental Protection Agency. 2018. Region 5 Model for Estimating Load Reductions. Retrieved from https://www.epa.gov/nps/region-5-model-estimating-pollutant-load-reductions

United States Environmental Protection Agency. 2018. STEPL 4.4 Spreadsheet Model for 10 Watersheds. Retrieved from https://www.epa.gov/nps/spreadsheet-tool-estimating-pollutant-loads-stepl

United States Environmental Protection Agency. 2020. Polluted Runoff: Nonpoint Source (NPS) Pollution. 319 Grant Program for States and Territories. Retrieved from https://cfpub.epa.gov/watertrain/moduleFrame.cfm?parent_object_id=2868&object_id=2873#2873

United States Environmental Protection Agency. *A Homeowner's Guide to Septic Systems.* Retrieved from https://www3.epa.gov/npdes/pubs/homeowner_guide_long.pdf

United States Environmental Protection Agency. Nutrient Pollution. The Sources & Solutions: In and Around the Home. Retrieved from https://www.epa.gov/nutrientpollution/sources-and-solutions-and-around-home

United States Environmental Protection Agency. Septic Systems (Onsite/Decentralized Systems). Retrieved from https://www.epa.gov/septic

United States Environmental Protection Agency. Watershed Academy Web. Introduction to Watershed Planning. Retrieved from https://www.epa.gov/nps/319-grant-program-states-and-territories

University of Missouri Extension. Establishing and Managing Riparian Forest Buffers. Retrieved from http://extension.missouri.edu/p/AF1009

US Fish & Wildlife Serve. 2017. Midwest Region Endangered Species. Retrieved from https://www.fws.gov/midwest/endangered/lists/illinois-spp.html

USGS. "Dissolved Oxygen and Water." *Water Science School*. Retrieved from https://www.usgs.gov/special-topic/water-science-school/science/dissolved-oxygen-and-water?qt-science_center_objects=0#qt-science_center_objects

Village of Homer Glen. 2008. Water Resources BMP Guidelines. Retrieved from https://www.homerglenil.org/DocumentCenter/View/944/Water-Resource-Best-Management-Practice-Guidelines-June-30-2008-PDF

Winer, Rebecca. 2000. National Pollutant Removal Performance Database for Stormwater Treatment Practices. 2nd Edition. Center for Watershed Protection. Retrieved from https://www.in.gov/indot/files/National_Pollutant_Removal_Database_2nd_Edition.pdf

WinGIS, Winnebago County. *Parcel Search*. Powered by esri. Retrieved on August 5, 2019. https://agis.wingis.org/maps/PropertySearch.aspx

Winnebago County 2030 Land Use Plan Map. https://wincoil.us/departments/regional-planning-economic-development/planning-zoning-division/plan-maps/

Wisconsin State Legislature. 2019. Private Onsite Wastewater Treatment Systems. Chapter SPS 383.54 Management requirements: (4) Existing POWTS. Retrieved from https://docs.legis.wisconsin.gov/code/admin_code/sps/safety_and_buildings_and_environment/380_387/383/V/54/4

Exhibit A

Fact Sheets for Federally Threatened & Endangered Species in Winnebago County

Threatened and Endangered Species

Indiana Bat
(Myotis sodalis)

Photo by Rich Fields

Indiana bats eat up to half their body weight in insects each night.

The Indiana bat is an endangered species. Endangered species are animals and plants that are in danger of becoming extinct. Threatened species are those that are likely to become endangered in the foreseeable future. Identifying, protecting, and restoring endangered and threatened species are primary objectives of the U.S. Fish and Wildlife Service's endangered species program.

What is the Indiana Bat?
Description

The scientific name of the Indiana bat is *Myotis sodalis* and it is an accurate description of the species. Myotis means "mouse ear" and refers to the relatively small, mouse-like ears of the bats in this group. Sodalis is the Latin word for "companion." The Indiana bat is a very social species; large numbers cluster together during hibernation. The species is called the Indiana bat because the first specimen described to science in 1928 was based on a specimen found in southern Indiana's Wyandotte Cave in 1904.

The Indiana bat is quite small, weighing only one-quarter of an ounce (about the weight of three pennies). In flight, it has a wingspan of 9 to 11 inches. The fur is dark-brown to black. The Indiana bat is similar in appearance to many other related species. Biologists can distinguish it from similar species by comparing characteristics such as the structure of the foot and color variations in the fur.

Habitat

Indiana bats hibernate during winter in caves or, occasionally, in abandoned mines. For hibernation, they require cool, humid caves with stable temperatures, under 50° F but above freezing. Very few caves within the range of the species have these conditions.

Hibernation is an adaptation for survival during the cold winter months when no insects are available for bats to eat. Bats must store energy in the form of fat before hibernating. During the six months of hibernation the stored fat is their only source of energy. If bats are disturbed or cave temperatures increase, more energy is needed and hibernating bats may starve.

After hibernation, Indiana bats migrate to their summer habitat in wooded areas where they usually roost under loose tree bark on dead or dying trees. During summer, males roost alone or in small groups, while females roost in larger groups of up to 100 bats or more. Indiana bats also forage in or along the edges of forested areas.

Reproduction

Indiana bats mate during fall before they enter caves to hibernate. Females store the sperm through winter and become pregnant in spring soon after they emerge from the caves.

After migrating to their summer areas, females roost under the peeling bark of dead and dying trees in groups of up to 100 or more. Such groups are called maternity colonies. Each female in the colony gives birth to only one pup per year. Young bats are nursed by the mother, who leaves the roost tree only to forage for food. The young stay with the maternity colony throughout their first summer.

Feeding Habits

Indiana bats eat a variety of flying insects found along rivers or lakes and in uplands. Like all insect-eating bats, they benefit people by consuming insects that are considered pests or otherwise harmful to humans. Their role in insect control is not insignificant – Indiana bats eat up to half their body weight in insects each night.

Range

Indiana bats are found over most of the eastern half of the United States. Almost half of all Indiana bats (207,000 in 2005) hibernate in caves in southern Indiana. In 2005, other states which supported populations of over 40,000 included Missouri (65,000), Kentucky (62,000), Illinois (43,000) and New York (42,000). Other states within the current range of the Indiana bat include Alabama, Arkansas, Connecticut, Iowa, Maryland, Michigan, New Jersey, North Carolina, Ohio, Oklahoma, Pennsylvania, Tennessee, Vermont, Virginia, West Virginia. The 2005 population estimate is about 457,000 Indiana bats, half as many as when the species was listed as endangered in 1967.

Why is the Indiana Bat Endangered?

Human Disturbance

Indiana bats, because they hibernate in large numbers in only a few caves, are extremely vulnerable to disturbance. During hibernation, they cluster in groups of up to 500 per square foot. Since the largest hibernation caves support from 20,000 to 50,000 bats, it is easy to see how a large part of the total population can be affected by a single event. Episodes of large numbers of Indiana bat deaths have occurred due to human disturbance during hibernation.

Cave Commercialization and Improper Gating

The commercialization of caves – allowing visitors to tour caves during hibernation – drives bats away. Changes in the structure of caves, such as blocking an entrance, can change the temperature in a cave. A change of even a few degrees can make a cave unsuitable for hibernating bats. Some caves are fitted with gates to keep people out, but improper gating that prevents access by bats or alters air flow, temperature, or humidity can also be harmful. Properly constructed gates are beneficial because they keep people from disturbing hibernating bats while maintaining temperature and other requirements and allowing access for bats.

Summer Habitat Loss or Degradation

Indiana bats use trees as roosting and foraging sites during summer months. Loss and fragmentation of forested habitats can affect bat populations.

Pesticides and Environmental Contaminants

Insect-eating bats may seem to have an unlimited food supply, but in local areas, insects may not be plentiful because of pesticide use. This can also affect the quality of the bats' food supply. Many scientists believe that population declines occurring today might be due, in part, to pesticides and environmental contaminants. Bats may be affected by eating contaminated insects, drinking contaminated water, or absorbing the chemicals while feeding in areas that have been recently treated.

What is Being Done to Prevent Extinction of the Indiana Bat?

Listing

Prompted by declining populations caused by disturbance of bats during hibernation and modification of hibernacula, the Indiana bat was listed in 1967 as "in danger of extinction" under the Endangered Species Preservation Act of 1966. It is listed as "endangered" under the current Endangered Species Act of 1973. Listing under the Endangered Species Act protects the Indiana bat from take (harming, harassing, killing) and requires Federal agencies to work to conserve it.

Recovery Plan

The Endangered Species Act requires that recovery plans be prepared for all listed species. The U.S. Fish and Wildlife Service developed a recovery plan for the Indiana bat in 1983 and is now revising that Plan. The recovery plan describes actions needed to help the bat recover.

Habitat Protection

Public lands like National Wildlife Refuges, military areas, and U.S. Forest Service lands are managed for Indiana bats by protecting forests. This means ensuring that there are the size and species of trees needed by Indiana bats for roosting; and providing a supply of dead and dying trees that can be used as roost sites. In addition, caves used for hibernation are managed to maintain suitable conditions for hibernation and eliminate disturbance.

Education and Outreach

Understanding the important role played by Indiana bats is a key to conserving the species. Helping people learn more about the Indiana bat and other endangered species can lead to more effective recovery efforts.

U.S. Fish & Wildlife Service
1 Federal Drive
Fort Snelling, Minnesota 55111
612/713-5350
http://www.fws.gov/midwest/endangered

December 2006

Northern Long-Eared Bat

Myotis septentrionalis

Photo by Steve Taylor, University of Illinois

This northern long-eared bat, observed during an Illinois mine survey, shows visible symptoms of white-nose syndrome.

The northern long-eared bat is federally listed as a threatened species under the Endangered Species Act. ***Endangered*** species are animals and plants that are in danger of becoming extinct. ***Threatened*** species are animals and plants that are likely to become endangered in the foreseeable future. Identifying, protecting and restoring endangered and threatened species is the primary objective of the U.S. Fish and Wildlife Service's Endangered Species Program.

What is the northern long-eared bat?

Appearance: The northern long-eared bat is a medium-sized bat with a body length of 3 to 3.7 inches and a wingspan of 9 to 10 inches. Their fur color can be medium to dark brown on the back and tawny to pale-brown on the underside. As its name suggests, this bat is distinguished by its long ears, particularly as compared to other bats in its genus, *Myotis*.

Winter Habitat: Northern long-eared bats spend winter hibernating in caves and mines, called hibernacula. They use areas in various sized caves or mines with constant temperatures, high humidity, and no air currents. Within hibernacula, surveyors find them hibernating most often in small crevices or cracks, often with only the nose and ears visible.

Summer Habitat: During the summer, northern long-eared bats roost singly or in colonies underneath bark, in cavities or in crevices of both live trees and snags (dead trees). Males and non-reproductive females may also roost in cooler places, like caves and mines. Northern long-eared bats seem to be flexible in selecting roosts, choosing roost trees based on suitability to retain bark or provide cavities or crevices. They rarely roost in human structures like barns and sheds.

Reproduction: Breeding begins in late summer or early fall when males begin to swarm near hibernacula. After copulation, females store sperm during hibernation until spring. In spring, females emerge from their hibernacula, ovulate and the stored sperm fertilizes an egg. This strategy is called delayed fertilization.

After fertilization, pregnant bats migrate to summer areas where they roost in small colonies and give birth to a single pup. Maternity colonies of females and young generally have 30 to 60 bats at the beginning of the summer, although larger maternity colonies have also been observed. Numbers of bats in roosts typically decrease from the time of pregnancy to post-lactation. Most bats within a maternity colony give birth around the same time, which may occur from late May or early June to late July, depending where the colony is located within the species' range. Young bats start flying by 18 to 21 days after birth. Maximum lifespan for the northern long-eared bat is estimated to be up to 18.5 years.

Feeding Habits: Like most bats, northern long-eared bats emerge at dusk to feed. They primarily fly through the understory of forested areas feeding on moths, flies, leafhoppers, caddisflies, and beetles, which they catch while in flight using echolocation or by gleaning motionless insects from vegetation.

Range: The northern long-eared bat's range includes much of the eastern and north central United States, and all Canadian provinces from the Atlantic Ocean west to the southern Yukon Territory and eastern British Columbia. The species' range includes 37 States and the District of Columbia: Alabama, Arkansas, Connecticut, Delaware, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Vermont, Virginia, West Virginia, Wisconsin, and Wyoming.

Why is the northern long-eared bat in trouble?

White-nose Syndrome: No other threat is as severe and immediate as this. If this disease had not emerged, it is unlikely that northern long-eared bat populations would be experiencing such dramatic declines. Since symptoms were first observed in New York in 2006, white-nose syndrome has spread rapidly from the Northeast to the Midwest and Southeast; an area that includes the core of the northern long-eared bat's range, where it was most common before this disease. Numbers of northern long-eared bats (from hibernacula counts) have declined by up to 99 percent in the Northeast. Although there is uncertainty about the rate that white-nose syndrome will spread throughout the species' range, it is expected to continue to spread throughout the United States in the foreseeable future.

Other Sources of Mortality:
Although no significant population declines have been observed due to the sources of mortality listed below, they may now be important factors affecting this bat's viability until we find ways to address WNS.

Impacts to Hibernacula: Gates or other structures intended to exclude people from caves and mines not only restrict bat flight and movement, but also change airflow and microclimates. A change of even a few degrees can make a cave unsuitable for hibernating bats. Also, cave-dwelling bats are vulnerable to human disturbance while hibernating. Arousal during hibernation causes bats to use up their energy stores, which may lead to bats not surviving through winter.

Loss or Degradation of Summer Habitat: Highway construction, commercial development, surface mining, and wind facility construction permanently remove habitat and are activities prevalent in many areas of this bat's range. Many forest management activities benefit bats by keeping areas forested rather than converted to other uses. But, depending on type and timing, some forest management activities can cause mortality and temporarily remove or degrade roosting and foraging habitat.

Wind Farm Operation: Wind turbines kill bats, and, depending on the species, in very large numbers. Mortality from windmills has been documented for northern long-eared bats, although a small number have been found to date. However, there are many wind projects within a large portion of the bat's range and many more are planned.

What Is Being Done to Help the Northern Long-Eared Bat?

Disease Management: Actions have been taken to try to reduce or slow the spread of white-nose syndrome through human transmission of the fungus into caves (e.g. cave and mine closures and advisories; national decontamination protocols). A national plan was prepared by the Service and other state and federal agencies that details actions needed to investigate and manage white-nose syndrome. Many state and federal agencies, universities and non-governmental organizations are researching this disease to try to control its spread and address its affect. See www.whitenosesyndrome.org/ for more.

Addressing Wind Turbine Mortality: The Service and others are working to minimize bat mortality from wind turbines on several fronts. We fund and conduct research to determine why bats are susceptible to turbines, how to operate turbines to minimize mortality and where important bird and bat migration routes are located. The Service, state natural resource agencies, and the wind energy industry are developing a Midwest Wind Energy Habitat Conservation Plan, which will provide wind farms a mechanism to continue operating legally while minimizing and mitigating listed bat mortality.

Listing: The northern long-eared bat is listed as a threatened species under the federal Endangered Species Act. Listing a species affords it the protections of the Act and also increases the priority of the species for funds, grants, and recovery opportunities.

Hibernacula Protection: Many federal and state natural resource agencies and conservation organizations have protected caves and mines that are important hibernacula for cave-dwelling bats.

What Can I Do?

Do Not Disturb Hibernating Bats:
To protect bats and their habitats, comply with all cave and mine closures, advisories, and regulations. In areas without a cave and mine closure policy, follow approved decontamination protocols (see http://whitenosesyndrome.org/topics/decontamination). Under no circumstances should clothing, footwear, or equipment that was used in a white-nose syndrome affected state or region be used in unaffected states or regions.

Leave Dead and Dying Trees Standing: Like most eastern bats, the northern long-eared bat roosts in trees during summer. Where possible and not a safety hazard, leave dead or dying trees on your property. Northern long-eared bats and many other animals use these trees.

Install a Bat Box: Dead and dying trees are usually not left standing, so trees suitable for roosting may be in short supply and bat boxes may provide additional roost sites. Bat boxes are especially needed from April to August when females look for safe and quiet places to give birth and raise their pups.

Support Sustainability: Support efforts in your community, county and state to ensure that sustainability is a development goal. Only through sustainable living will we provide rare and declining species, like the northern long-eared bat, the habitat and resources they need to survive alongside us.

Spread the Word: Understanding the important ecological role that bats play is a key to conserving the northern long-eared and other bats. Helping people learn more about the northern long-eared bat and other endangered species can lead to more effective recovery efforts. For more information, visit www.fws.gov/midwest/nleb and www.whitenosesyndrome.org

Join and Volunteer: Join a conservation group; many have local chapters. Volunteer at a local nature center, zoo, or national wildlife refuge. Many state natural resource agencies benefit greatly from citizen involvement in monitoring wildlife. Check your state agency websites and get involved in citizen science efforts in your area.

Rusty Patched Bumble Bee
Bombus affinis


Photo courtesy of Christy Stewart

The U.S. Fish and Wildlife Service listed the rusty patched bumble bee as endangered under the Endangered Species Act. Endangered species are animals and plants that are in danger of becoming extinct. Identifying, protecting and recovering endangered species is a primary objective of the U.S. Fish and Wildlife Service's endangered species program.

What is a rusty patched bumble bee?

Appearance: Rusty patched bumble bees live in colonies that include a single queen and female workers. The colony produces males and new queens in late summer. Queens are the largest bees in the colony, and workers are the smallest. All rusty patched bumble bees have entirely black heads, but only workers and males have a rusty reddish patch centrally located on the back.

Habitat: Rusty patched bumble bees once occupied grasslands and tallgrass prairies of the Upper Midwest and Northeast, but most grasslands and prairies have been lost, degraded, or fragmented by conversion to other uses. Bumble bees need areas that provide nectar and pollen from flowers, nesting sites (underground and abandoned rodent cavities or clumps of grasses), and overwintering sites for hibernating queens (undisturbed soil).


Illustrations of a rusty patched bumble bee queen (left), worker (center), and male (right) by Elaine Evans, The Xerces Society.

Reproduction: Rusty patched bumble bee colonies have an annual cycle. In spring, solitary queens emerge and find nest sites, collect nectar and pollen from flowers and begin laying eggs, which are fertilized by sperm stored since mating the previous fall. Workers hatch from these first eggs and colonies grow as workers collect food, defend the colony, and care for young. Queens remain within the nests and continue laying eggs. In late summer, new queens and males also hatch from eggs. Males disperse to mate with new queens from other colonies. In fall, founding queens, workers and males die. Only new queens go into diapause (a form of hibernation) over winter - and the cycle begins again in spring.

Feeding Habits: Bumble bees gather pollen and nectar from a variety of flowering plants. The rusty patched emerges early in spring and is one of the last species to go into hibernation.

Why conserve rusty patched bumble bees?

As pollinators, rusty patched bumble bees contribute to our food security and the healthy functioning of our ecosystems. Bumble bees are keystone species in most ecosystems, necessary not only for native wildflower reproduction, but also for creating seeds and fruits that feed wildlife as diverse as songbirds and grizzly bears.

Bumble bees are among the most important pollinators of crops such as blueberries, cranberries, and clover and almost the only insect pollinators of tomatoes. Bumble bees are more effective pollinators than honey bees for some crops because of their ability to "buzz pollinate." The economic value of pollination services provided by native insects (mostly bees) is estimated at $3 billion per year in the United States.

It needs a constant supply and diversity of flowers blooming throughout the colony's long life, April through September.

Range: Historically, the rusty patched bumble bee was broadly distributed across the eastern United States and Upper Midwest, from Maine in the U.S. and southern Quebec and Ontario in Canada, south to the northeast corner of Georgia, reaching west to the eastern edges of North and South Dakota. Its range included 28 states, the District of Columbia and 2 provinces in Canada. Since 2000, this bumble bee has been reported from only 13 states and 1 province: Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Minnesota, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, Wisconsin – and Ontario, Canada.

Why is the rusty patched bumble bee declining?

Habitat loss and degradation: Most prairies and grasslands of the Upper Midwest and Northeast have been converted to monoculture farms or developed areas, such as cities and roads. Grasslands that remain tend to be small and isolated.

Intensive farming: Increases in farm size and technology advances improved the operating efficiency of farms but have led to practices that harm bumble bees: increased use of pesticides, loss of crop diversity resulting in flowering crops being available for only a short time, loss of hedgerows with flowering plants, and loss of legume pastures.

Disease: Pathogens and parasites may pose a threat, although their prevalence and effects in North American bumble bees are not well understood.

Pesticides: The rusty patched bumble bee may be vulnerable to pesticides. Pesticides are used widely on farms and in cities and have both lethal and sublethal toxic effects. Bumble bees can absorb toxins directly through their exoskeleton and through contaminated nectar and pollen. Rusty patched bumble bees nest in the ground and may be susceptible to pesticides that persist in agricultural soils, lawns and turf.

Global climate change: Climate changes that may harm bumble bees include increased temperature and precipitation extremes, increased drought, early snow melt and late frost events. These changes may lead to more exposure to or susceptibility to disease, fewer flowering plants, fewer places for queens to hibernate and nest, less time for foraging due to high temperatures, and asynchronous flowering plant and bumble bee spring emergence.

What is being done to conserve rusty patched bumble bees?

U.S. Fish and Wildlife Service: Several Service programs work to assess, protect, and restore pollinators and their habitats. Also, the Service works with partners to recover endangered and threatened pollinators and pollinator-dependent plants. Concern about pollinator declines prompted formation of the North American Pollinator Protection Campaign, a collaboration of people dedicated to pollinator conservation and education. The Service has a Memorandum of Understanding with the Pollinator Partnership to work together on those goals. The Service is a natural collaborator because our mission is to work with others to conserve, fish, wildlife, and plants and their habitats.

Other Efforts: Trusts, conservancies, restoration groups and partnerships are supporting pollinator initiatives and incorporating native plants that support bees and other pollinators into their current activities. For example, the USDA Natural Resource Conservation Service is working with landowners in Michigan, Minnesota, Montana, North Dakota, South Dakota, and Wisconsin to make bee-friendly conservation improvements to their land. Improvements include the practices of planting cover crops, wildflowers, or native grasses and improved management on grazing lands.

Research: Researchers are studying and monitoring the impacts of GMO crops and certain pesticides on pollinators. Efforts by citizen scientists and researchers to determine the status of declining bee species are underway throughout the United States.

What can I do to help conserve the rusty patched bumble bee?

Garden: Grow a garden or add a flowering tree or shrub to your yard. Even small areas or containers on patios can provide nectar and pollen for native bees.

Native plants: Use native plants in your yard such as lupines, asters, bee balm, native prairie plants and spring ephemerals. Don't forget spring blooming shrubs like ninebark and pussy willow! Avoid invasive non-native plants and remove them if they invade your yard. For more information on attracting native pollinators, visit www.fws.gov/pollinators/pdfs/PollinatorBookletFinalrevWeb.pdf.

Natural landscapes: Provide natural areas - many bumble bees build nests in undisturbed soil, abandoned rodent burrows or grasss clumps. Keep some unmowed, brushy areas and tolerate bumble bee nests if you find them. Reduce tilling soil and mowing where bumble bees might nest. Support natural areas in your community, county and state.

Minimize: Limit the use of pesticides and chemical fertilizer whenever possible or avoid them entirely. Pesticides cause lethal and sublethal effects to bees and other pollinators.

January 10, 2017

Threatened and Endangered Species

Hine's Emerald Dragonfly
Somatochlora hineana

States in which the Hine's emerald dragonfly is found. The Hine's emerald dragonfly is also known as the Ohio emerald dragonfly or Hine's bog skimmer.

The Hine's emerald dragonfly is an **endangered species**. Endangered species are animals and plants that are in danger of becoming extinct. **Threatened species** are animals and plants that are likely to become endangered in the foreseeable future. Identifying, protecting and restoring endangered and threatened species is the primary objective of the U.S. Fish and Wildlife Service's endangered species program.

What is the Hine's Emerald Dragonfly?

Appearance - This dragonfly has brilliant emerald-green eyes and a dark brown and metallic green body, with yellow stripes on its sides. Its body is about 2.5 inches long; its wingspan reaches about 3.3 inches.

Range - Historically, the Hine's emerald dragonfly was found in Alabama, Indiana, and Ohio and probably has been extirpated in those states. Today the dragonfly can only be found in Illinois, Michigan, Missouri and Wisconsin.

Habitat - The Hine's emerald dragonfly lives in calcareous (high in calcium carbonate) spring-fed marshes and sedge meadows overlaying dolomite bedrock.

Reproduction - Adults males defend small breeding territories, pursuing and mating with females who enter. The female lays eggs by repeatedly plunging the tip of her body into shallow water. Later in the season or the following spring, immature dragonflies, called nymphs, hatch from the eggs. The nymph lives in the water for 2 to 4 years, eating smaller aquatic insects and shedding its skin many times. The nymph then crawls out of the water and sheds its skin a final time, emerging as an flying adult. The adults may live only 4 to 5 weeks.

Why Save a Dragonfly?
Dragonflies play an important role in nature. They catch and eat smaller flying insects, including mosquitoes, biting flies, and gnats. In its immature stage (nymph), a dragonfly is an important food source for larger aquatic animals such as fish. They serve as excellent water quality watchdogs, are part of our nation's natural heritage, and add beauty to our world.

Why is the Hine's Emerald Dragonfly Endangered?

Habitat Loss or Degradation - The greatest threat to the Hine's emerald dragonfly is habitat destruction. Most of the wetland habitat that this dragonfly depends on for survival has been drained and filled to make way for urban and industrial development.

Pesticides and Other Pollutants - Contamination of wetlands by pesticides or other pollutants also poses a threat. The dragonfly depends on pristine wetland or stream areas, with good water quality, for growth and development.

Changes in Ground Water - Development that decreases the amount or quality of ground water flowing to the dragonfly's habitat threatens its survival because it depends on spring-fed shallow water to breed.

What Is Being Done to Prevent Extinction of the Hine's Emerald Dragonfly?

Listing - The Hine's emerald dragonfly was added to the U.S. List of Endangered and Threatened Wildlife and Plants on January 26, 1995. It is illegal to harm, harass, collect, or kill the dragonfly without a permit from the U.S. Fish and Wildlife Service.

Recovery Plan - The U.S. Fish and Wildlife Service prepared a recovery plan that describes and prioritizes actions needed to help the dragonfly survive. The Recovery Plan is available on the website below or by writing to the address below.

Research - Researchers are studying the Hine's emerald dragonfly to find the best way to manage for this species and its habitat.

Habitat Protection - Where possible, the dragonfly's habitat is being protected and improved.

Public Education - Public education programs will be developed to raise awareness of the dragonfly's plight. Residents living near prime dragonfly habitat may be contacted by an "ambassador" and provided with information about the dragonfly.

What Can I Do to Help Prevent the Extinction of Species?

Learn - Learn more about the Hine's emerald dragonfly and other endangered and threatened species. Understand how the destruction of habitat leads to loss of endangered and threatened species and our nation's plant and animal diversity. Tell others about what you have learned.

Join - Join a conservation group or volunteer at a local nature center, zoo, or Refuge.

Protect – Protect water quality by minimizing use of lawn chemicals (i.e., fertilizers, herbicides, and insecticides), recycling used car oil, and properly disposing of paint and other toxic household products.

U.S. Fish & Wildlife Service
Endangered Species Division
1 Federal Drive
Fort Snelling, Minnesota 55111-4056
612/713-5350
Federal Relay Service 1-800-877-8339
http://www.fws.gov/midwest/endangered
March 2006

Exhibit B

Identifying Major Pollutants in Water

Olson Ecological Solutions, LLC

All water systems are connected; they flow into one another. The water we use for drinking and to do laundry comes from, and moves into, the water systems that surround us. Creeks flow into rivers which seep into groundwater and trickles into lakes. This collection of water systems is called a watershed, it is found in the natural environment but also moves through our bodies, homes, and even our sewers. Pollutants in the water might come in the form of increased nitrogen, phosphorous, and fecal coliform. These nutrients and bacteria are harmful to the overall health of a watershed and those who are part of it. They can be found on Earth's surfaces like farmland and urban streets which are exposed to waste and pollution. Rainfall typically washes them off the surfaces and into our water supply; this is called runoff. These major pollutant cause poor water quality. They must be better understood in order to find solutions for a healthier watershed.

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

Nitrogen

Nitrogen is an essential nutrient for plant and animal growth. In excess, nitrogen negatively effects the health of aquatic systems. Extreme concentrations of nitrogen can lead to hypoxic conditions in which no oxygen is left in the water for plants and wildlife. Surpluses of nitrogen come from agricultural outputs (fertilizer, animal waste) and urban outputs (sewage, water treatment plants); these trickle into a watershed with the downstream movement of runoff over nutrient dense surfaces.

Problems

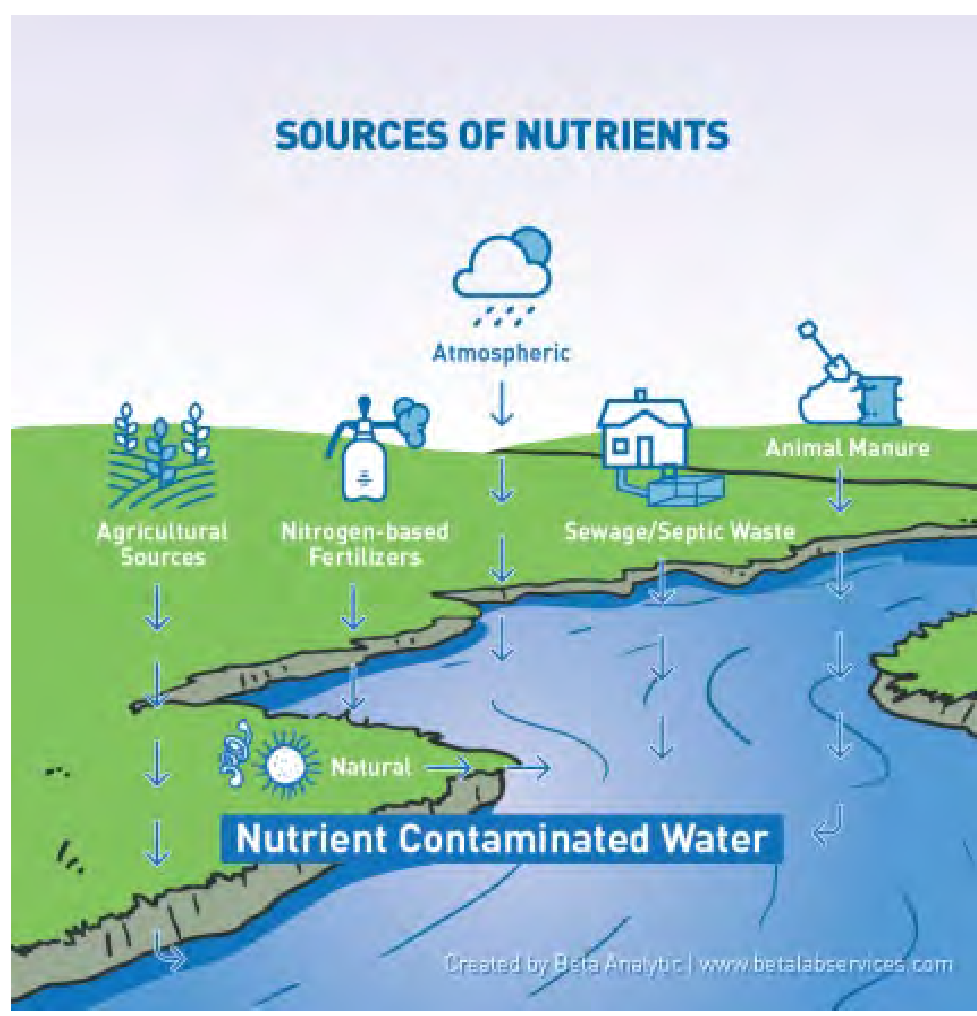
Excess nitrogen overstimulates the growth of aquatic plants and algae. Algae uses up all the oxygen in water and then decomposes, leaving fish without air or food. What is left is a water body or stream that can no longer sustain life.

Nitrates in our drinking water are unhealthy for human consumption and can restrict oxygen from entering the bloodstream. Most of the drinking water in the United States comes from subsurface water which are at risk due to nitrogen inputs, well draining soil, and a high ratio of cropland to woodland.

With human and environmental health at risk, it is essential to have a better understanding of our local watershed.

Solutions

Wastewater management plans have biological, chemical, and physical solutions to protect our fresh water from contaminations found from human and animal sources.
Vegetated areas, engineered pathways and blockades, and chemical treatments near sensitive water or contaminant sources are clever ways to reduce nitrogen loading.



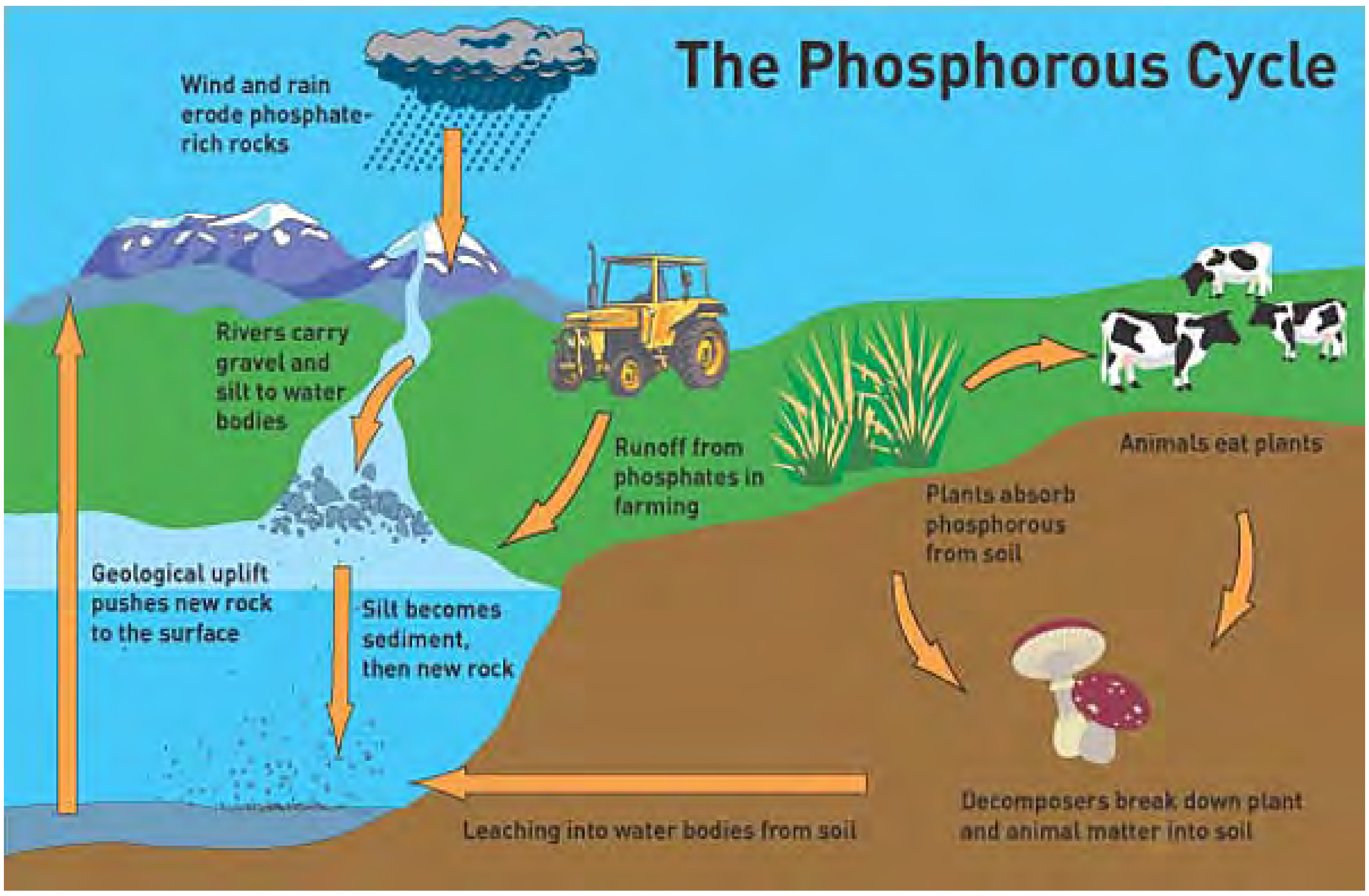
Nitrogen in water (BETA Analytic, 2019)

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

Phosphorous

Phosphorous is a common nutrient found in fertilizers, manure, and other organic wastes. It is essential to plant growth and animal nourishment, although too much of it may cause damaging health effects. Phosphorous and nitrogen surpluses speed up the eutrophication of water bodies in which nutrients overtake oxygen levels to the point of toxicity. Agricultural runoff and residential use of fertilizers are major sources of phosphorous.



Interference in the phosphorous cycle (Socratic, 2016)

Problems

Phosphorous typically attaches to soil particles and migrates with runoff into surface water. US Geologic Survey has found that phosphorous is also able to migrate via sediment in groundwater (Morganwalp, 2019). Phosphorous that enters water bodies reduces levels of available oxygen for aquatic life and causes algal blooms. The influx of nutrients comes from wastewater treatment facilities, lawn and agricultural fertilizers, domestic and farm animal waste, and even detergents that drain into sewage systems.

Solutions

Soil is prone to erosion in high concentrated runoff areas, typically around impervious land developments. Management practices to collect, slow, and redirect runoff are one way of keeping contaminated water from our fresh supply. Septic systems and waste facilities are not perfect and can leak into surface and ground water. Being aware of what runs down the drain or off the lawn can help prevent excess contamination.

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

Algae

Algal blooms (Palmero 2014)

Nutrient build up in water is a natural occurrence, creating a beneficial environment for plankton and algae to grow. Fish feed on these algae and in turn, create more nutrients which they deposit into the water. It is a highly effective ecosystem when left unchanged, although critical transitions in our water systems occur in areas heavily used by humans.

Problems

The discharge of nitrates and phosphates build-up in the water causing phytoplankton growth to increase. Ponds and lakes will quickly turn green with algae which decays in the water and depletes it of oxygen, food, and habitable space for aquatic life. This process is called eutrophication. Eutrophication result in what some may think of as "pond scum." Some algae release toxins and have been known to cause deaths in dogs, cattle, elk, and fish. It has implications for human health as well.

Solutions

Nutrient loading comes from sewage and wastewater treatment facilities, detergents, cars and factories, manure from farm feedlots, streets, lawns, construction lots and more. Rethinking our cultural practices could keep our water from falling victim to eutrophication.

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

Total Suspended Solids

Total Suspended Solids (TSS) refer to the sediments in water that could be caught in a filter. Silt, soil erosion, decaying organic material, sewage, as well as agricultural, urban, and industrial wastes all contribute to TSS levels in water. Total suspended solids in water are often associated with excessive amounts of nutrients and harmful bacteria that can attach themselves to sediment. Heavy rainfalls pick up these sediments which run off into surface water. High concentrations of these sediments are problematic for the health and quality of aquatic systems.

Variations of total suspended solids (Fondriest Environmental Inc., 2014)

Problems

Aquatic plants are affected by solids that block the light from reaching them, which is needed for photosynthesis (Murphy 2007). If TSS accumulate in surface waters and block sunlight, the plants can not undergo photosynthesis, can no longer produce oxygen, and die. Fish are greatly effected by the decreased levels of oxygen that takes place after aquatic plants die. In addition, suspended sediments can clog fish gills, make them more prone to disease, and prevent egg development. TSS accumulation in surface water also reduces the amount of storage capacity for these streams and water bodies to capture and store runoff. If storage capacity is reduced, areas near the surface water are more prone to flooding.

The USEPA does not specify standards for TSS in the drinking supply, although the contaminants which are able to dissolve and infiltrate into our drinking supply by sediments should be looked at and managed to protect overall human health.

Solutions

Water quality management of sediment and contaminants should be revised and implemented in sensitive areas heavily used by people. In addition to conservation best management practices, local communities and organizations can raise awareness to clean and protect water bodies that have already been afflicted by high levels of sedimentation. Implementing projects that increase the growth rates of fish populations, revitalize aquatic plant life, or remove and redirect TSS.

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

Fecal Coliform

Fecal bacteria are naturally found in the intestines of warm-blooded mammals like humans and cows, helping them digest food. Fecal coliforms are known as indicator bacteria when testing water for other pathogens that may cause illness or disease. One group of coliforms is called *Echerichia coli*. Humans are at increased risk of contracting fever, nausea, stomach cramps, ear infections, Dysentery, Typhoid, and Hepatitis A from water contaminated with high concentrations of fecal coliforms and the associated pathogenic bacteria.

Fecal coliforms not only live in the intestines but continue to live outside of human and animal bodies in their waste. Potential sources of fecal coliform within a watershed include faulty septic systems, livestock, and concentrations of wildlife. When left untreated, bacterial colonies may grow by using available oxygen and nutrients that aquatic plants and animals would otherwise use.

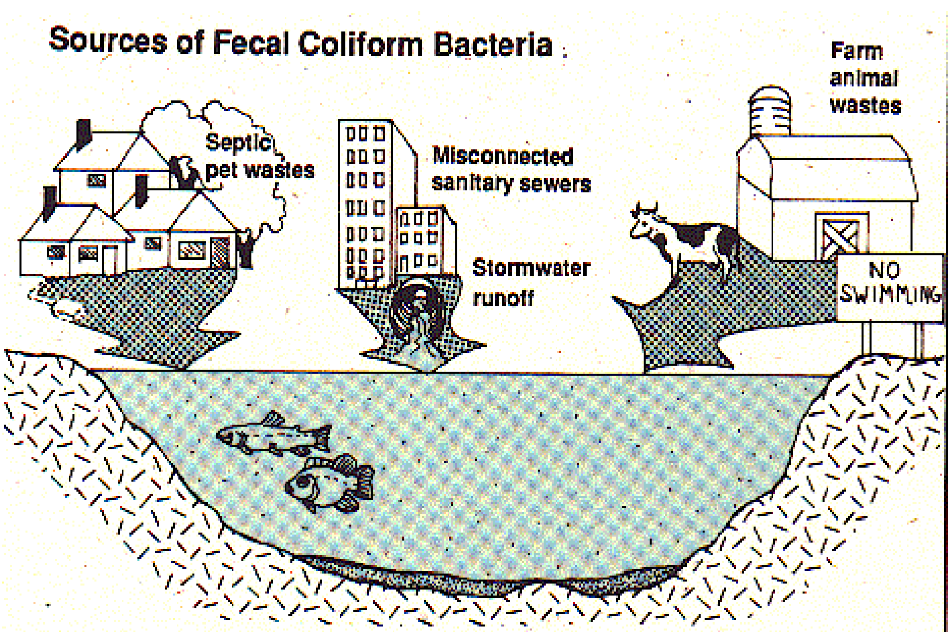


Diagram of fecal bacteria entering water supply (OSU Environmental Health Sciences Center)

Coliform bacteria colonies in petri dish (Oram, 2014)

The environmental impact and human health risks by fecal bacteria has been acknowledged by USEPA regulations to monitor, test, and treat water supply for drinking purposes. It is recommended to only drink water with a concentration of less than 1 fecal coliform colony per 100mL of water. The standards for bodily contact, such as swimming, is fewer than 200 colonies per 100mL of water, and fewer than 1000 colonies per 100mL for fishing and boating activities (Oram, 2014).

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

Fecal Coliform

Problems

Human septic systems and wastewater treatment plants are susceptible to leaks and spills that can potentially contaminate surface and subsurface water. Reported failures have been attributed to the age of a sewer system, the placement of a system where groundwater is present, the incapacity of a system to process the amount of waste generated, and limited space for the treatment area (Lee, 2012). Poorly managed sewage and septic systems back up, flood, and degrade the surrounding environments. Increased nutrients and bacterial contaminants associated with human waste have detrimental effects on water quality which are noticeable in a local watershed. Signs of erosion along embankments, water bodies turned green from algal blooms, and the death or disappearance of aquatic and terrestrial wildlife in affected areas can all be assessed.

Animal waste is of major concern in both rural and urban settings in the form of agricultural livestock and domestic pets. Management practices of animal excrement in and around agricultural feedlots, manure-holding facilities, and other areas heavily used by livestock are important to reduce contamination in surface water. Pet owners should also dispose of pet waste properly and discourage pets from defecating near surface water. Wildlife, particularly geese, are also a concern for contaminating streams directly by inhabitation near wetlands. Installing riparian filter strips with tall native vegetation discourages geese presence near streambanks and pond shorelines.

Solutions

To protect human and environmental health, it is best to continuously screen for fecal coliforms in sensitive watersheds heavily afflicted by humans and animals.

Wastewater treatment facilities should be regulated and homeowners with septic systems should take responsibility for proper maintenance regarding septic system function and failures. Use of best management practices by conservation specialists coupled with local community involvement can decrease the amount of fecal coliform entering surface water and the adverse affect that result from it.

River basin utilized by cattle (top) and signpost of hazardous contamination (bottom) (Hampson 2016)

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

References

Olson Ecological Solutions, LLC

BETA Analytic. 2019. Nitrate pollution in water, high nitrate levels. Retrieved from https://www.betalabservices.com/nitrate-test/.

Fondriest Environmental Inc. 2014. Turbidity, Total Suspended Solids & Water Clarity. Retrieved from https://www.fondriest.com/environmental-measurements/parameters/water-quality/turbidity-total-suspended-solids-water-clarity/.

Hampson, P. S., Treece, M. W., Johnson, G. C., Ahlstedt, S. A., & Connell, J. F. 2016. NAWQA - Water Quality in the Upper Tennessee River Basin - Major Findings. Retrieved from https://pubs.usgs.gov/circ/circ1205/major_findings.htm.

Lee, B. D. 2012. Septic System Failure and Environmental Impacts. *Cooperative Extension Service, University of Kentucky College of Agriculture*.

Morganwalp, D. W. 2019. Phosphorus Doesn't Migrate in Ground Water? Better Think Again! Retrieved from https://toxics.usgs.gov/highlights/phosphorous_migration.html.

Murphy, S. 2007. General Information on Solids. Retrieved from http://bcn.boulder.co.us/basin/data/NEW/info/TSS.html.

Oram, B. 2014. Bacterial Testing Fecal Coliform, E. coli., Total Coliform Drinking Water Lakes Streams Ponds Pools . Retrieved from https://water-research.net/index.php/water-testing/bacteria-testing/fecal-coliform-bacteria.

OSU Environmental Health Science Center. Coliform bacteria in well water: Facts and testing. Retrieved from https://ehsc.oregonstate.edu/well-coliform.

Palmero, C. 2014. Environmental Science: Water Research & Technology blog. Retrieved from https://blogs.rsc.org/ew/2014/12/11/removing-phosphate-from-water/?doing_wp_cron=1571767235.9982600212097167968750.

Socratic. 2016. How do humans interfere in the phosphorus cycle?: Socratic. Retrieved from https://socratic.org/questions/how-do-humans-interfere-in-the-phosphorus-cycle.

Exhibit C

Educational Fliers
for
Best Management Practices in Developed Areas

South Fork Kent Creek Watershed

Rockford, Illinois, Winnebago County

Created by Olson Ecological Solutions

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

Olson Ecological Solutions, LLC

South Fork Kent Creek Watershed
Developed Area Best Management Practices:

Vegetated Swales

Vegetated swales are shallow channels or swales vegetated with deep rooted plants, which filter out pollutants and slow stormwater. Similar to filter strips, vegetated swales intercept stormwater runoff from nearby impervious areas. Their primary function is to filter pollutants and sediment from stormwater runoff.

Benefits:

- ✓ Collect stormwater sediment
- ✓ Filter pollutants
- ✓ Slow stormwater runoff

Permeable paving drains into a vegetated swale at Elmhurst College

Agrecol Native Nursery Swale Mix

Vegetated swales can be applied in most development situations with few restrictions. They are well-suited to treat highway or residential road stormwater runoff due to their linear nature.

Applicable locations: at the end of drains or buildings, adjacent to impervious surfaces such as parking lots and roads

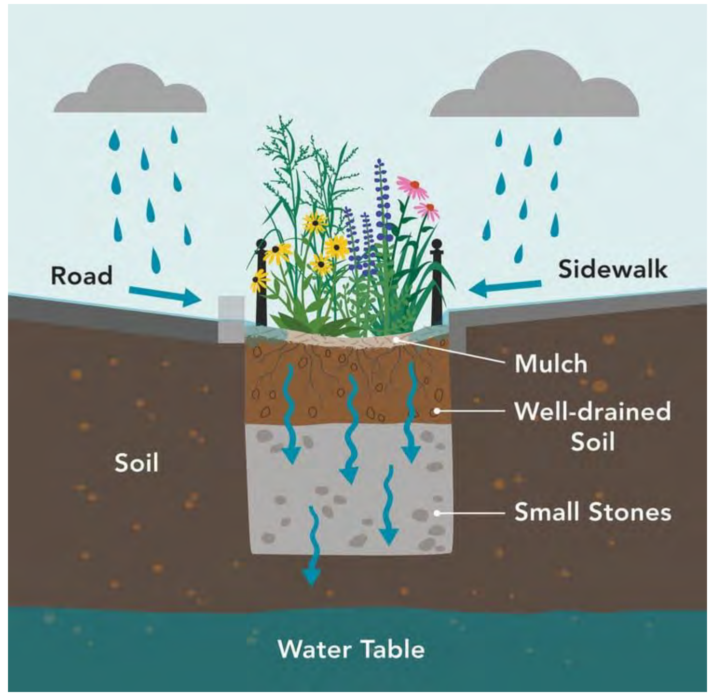
Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed
Developed Area Best Management Practices:

Vegetated Swales

Vegetated swales must be sized to allow runoff sufficient contact time within the swales, such as shallow water depths and low velocities, for adequate pollutant removal to occur. In designing these swales, they also must consider drainage area, soils, and the volume control storage. Swales utilize drainage pipes, well-drained soils, and/or gravel underneath vegetation to aid in water infiltration. Any existing ditches planted with turf grass are a great location to convert to vegetated swales, simply by removing turf grass and installing native vegetation suitable for that location.



Connecticut Fund for the Environment

City of Columbus, columbus.gov

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed
Developed Area Best Management Practices:

Vegetated Filter Strips

Filter strips are vegetated sections of land located between impervious surfaces or agricultural fields and the waters to which they drain. When installed next to impervious surfaces, vegetated filter strips slow runoff, enable stormwater to pass through deep-rooted vegetation, and filter out pollutants before emptying into swales or other bodies of water. Filter strips may provide some reduction in stormwater runoff volume, but their primary function is to filter out contaminants in stormwater runoff.

Figure 5.19. Illustration of a Filter Strip (MWRD, 2015)

Nitrogen and phosphorous naturally occur as nutrients in aquatic systems; however, human activities have greatly increased the amounts that occur. Too much of these nutrients cause significant jumps in algae growth, which negatively impacts water quality, reduces or eliminates oxygen within the water, harms food resources, degrades aquatic habitats, and can eventually cause algal blooms. Some algal blooms produce toxins and promote bacteria growth, which can harm humans who come in contact with the water (USEPA 2020).

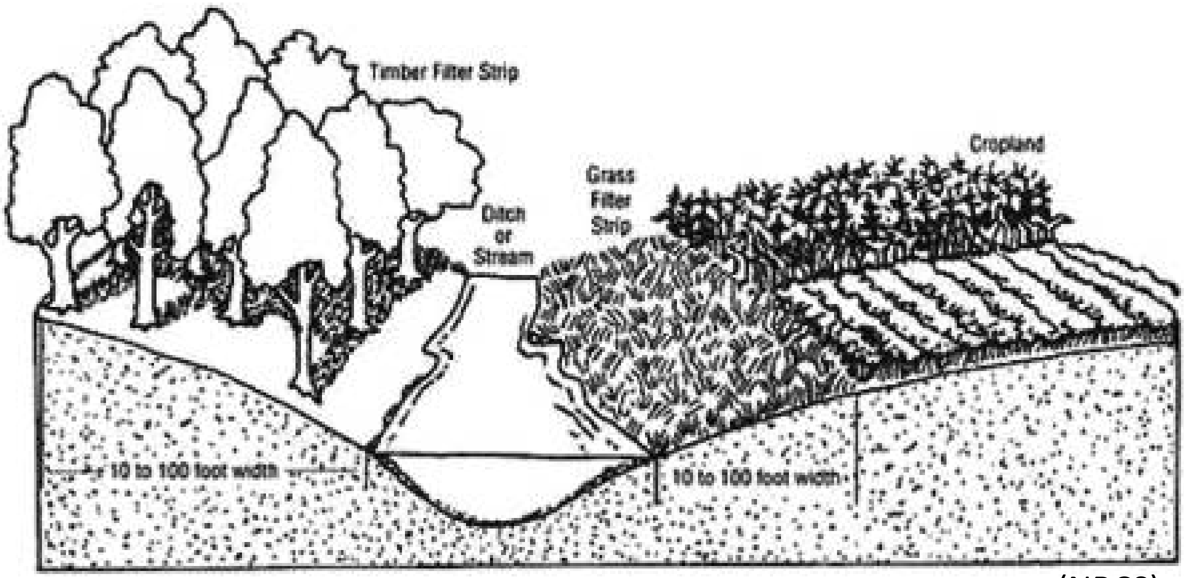
Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed
Developed Area Best Management Practices:

Vegetated Filter Strips

Vegetated filter strips include various types of vegetation, including timber filter strips, grass filter strips, or native plant filter strips.



(NRCS)

It is suggested to plant native vegetation around waterbody shorelines, streambanks of South Fork Kent Creek and its tributaries, and at the edges of farmland in order to filter out incoming pollutants. The more land near water that is covered with native plant vegetation, the more likely it is for pollutants (i.e. organic matter, sediments, heavy metals, bacteria, garbage, gasoline, chemicals, etc.) to be filtered out of water runoff before it hits fresh surface water. It is recommended for each strip of native vegetation to be 35 feet wide. If space will allow for a 35-foot filter strip, then a minimum of 15 feet is recommended. Applicable Locations: downslope of any area that produces large amounts of stormwater runoff

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed
Developed Area Best Management Practices:

Riparian Filter Strip

Riparian filter strip are located along the banks of lakes, streams, or ponds by installing native plant, which grow in or near water and can tolerate various levels of saturation. This is a type of filter strip, called a riparian filter strip, but is often described as a riparian buffer.

Figure 6.13. Examples of Riparian and Non-riparian Environments

Benefits:

- ✓ Reduces flood flow rates, velocities, and volumes
- ✓ Minimizes erosion and promotes bank stability of streams, lakes, ponds, or wetland shorelines
- ✓ Helps to control sediment from upland areas by filtering and assimilating nutrients discharged from surrounding uplands
- ✓ Enhances wildlife habitat
- ✓ Overhanging vegetation within buffer helps to cool stream flow
- ✓ Provides nutrient uptake that may reduce algal blooms and subsequent depressed levels of dissolved oxygen in-stream.
- ✓ Enhances natural aesthetics of water bodies

(MWRD, 2015)

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed
Developed Area Best Management Practices:

Riparian Filter Strip

Riparian filter strips should be *at least* 10 feet of dense native vegetation with rigid stem grown along the water's edge to allow pollutants to filter out and the banks to stabilize (Lake County). The EPA requires a minimum of 20-foot buffers to qualify for Section 319 funding. The South Fork Kent Creek Watershed plan recommends a 35-foot riparian buffer. The wider the filter strip, the more effective it is.

Riparian filter strips above rip rap shoreline protection would detract geese and filter pollutants from stormwater running from lawns, parking lots, and other land uses next to the shoreline. Steep terrain leading to waterbodies and streams heightens the need for riparian buffers because these buffers help to stabilize the land just next to the surface water and provide erosion control.

Applicable locations: There are opportunities to install riparian buffers enveloping waterbody shorelines and streambanks throughout the watershed.

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed
Developed Area Best Management Practices:

Constructed Stormwater Wetlands

Natural wetlands act as buffers between land and water bodies. They filter nonpoint source pollutants such as nitrogen, phosphorous, sediment, pathogens, and metals. Preserving and restoring existing natural wetlands can improve the water quality of adjacent streams and lakes and decrease the need for costly storm water and flood protection structures and facilities. However, wetlands can also be created in the form on constructed wetlands. Artificial or constructed wetlands mimic natural wetlands in their ability to remove sediment, nutrients, and heavy metals from the water. Constructed wetlands do not necessarily have the same hydrologic regime as naturalized wetlands and are therefore termed differently (OES).

Minnesota Stormwater Manual

US EPA

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed
Developed Area Best Management Practices:

Constructed Stormwater Wetlands


American Society of Landscape Architects

Constructed wetlands are artificial wetland ecosystems with hydrophytic, or water-loving, vegetation for biological treatment of water and water storage. These constructed wetlands can treat wastewater or contaminated runoff from cropland, livestock, aquaculture facilities, residential areas, and urban/commercial areas. They can improve water quality of stormwater runoff (NRCS). If designed property constructed stormwater wetlands can capture, detain, and filter runoff. Ideal locations for implementation are areas with hydric soils prone to saturation or inundation. If designed in a way to create an aquatic ecosystem with a diversity of plants and wildlife, then mosquitoes should not be an issue as other birds and amphibians can predate mosquitoes.

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed
Developed Area Best Management Practices:

Native Plantings

Plants native to the region provide benefits to water quality, streambank stabilization, erosion control, animal and insect habitat, and aesthetic appeal. Many native plants have much deeper roots than cultivated or invasive plants.

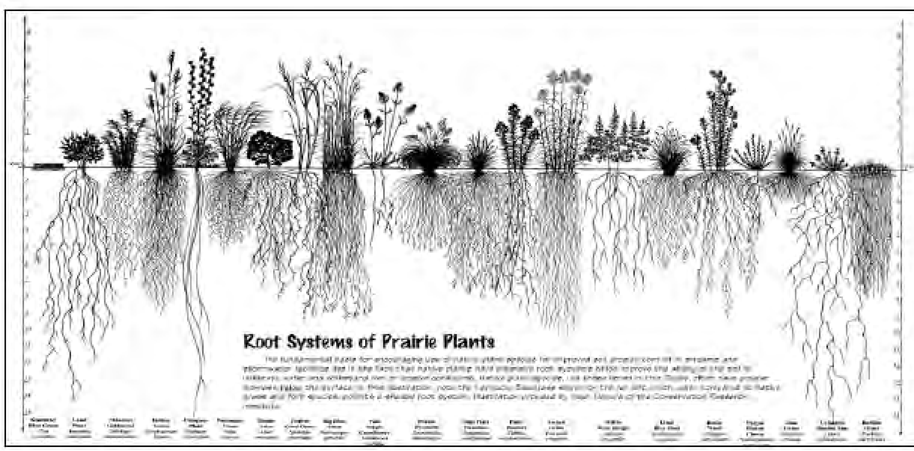


Figure 5.16. Root Systems of Grass and Prairie Plants (Source: Heidi Natura, CRI, 1995). (MWRD, 2015)

Deep-rooted plants can trap suspended sediment and incorporate excessive nutrients into their biomass as polluted water flows through the vegetation. Deep roots also stabilize water shorelines, decrease erosion, and prevent sediment from entering water bodies. Sediment is considered a pollutant to water quality because it alters the volume capacity that a lake or steam can hold, thus eliminating potential habitat, and fluctuates water temperatures, which negatively impacts aquatic life and water quality. Planting natural areas with native plants also increases habitat for birds, mammals, butterflies, and amphibians.

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed
Developed Area Best Management Practices:

Native Plantings

In 2015 the Metropolitan Water Reclamation District compared the runoff coefficient between impervious surfaces (ie. asphalt parking lots, concrete sidewalks, etc.) to other permeable surfaces like native plantings and porous pavement. The runoff coefficient (C) relates the amount of runoff to the amount of precipitation. A larger value in C means lower infiltration rates and higher runoff. They found that while impervious surfaces have a runoff coefficient of .90, areas planted with native plants has a much lower C of .15.

Table 5-2. Runoff Coefficients (C Values) for the Rational Method

Surface Type	Runoff Coefficient, C
Impervious area (Roads, roofs, sidewalks, etc.)	0.90
Pervious Area	0.45
Gravel (loose, unbound)	0.75
Water Surface (open water)	1.00
Native Plantings	0.15
Wetlands	0.79
Synthetic Turf Fields	0.75
Green Infrastructure:	
Pervious Surfaces (Porous Asphalt, Pervious Concrete, Permeable Pavers)	0.75
Bioswale	0.10
Rain Garden	0.10
Green Roof	(Refer to Table 5-9)

(MWRD, 2015)

Native plants can be utilized in many of the best management practices recommended in this plan, including vegetated swales, vegetated filter strips, riparian buffer restoration, and floating islands. Native plantings help the South Fork Kent Creek watershed plan goals no matter where they are planted, but they are most beneficial when planted within the path of stormwater.

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed
Developed Area Best Management Practices

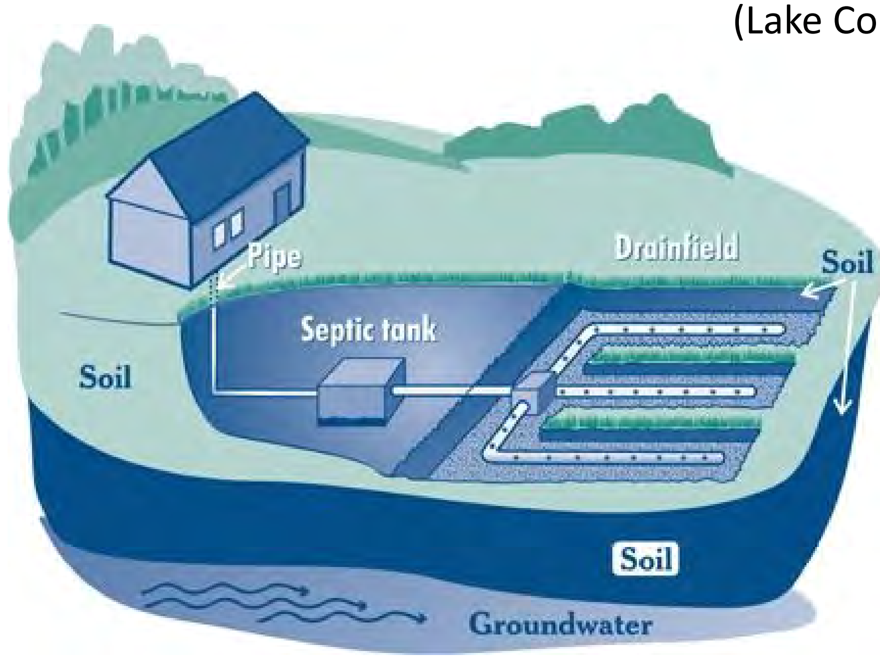
Septic System Maintenance

Proper use and maintenance of your septic system is necessary to prevent it from malfunctioning and leaking pollutants into local waterways.

Some recommended proactive measures include:

- Pumping or inspecting the system once every three years
- Diverting surface water away from the drain field
- Avoiding driving or parking on the drain field to prevent soil compaction
- Keeping the roots of trees and shrubs away from the drain field pipes to avoid obstructed drain lines
- Conserve household water use
- Do not put harsh cleaners, oils, or other items down the drain that can cause blockages
- Consider aerobic digesters when it is time to replace the system

(Lake County)



Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Creek Kent Watershed
Developed Area Best Management Practices:

Garden Care

- Plant a native plant rain garden to reduce the amount of fertilizer needed and provide a way for water to soak into the ground.


Elkhart County SWCD

- Use pervious pavers for walkways and low traffic areas to allow water to soak into the ground.

- Use yard waste, i.e. grass clippings and leaves, in mulch or compost for your garden. If this is not an option, prepare all clippings and leaves for community composting, or in barrels or secured papers bags for disposal, which keeps them from washing into streams.

- Incorporate best management practices, such as grassed swales, filter strips, or buffer strips on your property to control and temporarily store stormwater runoff.


Great American Rain Barrels

- Install a rain barrel to collect rainwater; the rainwater can later be used to wash your car or water your plants and lawn. (US EPA)

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Creek Kent Watershed
Developed Area Best Management Practices:

Lawn Care

Apply	Apply fertilizers only when necessary and at the recommended amount based on soil sampling from your lawn.
Don't apply	Don't apply fertilizer before windy or rainy days. Don’t apply phosphorous. It is usually already present in the soil.
Apply	Apply fertilizer as close as possible to the period of maximum uptake and growth for grass and other plants, which is usually spring and fall in cool climate, and early and late summer in warm climates.
Avoid	Avoid applying fertilizer close to waterways.
Do not overwater	Do not overwater lawns and garden.
Store & Dispose	Properly store unused fertilizers and properly dispose of empty containers of fertilizers and pet waste.

(US EPA)

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed
Developed Area Best Management Practices

Rain Garden

A rain garden is a depressed, landscaped garden planted with native plant species that is designed to retain and infiltrate stormwater runoff from individual residential or commercial lots, sump pumps and roofs. Rain gardens are versatile features that can be installed in almost any unpaved space. Rain gardens have also been used successfully along streets to reduce and filter street runoff.

Benefits

- Reduces runoff volumes and rates.
- Recharges groundwater and stream baseflows
- Filters runoff pollutants
- Can increase aesthetic value for the properties
- Provides wildlife habitat
- Typically low maintenance

(Lake County)

Olson Ecological Solutions, LLC

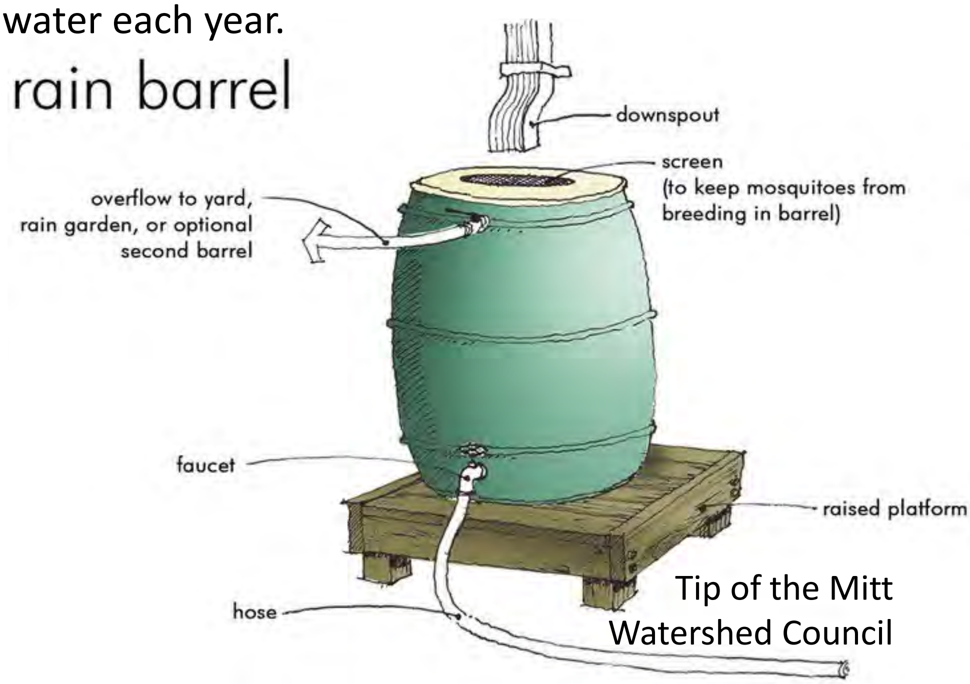
This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed
Developed Area Best Management Practices

Rain Barrels

Rain barrels are vessels, usually connected to downspouts, that capture water from a roof and store it for later use on lawns, rain gardens, or indoor plants. By capturing this water, homeowners reduce the amount of stormwater runoff from their property and conserve water by reusing rainwater. Cisterns can also harvest rainwater but have a larger storage capacity and can be located above or below ground. According to the EPA, approximately 24,000 gallons of water run off a single rooftop each year. One 55-gallon rain barrel can save 855 gallons of otherwise wasted water each year.

Tip of the Mitt Watershed Council



Tip of the Mitt Watershed Council

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed
Developed Area Best Management Practices

Retention & Detention Systems

Retention ponds maintain a pool of water throughout the year and hold stormwater runoff following storms.

Detention ponds hold water for a short period of time; this pond temporarily holds water before it enters the stream.

Laramie County Conservation District

Two different kinds of ponds are often used for flood control and stormwater runoff treatment: wet ponds and dry ponds. Both systems function to settle suspended sediments and other solids typically present in stormwater runoff. Wet ponds are also called retention ponds, and they hold back water similar to water behind a dam. The retention pond has a permanent pool of water that fluctuates in response to precipitation and runoff from the contributing areas. Maintaining a pool discourages pollutants and other sediment from resuspending in water and keeps deposited sediments at the bottom of the holding area (Laramie County Conservation District). Dry ponds are also called detention ponds or detention basins. Dry ponds normally have dry bottoms and only hold temporarily during and after storms before it enters nearby streams.

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

Extended Wet Detention

According to the U.S EPA, a wet detention pond is a stormwater control structure that provides both retention and treatment of contaminated stormwater runoff. It contains a perennial pool of water, which holds runoff from one rainfall event until displaced by a new rainfall event. This pool is the primary pollutant removal mechanism, such that solid particles drop out of suspension in the water column. The amount of urban pollutants that a wet pond can filter depends on the ratio of the size of the detention pond to the runoff from the surrounding watershed.

Typically, wet ponds are more effective at nutrient removal and stormwater quality control than dry basins (Lake County).

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed

Developed Area Best Management Practices

Dry Detention

Phys.org

Dry detention ponds or basins are storage practices with dry bottoms designed to capture and detain stormwater during storm events. They reduce flooding and have capacity to filter runoff. This filtering capacity can be improved by planting native vegetation. Their extensive root systems change compacted soil into spongy earth that can soak up more rainwater. In addition to improving water quality, converting areas that are unmanaged or that only have mowed grass into prairie and wetland provides habitat for wildlife including important pollinators and makes the area more interesting and beautiful.

Perkins

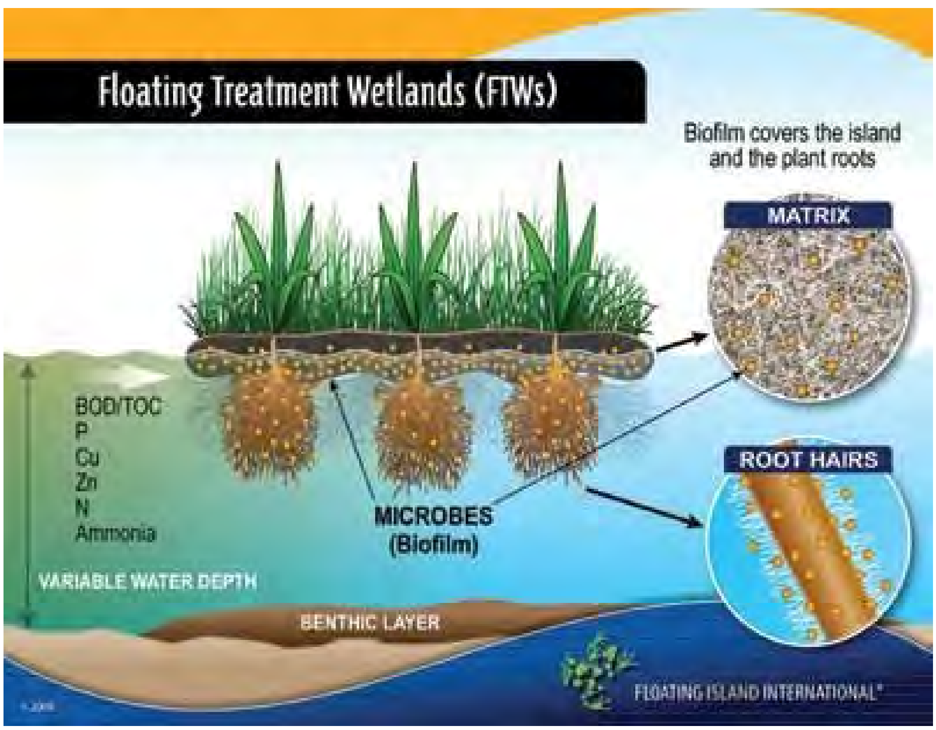
This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

Olson Ecological Solutions, LLC

South Fork Kent Creek Watershed
Developed Area Best Management Practices:

Floating Islands

Many best management practices for water quality focus on preventing pollutants from entering local fresh water sources, i.e. preventative measures. There is a best management practice that focuses on filtering out pollutants that still entered the targeted bodies of water. Floating wetlands, or islands, can further reduce pollutants in the lake as a long-term solution: 82% reduction in total phosphorous, 70% reduction in total nitrogen, and 45% reduction in BOD (biological oxygen demand).



Floating Treatment wetlands are manmade floating wetlands that when installed mimic naturally occurring wetlands in a concentrated capacity. 250 square feet of island translates to the equivalent filtering capacity of 1 acre of wetland. Natural wetlands are nature's water filters. Wetlands remove nitrates, filter excessive nutrients and sediment, recharge groundwater, and aid in erosion and flood control (Floating Islands West).

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed
Developed Area Best Management Practices:

Floating Islands

Floating islands have seen successful implementation in various waterways with a diverse wealth of benefits: habitat enhancement, wetland and lake restoration, water quality improvement, stormwater treatment, and recreational use. Floating islands use marine-grade, non-toxic materials. These islands have also been shown to remove heavy metals, nutrients and other pollutants at removal rates of 63%-98%.

Floating islands in Levings Lake, Rockford, IL

Floating islands are already in place at Levings Lake, along with other best management practices like constructed wetlands and native plantings. These best management practices at Levings Lake have demonstrated effectiveness in reducing excess nutrients and sediment. Floating islands allow filtering plants and good bacteria to float on the water in a constructed island, introducing a filtration capability where there wasn’t an opportunity before. Floating islands are recommended in addition to preventative measures in areas where pollutant reduction goals cannot be met using preventative measures alone, or where other benefits such as fish habitat are desired.

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed
Developed Area Best Management Practices:

Porous Pavement

Porous pavement is pavement designs with various percolating layers that filter stormwater. They are especially important in filtering out the first flush pollutants, like car oil, gasoline, heavy metals, litter, suspended solids, and road salt, at the beginning of a storm event. The concept of porous pavement is to allow rainwater to infiltrate into and through the surfaces of parking lots, streets, and other traditional impervious surfaces. When designing a porous surface, the designer must carefully evaluate where the infiltrated rainwater is draining and how the stormwater is being conveyed.

Applicable locations for implementation: The installation of porous pavement is recommended for parking lots, overflow parking, fire lanes, driveways, access roads, walkways, sidewalks, and other low traffic impervious surfaces.

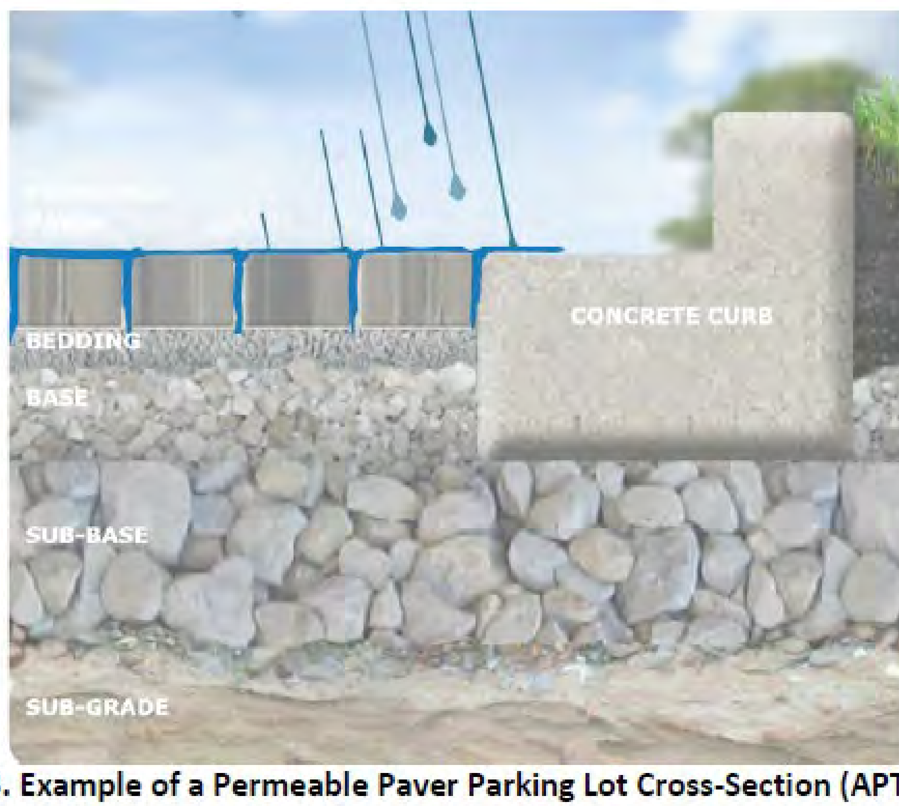


Figure 5.13. Example of a Permeable Paver Parking Lot Cross-Section (APT, 2011)

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed
Developed Area Best Management Practices

Porous Pavement

Morton Arboretum, Lisle. Permeable pavers

Porous pavement and permeable pavers are materials, structures and pavement designs that are specifically designed to allow water to pass through them so they can infiltrate into the underlying soils. Porous pavements infiltrate, filter, and/or store precipitation where it falls. Currently, they work well when used in pedestrian areas, on and off-street parking stalls and alleys (Lake County). This best management practice could be cost effective where property values are high and flooding or icing is an issue (EPA, What is Green Infrastructure?). Porous pavement is benefits from vacuum sweeping to ensure optimal performance and prevent sediment from clogging the surface.

Benefits:
✓decreased surface runoff
✓reduced runoff velocity
✓improved water quality
✓groundwater recharge through more direct infiltration

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Creek Kent Watershed
Developed Area Best Management Practices:
Infiltration Trench

In urban areas, rain fall flows over impervious surfaces, such as asphalt, collecting pollutants as it makes its way downhill. Storm water typically flows into drains leading to a sewage system and ultimately into Earth's water system. In developed areas, overflow of sewers is a common occurrence during a heavy rainfall, contributing organic pollutants to the fresh storm water. Flooding and faulty septic systems threaten local watersheds with increased exposure to contaminants.

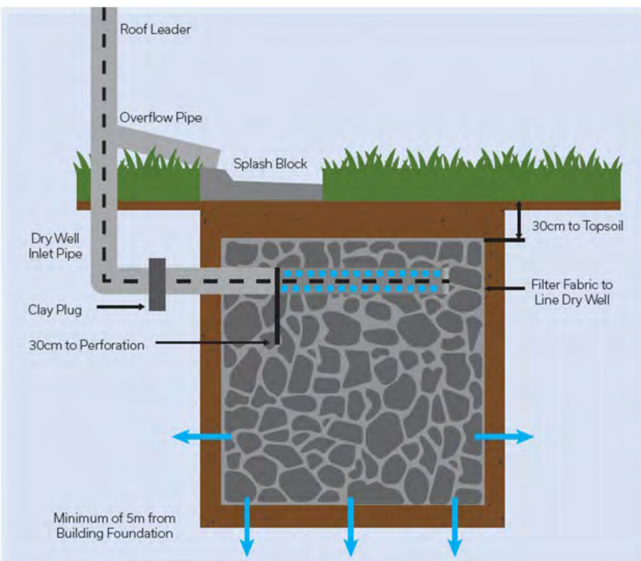


Diagram of an infiltration trench (Windsor City Hall)

A built structure called an infiltration trench is designed to collect fresh storm water. The trenches are excavated near infrastructure where running water could be captured, like the end of a sloped driveway, and temporarily held beneath ground. They are lined with a geotextile material and then filled with granular stone. This facilitates the infiltration of water into the ground to recharge the water table with uncontaminated water.

Benefits:

- ✓ Reduces fresh water in sewer system
- ✓ Reduces risk of flooding
- ✓ Recharges the water table
- ✓ Reduces peak flows in sewer
- ✓ Improves water quality
- ✓ Reduces channel erosion

Applicable locations for implementation:

- Rooftop downspouts
- Driveways
- Parking lots
- Roadsides

Infiltration trenches should not be used near farms or industrial complexes to ensure that pollutants in these areas do not leach into the ground water.

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Creek Kent Watershed
Developed Area Best Management Practices:

Infiltration Trench

Infiltration trench (Nebraska Stormwater Cooperative 2017)

This BMP mimics the natural processes that result in the infiltration and evapotranspiration of storm water to protect water quality and maintain a watershed's hydrological function (USEPA 2018).

When used correctly, green infrastructure has the capability of restoring damaged Earth systems. One potential downfall of an infiltration trench is that it ineffectively captures sediments which can clog the system (SUNY College). Pairing with vegetative filter strips or other natural buffers can increase the overall effectiveness of storm water management.

Infiltration trench intermixed with other BMPs (Wikipedia 2018)

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

References

Olson Ecological Solutions, LLC

Floating Islands West. Retrieved from https://floatingislandswest.com/

Floating Islands International. Retrieved from https://www.floatingislandinternational.com/

Lake County Stormwater Management Commission. Retrieved from https://www.lakecountyil.gov//553/Stormwater-Management-Commission

Laramie County Conservation District. Best Management Practices for Stormwater Runoff: Ponds. Retrieved from https://www.lccdnet.org/wp-content/uploads/Ponds.pdf

Metropolitan Water Reclamation District of Greater Chicago. 2018. Technical Guidance manual for the Implementation of the Watershed Management Ordinance. Retrieved from https://mwrd.org/sites/default/files/documents/TGM.pdf

Nebraska Stormwater Cooperative. 2017. infiltration-trench-.original. Retrieved from http://www.nebraskah2o.org/infiltration-trench-original/.

NRCS. Electronic Field Office Technical Guide. Retrieved from https://efotg.sc.egov.usda.gov/#/.

SUNY College, E. S. F. D. (n.d.). Stormwater Management: Infiltration Trenches. Retrieved from https://www.esf.edu/ere/endreny/GICalculator/InfiltrationIntro.html.

USEPA. 2003. Protecting Water Quality from Urban Runoff. Retrieved from https://www3.epa.gov/npdes/pubs/nps_urban-facts_final.pdf

USEPA. 2018. Urban Runoff: Low Impact Development. Retrieved from https://www.epa.gov/nps/urban-runoff-low-impact-development.

USEPA. 2019. What is Green Infrastructure. Retrieved from https://www.epa.gov/green-infrastructure/what-green-infrastructure

USEPA. 2020. Nutrient Pollution. Retrieved from https://www.epa.gov/nutrientpollution

Windsor City Hall. (n.d.). Climate Resilient Home: Infiltration Trench. Retrieved from https://www.citywindsor.ca/residents/environment/climate-change-adaptation/climate-resilient-home/Pages/Infiltration-Trench.aspx

Exhibit D

Educational Fliers
for
Best Management Practices in Rural Areas

South Fork Kent Creek Watershed

Rockford, Illinois, Winnebago County

Created By Olson Ecological Solutions

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

Olson Ecological Solutions, LLC

South Fork Kent Creek Watershed:
Rural Best Management Practices

Grassed Waterways

Grassed waterways, either natural or constructed, are shaped or graded channels that are planted with suitable vegetation for runoff conveyance without causing channel erosion. (EPA 2018).

Benefits:

- ✓ Conveys runoff from terraces, diversions, and other water concentrations without flooding or erosion
- ✓ Prevents gully formation
- ✓ Protects and improves water quality
- ✓ Provide wildlife habitat, corridor connections, and vegetative diversity

Clean Water Iowa

NRCS Wisconsin

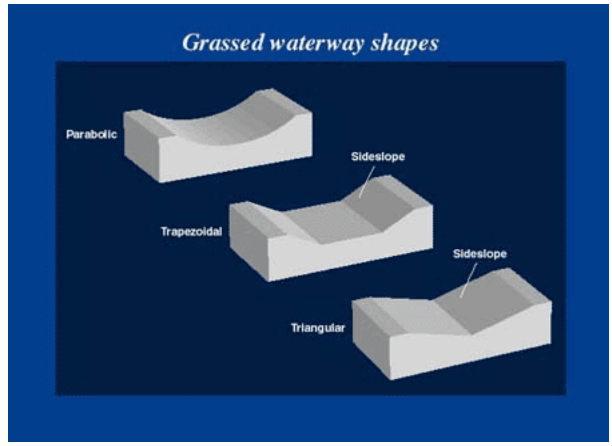
With a life span of ten years, some waterways are maintained and improved each year. Existing grassed waterways within the watershed can be improved in order to handle larger storm events. The watershed-based plan will recognize the efforts being taken to maintain these grassed waterways, and implementation projects may include match funding for repairs.

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

Grassed Waterways

When designing grassed waterways, one must consider slope, vegetative cover, soil conditions and erodibility, channel shape and maintenance (US EPA Agricultural Management Practices for Water Quality Protection). Generally farmers use one of three grassed waterway shapes: parabolic, trapezoidal, or triangular. Many favor the parabolic shape as it is the shape naturally taken in watercourses, an easier shape to visualize and build, and easiest shape to cross with farm equipment. However, small water flows are less likely to meander in parabolic waterways (University of Illinois Extension).



University of Illinois Extension, This Land

US EPA

When initially installing grassed waterways, it is important to allow for grassed vegetation to establish in order for it to withstand the water velocities it is designed to accommodate. To aid in this process, side diversions can be installed along the sides of the waterway to keep flow out of the channel. Once grass has established, these diversions should be removed. Alternatively, one may utilize rock/fabric checks or mulching.

Conservation Practice Standard: Grassed Waterway, **Code 412**

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed:
Rural Best Management Practices

Ponds & Basins

Ponds and basins are constructed bodies of water created by either excavating an area for water storage or installing a dam across an existing water course (i.e. an existing gully or low-lying area). When installing these ponds and basins, one should ensure compliance with state laws and permits during planning, design, and layout phases. When possible, a pond should be installed with 2 or more specified uses. These intended uses should impact the installation and storage requirement specifications. The stated uses below are not all compatible with each other. It is also recommended that the plan include vegetation to allow for pollution to be filtered out of the water (NRCS Engineering Field Handbook).


NRCS USDA Ohio

Benefits and Uses:

- ✓ Captures runoff water and reduces peak stormwater runoff
- ✓ Reduces stormwater velocity
- ✓ Provides water for livestock or household use
- ✓ Offers irrigation storage
- ✓ Provides water source for pesticide spraying and/or fire protection
- ✓ Allows for recreational uses (fishing, boating, swimming, etc.)
- ✓ Enhances wildlife habitat and/or aesthetic appearance

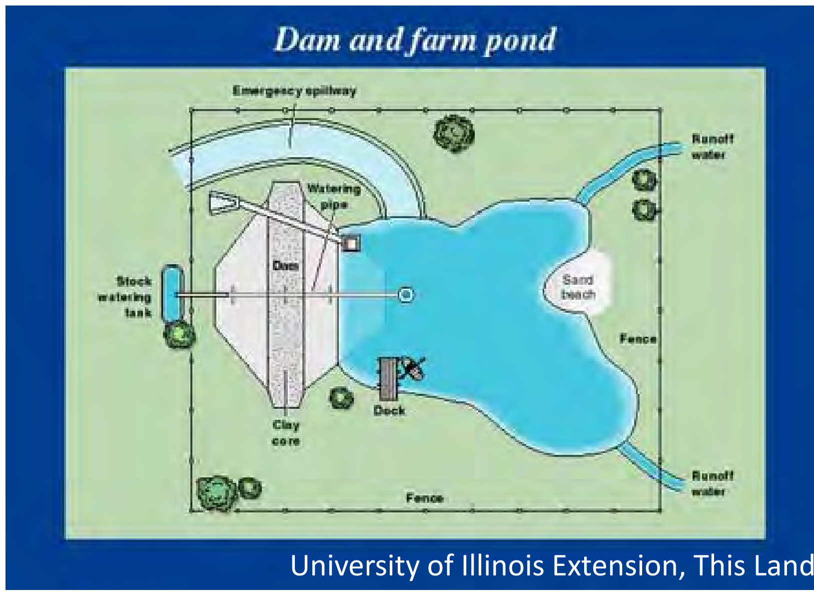
Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed:
Rural Best Management Practices

Ponds & Basins

Topography, hydrology, and water storage capacity play key roles in site selection for farm ponds and basins. One should locate a pond where the largest amount of storage capacity exists with the least amount of earthfill. Ideal topography utilizes existing low-lying areas. For instance, an area with a wide and gently sloping basin along with steep banks that come together at the dam site provides ideal water storage and a location for dam construction (University of Illinois Extension). Soils surrounding the pond must contain enough clay to ensure a watertight dam as well as to reduce the amount of water seepage through the bottom of the pond. Alternatively, a clay core in the dam center can assist in sealing the dam if there is not enough watertight soil. Installing a pre-fabricated pond liner could also help with minimizing seepage.



University of Illinois Extension, This Land

For more information on installing farms ponds and basins, please see the USDA NRCS Engineering Field Handbook.
Conservation Practice Standard: Pond, **Code 378**

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed:
Rural Best Management Practices

Forest Stewardship

Problem: Current forested lands are choked out by invasive plant species. Invasive plants grow, reproduce, and spread very quickly and eventually choke out native vegetation as they outcompete native plants and fill in the seed bank. Invasive plants are plants from other countries that have been brought over and established in natural areas. Invasive are able to kill off native habitats by spreading aggressively because of the lack of established predators and diseases that normally regulate them in their origin countries. If these invasive species are left unmanaged they have the high potential of taking over natural areas by drowning out native plants, forming a monoculture, decreasing biodiversity, reducing habitat, and negatively affecting the natural ecosystem and its inhabitants. Invasive and weedy trees and shrubs create an overstory that blocks the sun and reduces the potential for native seed germination.

Northwest Illinois Forestry Association

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

Olson Ecological Solutions, LLC

South Fork Kent Creek Watershed:
Rural Best Management Practices

Forest Stewardship

Solution: By clearing invasive/weedy trees and shrubs, the canopy is opened for sunlight to reach the forest floor, which can then foster a healthy environment for establishment of native vegetation. More ground layer vegetation reduces and filters stormwater runoff and stabilizes the soil. Cutting woody stems (via chainsaw, brush cutters, or loppers) and herbicide treatment of stumps is an easy way to clear woody invasive plants and can be conducted at any time of the year. Larger tree clearing projects usually occur in the winter months as frozen grounds help to reduce soil disturbance.


Tall Bellflower, native woodland plant

Lake County Forest Preserves

For herbaceous plants, invasive plant management includes manual removal (i.e. hand weeding), mowing (annuals or biennials soon before going to seed), or foliar herbicide application during the growing season. Foliar application is used for aggressive, perennial invasive plants like purple loose-strife, reed canary grass, common and cut-leaved teasel. For more information visit: www.invasive.org/illinois/SpeciesofConcern.html

Conservation Practice Standard: Forest Stand Improvement, **Code 666**

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

Stabilize Highly Erodible Land

According to the Food Security Act of 1985, USDA program participants who farm fields that are designed as Highly Erodible Land (HEL) are required to control sheet, rill, and wind erosion, control all ephemeral gullies and maintain wetlands. If farmers do not control this erosion, they can risk losing USDA farm program benefits and crop insurance eligibility. The Natural Resources Conservation Service (NRCS) randomly selects HEL fields to perform compliance reviews to verify that erosion is sufficiently controlled (USDA Iowa NRCS 2018). Ephemeral gullies are eroded channels cutting into the soil that form in natural concentrated flow areas due to the erosive nature of flowing water. There are many different types of conservation practices (BMPs) that can aid in reducing this type of erosion on HEL: Grassed Waterways, Terraces, Water and Sediment Control Basins (WASCOBs), Critical Area Planting, Cover Crops, and No-Till.

USDA, NRCS. Ephemeral gullies and rill erosion.

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed:
Rural Best Management Practices

Stabilize Highly Erodible Land

When deciding on which conservation practice to enlist for stabilizing HEL and preventing ephemeral gullies, a primary factor to consider is the size and slope of the watershed. The steeper the slope and the larger the watershed results in the need for a more efficient conservation practice.

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed:
Rural Best Management Practices

Streambank Stabilization

Streambank stabilization, or streambank and shoreline protection, is the process of employing methods that protect and stabilize banks of streams, shorelines of lakes, reservoirs, or estuaries, and constructed water channels. These methods are employed on banks that are particularly susceptible to erosion and siltation.


NRCS Iowa


NRCS Iowa

A channel is considered stable if the bottom of the channel remains at a relatively consistent elevation over long periods of time. Methods of protecting and stabilizing banks include altering channel capacity, installing riprap lining (use of stones and rocks to armor banks against water's force), vegetating the banks and channel, and creating channel crossing for livestock.


NRCS Vermont

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed:
Rural Best Management Practices

Streambank Stabilization

In order to implement these streambank stabilization methods, it is important to identify the causes of streambank erosion and instability through shoreline site assessments. Potential causes of shoreline instability include watershed alterations (which can modify discharge and sediment amounts), in-channel modifications such as gravel mining, livestock access, water level fluctuations, and boat-generated waves.

Benefits:

- ✓ Reduces the negative effects of sedimentation, both on-site and downstream, resulting from bank erosion
- ✓ Prevents the loss of land or destruction of land uses or facilities near the waterway
- ✓ Helps to maintain the flow capacity of the waterway
- ✓ Improves stream corridor for fish and wildlife habitat and recreational uses
- ✓ Enhances aesthetics

Conservation Practice Standard: Streambank and Shoreline Protection, **Code 580**


NRCS USDA


NRCS Georgia

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed:
Rural Best Management Practices

Filter Strips

A filter strip is an area or strip of permanent, herbaceous vegetation for removing organic matter, sediment, and other pollutants from runoff before it enters water sources or water bodies. Filter strips are installed in environmentally sensitive areas that need protection from contaminated runoff.

Conservation Practice Standard: Filter Strips, **Code 393**

Benefits:

- ✓ Reduces suspended solids and other pollutants in runoff
- ✓ Reduces excessive sediment in waterways
- ✓ Decreases dissolved contaminant loadings in runoff


NRCS Georgia


NRCS USDA

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed:
Rural Best Management Practices

Filter Strips

Design Considerations: Filter strips should be planted cross-slope or on the contour downhill from the source of contamination. They should be wide enough to accomplish intended purposes. According to the NRCS Conservation Practice Standard, filter strip width should be based on a 15-minute flow through time determined not to exceed a 30-minute flow through time.

Species Considerations: Plant species should be adapted to climate and soil of the planting site and have a moderate to aggressive establishment rate in order to inhabit the site quickly. Chosen plants should also be able to tolerate polluted runoff, sediment deposition, and herbicide runoff. Ideally, selected plant species could have stiff stems and a high stem density close to ground surface.

Operation/Maintenance Considerations: In order to maintain the filter strip's filtering capacity, filter strip vegetation should be harvested and removed at appropriate times. Harvesting and removing dead vegetation will improve vigor and density of vegetation, remove pollutants absorbed in plant tissue, and aid in maintaining upright growth habit. Periodically it may be necessary to regrade or reestablish filter strip vegetation when sedimentation jeopardize the filter strip's function.

NRCS Iowa

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed:
Rural Best Management Practices

Reduced Tillage

Tilling the soil with conventional plow-based systems leaves the soil vulnerable to erosion and intensifies agricultural runoff. Many farmers have been turning to more conservative tillage practices to reduce negative impacts. Reduced tillage as a BMP is the process of utilizing any tillage practices that are less intensive or aggressive than conventional tillage. For example, if a tillage process that requires less energy per unit area replaces a conventional tillage process, then the farmer has achieved reduced tillage. The term reduced tillage sometimes implies conservation tillage, but conservation tillage Systems require farmers to cover 30 percent of the soil surface with residue after planting (EPA 2018).


Photo credit: Jason Johnson, NRCS-Iowa. A no-till planter plants soybeans into a terminated cover crop

It is recommended to learn how to perform continuous no till from other producers who have had success, since periodic conventional till negates some of the benefits.

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed:
Rural Best Management Practices

Reduced Tillage

Conservation Practice Standard: Residue and Tillage Management, **Code 345**

Positives:

- ✓ Reduces soil erosion (in some cases by 70-100%)
- ✓ Reduces polluted runoff flow into water bodies
- ✓ Improves soil health and structure & reduces soil compaction
- ✓ Conserves water
- ✓ Decreases fuel by 50-80% and labor costs by 30-50%
- ✓ Sequesters carbon

Negatives:

- ✓ Transition from conventional to no till is difficult
- ✓ Requires pricey equipment (i.e. specialized no-till seeding equipment)
- ✓ Increases reliance on herbicide (alternatively farmers can use cover crop and crop rotation to aid in weed management)
- ✓ Causes unexpected shifts in weeds, disease, or pest prevalence
- ✓ Potentially slows germination and reduces yields

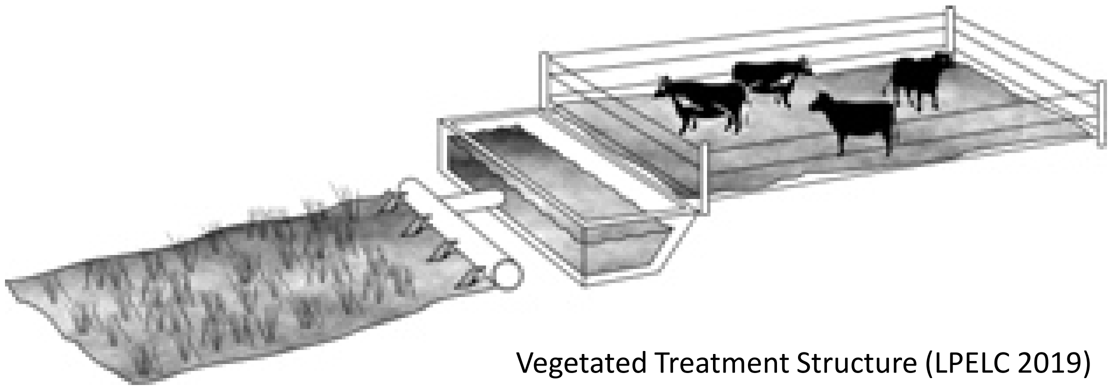
(Huggins et al. 2008)

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed:
Rural Best Management Practices

Vegetated Treatment Area



Vegetated Treatment Structure (LPELC 2019)

An area of perennial vegetation can be placed near feedlots for livestock, barnyards, compost and solid waste operations, and other agricultural facilities. The purpose of this area is to collect contaminated runoff and reduce nutrients, organic materials, and pathogens from entering local water systems.

Runoff is first directed into a basin in which sediments settle before releasing the controlled liquids into the treatment area. Next, natural processes take place, using the nutrients and killing off any pathogens.

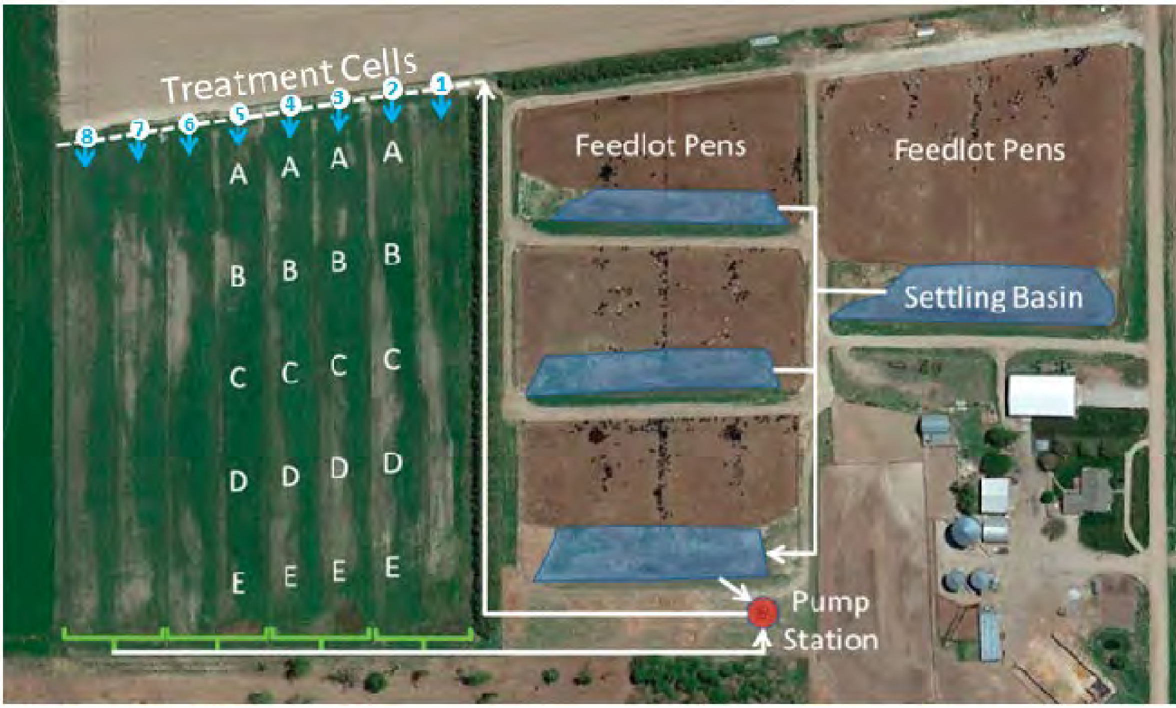
When designing a vegetative treatment structure, it is imperative that the land is graded or terraced to allow for both the basin, in which runoff is sorted, and a lower land area with enough surface area to evenly and meaningfully release liquids. High capacity nutrient cycling is contingent on the size of this area as is harvesting the vegetation to promote denser growth (LPELC). Selection of vegetation should be contingent on species that can grow there permanently and withstand flooding.

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed:
Rural Best Management Practices

Vegetated Treatment Area



Bird's eye view of feedlots next to treatment area (Durso 2016)

Benefits:

✓Reduces loading of nutrients, organic material, pathogens, other contaminants from waterways

✓Protects water quality in sensitive areas

Additional management of treatment areas may also be implemented:

- Pumps that reroute runoff that is not infiltrated in time.
- Berms at the lower end of area will help to retain discharge.
- Water table monitoring is vital in the placement of the treatment area and to protect against watershed contamination.
- Storing excess effluent for other uses.
- Keeping humans and animals out of the area with fencing.

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

Olson Ecological Solutions, LLC

South Fork Kent Creek Watershed:
Rural Best Management Practices

Stream Crossing

Stream crossings are constructed access bridges, culverts, or fords to allow passage over a stream for wildlife, livestock, or people. The function of the crossings is to keep direct contamination out of a stream whilst maintaining the integrity of the physical streambed. A stream crossing must be non-erosive and structurally stable. Bridges typically cause the least amount of disturbances to the stream bed or flow, but they are the most expensive to implement. Culverts are the most common and least expensive crossing to construct because building material can be reclaimed. Culvert crossings result in higher disturbance of a stream and surrounding area. Fords are best suited to areas where crossing is left at a minimum, they are most common in areas prone to flash flooding.

Bridge Crossing (Massachusetts DEP 1997)

Benefits and Uses:

- ✓ Reduces load of sediment, nutrient, and organic material into steams
- ✓ Reduces erosion
- ✓ Provides access for livestock across sensitive areas
- ✓ Enhances wildlife habitat

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed:
Rural Best Management Practices

Stream Crossing

When planning a stream crossing it is best to evaluate stream channel conditions for any cases of overflow. Flooding of a stream bank may damage a crossing and reverse the positive effects of its placement. It is best to select locations where erosion activity is low to avoid stream and water degradation. The NRCS Conservation Practice Standard (CPS) Channel Bed Stabilization (Code 584) has more information on stable site locations on construction standards.

After construction, highly disturbed areas must be vegetated in compliance with CPS Critical Area Planting (Code 342) and CPS Heavy Use Area Protection (Code 561).

Fencing (Code 382) may also be used to deter livestock or wildlife from entering the stream and crossing: this is efficient for agriculture use.

Culvert Crossing (left) and Ford Crossing (right) (Massachusetts DEP 1997)

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed:
Rural Best Management Practices

Heavy Use Area Protection

Heavy Use Area Protection (HUAP) is a technique used to stabilize the ground's surface in an area that is heavily used by livestock, people, or vehicles. HUAP surface treatments can be made of concrete, asphalt, gravel, mulch, or any other non-erosive surface. Areas at risk of concentrated contamination are considered when stabilizing a surface for HUAP. Treatments are often practiced but not limited to livestock feeding areas and watering facilities.

Barnyard before (left) and after (right) surface stabilization using Heavy Use Are Protection (USDA 2014).

Placement of HUAP should be away from any surface water. Alternatively, any surface water flow should be diverted from the treatment area. Other considerations should be made to collect, store, and treat manure when it may be a cause for concern. HUAP operations work best when introduced with a prescribed grazing plan on a site. HUAPs can be used as stand-alone solutions if proper maintenance and waste disposal practices are implemented. Fences (Code 382), Roof and Covers (Code 367), Vegetated Treatment Areas (Code 635), and Filter Strips (Code 393) are commonly used to accompany this conservation practice.

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed:
Rural Best Management Practices

Prescribed Grazing

(Code 528)

Benefits:
- ✓ Improves surface and subsurface water quality
- ✓ Reduces erosion
- ✓ Improves soil quality
- ✓ Enhances plant communities
- ✓ Enhances wildlife habitat

Managing the frequency, duration, and location of grazing or browsing by livestock is a highly effective conservation practice. Harvesting in prescribed areas increases productivity and diversity of plant communities, which in turn is beneficial to wildlife habitation. Soil and water quality also benefit from a balanced nutrient load while not being stripped of their vegetative cover. This cyclical practice should be used away from any surface water to protect from direct contamination. After grazing, livestock should be returned to their quarters, preferably in an area with heavy use protection (USDA NRCS).

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed:
Rural Best Management Practices

Amendments for Treatment of Agricultural Waste

Manure, wastewater, and other organic contaminants from heavy use areas are not easily managed. Many times multiple conservation practices are used to ensure environmental safety in agricultural facilities. Treatment of these wastes with biological and chemical additives is usually implemented in waste management processes. The impact of certain amendments varies. For instance, some can be used to reduce ammonia emissions from manure to increase its nitrogen content. The best solutions have both environmental and economic benefits.

The planning and implementation of any amendments must follow federal, state, and local laws. They should be labelled with active ingredients, recommended application, safety and storage.

Manure amendment application (NRCS)

Benefits:
- ✓Improves air and water quality
- ✓Protects animal health

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

South Fork Kent Creek Watershed:
Rural Best Management Practices

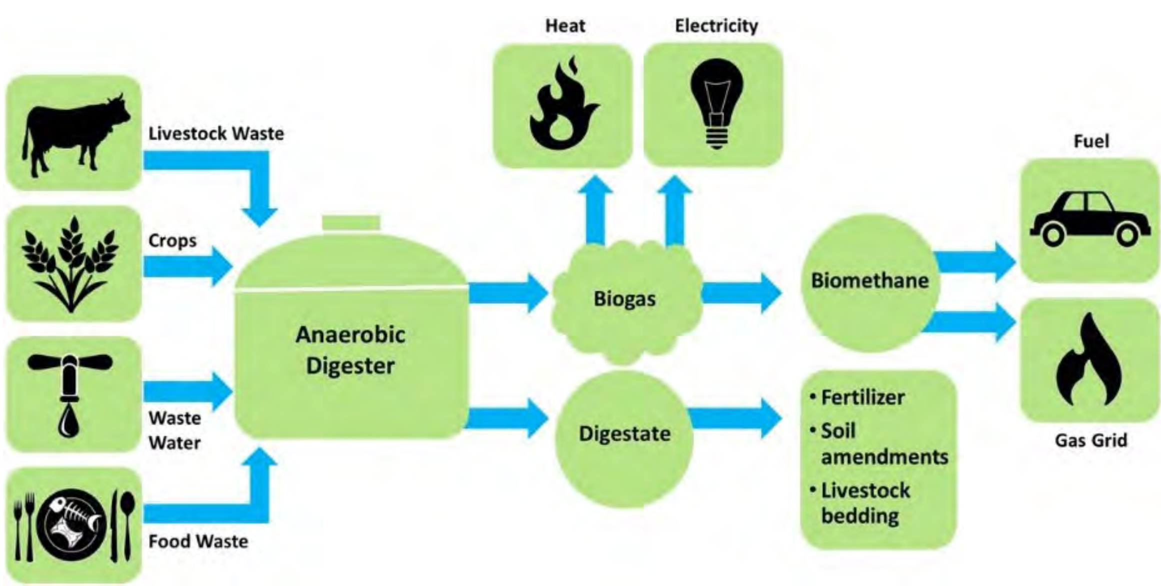
Anaerobic Digester

Organic materials from plants and animals break down by bacteria in an oxygen free environment to produce biogases. This process is called anaerobic digestion. An anaerobic digester is used to optimize the use of biogas as a renewable energy source and efficient waste management, and they are commonly used in waste facilities. A digester can be used to reduce odors, eliminate pathogens, and combat water pollution.

Operations using anaerobic digesters must comply with federal, state, and local laws. The digester is to be located outside of a floodplain to protect the facility from damage.

Other considerations to account for before using this type of facility:

- Proximity to sensitive areas and inhabited areas.
- Characteristic of inputs (animal waste, wastewater, food waste)
- Soil properties and nutrient availability



Anaerobic digestion and uses of biogas (Tanigawa 2017)

Olson Ecological Solutions, LLC

This flier was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

References

Durso, L. M., et al. 2016. Evaluation of Fecal Indicators and Pathogens in a Beef Cattle Feedlot Vegetative Treatment System. *Journal of Environment Quality*, *46*(1), 169.

Huggins, David & John Reganold. No-Till: The Quiet Revolution. *Scientific American Inc*. 2008, pp. 70-77.

Illinois Invasive Species. Invasive Species of Concern. Retrieved from https://www.invasive.org/illinois/speciesofconcern.html

LPELC. 2019. Introduction to Vegetative Treatment Systems. Retrieved from https://lpelc.org/introduction-to-vegetative-treatment-systems/.

Massachusetts Department of Environmental Protection. 1997. Erosion and Sediment Control Guidelines for Urban and Suburban Areas. Retrieved from http://prj.geosyntec.com/npsmanual/streamcrossingtemporary.aspx.

NRCS. Electronic Field Office Technical Guide. Retrieved from https://efotg.sc.egov.usda.gov/#/.

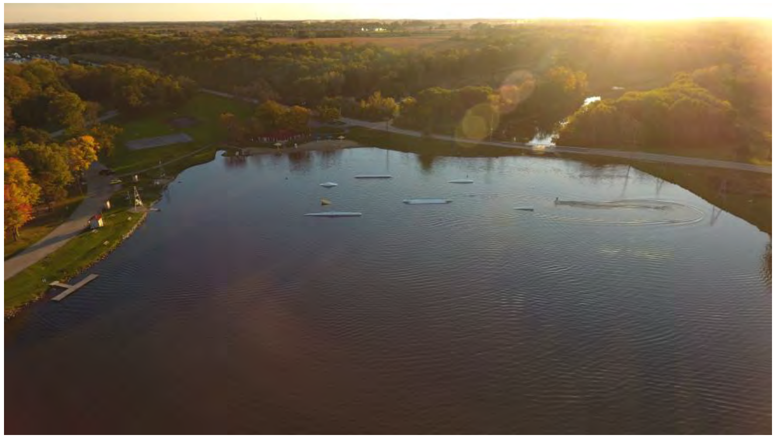
Tanigawa, S. 2017. Fact Sheet - Biogas: Converting Waste to Energy. Retrieved from https://www.eesi.org/papers/view/fact-sheet-biogasconverting-waste-to-energy.

USDA Iowa NRCS. 2018. Conservation Choices: Controlling Ephemeral Gullies. Retrieved from https://www.nrcs.usda.gov/wps/portal/nrcs/ia/newsroom/features/bc7ee685-0512-4e10-a9c0-3520e5017507/

US EPA. 2018. BMP Descriptions for STEPL and Region 5 Model. Retrieved from http://it.tetratech-ffx.com/steplweb/STEPLmain_files/BestManagementPracticesDefinitions.pdf

University of Illinois Extension. This Land: 60 Ways Farms Can Protect Surface Water. Retrieved from http://www.thisland.illinois.edu/60ways/60ways_14.html

Important Resources for Planning and Designing:
NRCS National Handbook of Conservation Practices
NRCS Engineering Field Handbook



A Cleaner Levings Lake

Putting Nature to Work

Olson Ecological Solutions, LLC

January 2017

Acknowledgements

Report Prepared for: Rockford Park District

Authors and Acknowledgements:

Report Prepared by:
Rebecca Olson, Steve Yost, & Shannon Thruman, Olson Ecological Solutions, LLC

Water Quality Assessment:
Joe Rush, JadEco Natural Resource Consultants, LLC

Watershed Analysis:
Nathan Hill, Rockford Park District

Lab Analysis:
Ann St. Amand, Ph. D., CLP, Phyco Tech, Inc.

Best Management Practices Recommendations
Rebecca Olson, Olson Ecological Solutions, LLC
Joe Rush, JadEco Natural Resource Consultants, LLC
Bruce Kania, Mark Reinsel, & Frank Stewart, Floating Island International, Inc.
Dan Jarrett, West Rock Wake Park

Photographs on Cover Provided by:
Dan Jarrett, West Rock Wake Park

Olson Ecological Solutions, LLC

Table of Contents

Introduction

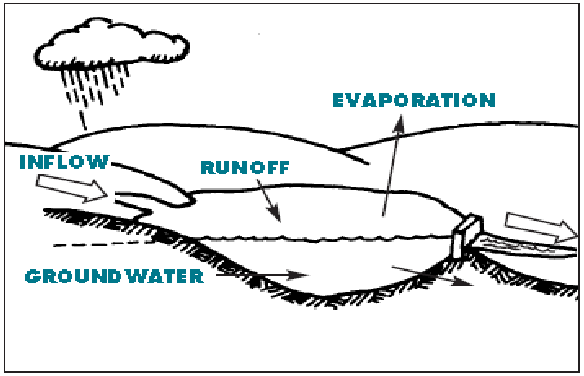
Process and Partnerships
In 2016, the Rockford Park District (RPD) began working with Olson Ecological Solutions (OES) and JadEco Natural Resources (JadEco) to address water quality concerns at Levings Lake: algae blooms, beach closings, turbid water, and a shallow and silty bottom. At that time, RPD was looking for projects that they could implement to provide immediate relief on properties under their ownership or control. As a first step, OES and JadEco focused on assessing and offering solutions to decrease algae blooms. This information was presented to RPD in September of 2016. As support started to build, OES and JadEco turned their attention to relieving beach closings, turbid water, and shallow lake depth with a silty bottom. This report is a combination of the water quality assessments and project recommendations.

Scope of Report
This report offers an assessment of Levings Lake and its watershed and suggestions to improve the water quality of the lake. In order to understand how to improve lake conditions, we first study the current conditions, uses, and problems experienced by the lake. Then we turn our attention upstream to the watershed to understand the land uses and estimate the sediment, nutrients, and pathogens that wash into the lake each year from runoff during storm events. With a general understanding of the lake's problems and the causes and potential sources of these problems coming from the land uses in the watershed and already accumulated in the lake, we offer goals, objectives, milestones, and recommended projects and programs. The improvements contribute to making Levings Lake a recreation destination for the people of Rockford and surrounding communities.

Limitations of Report
This report does not represent all of the actions necessary to take care of the lake; it only considers projects and practices that can be accomplished on lands owned or controlled by RPD. For sustainable care, projects and practices will need to occur upstream within the lake's watershed. Most of the land within the watershed is in private ownership. We encourage RPD to partner with private entities and individuals within the watershed to plan and implement such projects. The next step is to conduct an organized planning effort according to the Environmental Protection Agency's nine elements of a watershed-based plan that involves not only RPD, but representatives from the private and public entities that live, work, and play within the watershed.

Problem Statement

In the United States, water pollution's most serious and common form is nutrients (Kania, 2016). Total suspended solids (TSS), sediment, and pathogens also commonly cause issues for lake health and enjoyment. Lakes affected most severely are man-made impoundments (U of WI, 2004), and Levings Lake is no exception. Nutrients, TSS, and pathogens collect in this impoundment from land uses upstream in Kent Creek, a southern tributary, and runoff directly into the lake. Once in the lake, they lead to nuisance algae blooms; turbid water; a shallower lake with a soft, silty bottom; and beach closings.



4. IMPOUNDMENT—a manmade lake created by damming a stream. An impoundment is also drained by a stream.

(University of Wisconsin Extension, 2004)

History

Levings Lake is man-made: an impounded portion of Kent Creek held by a dam. It is about 23.4 acres, and has an average depth of 4-6 feet (see Appendix A). It is fed by Kent Creek and a southern tributary that form a 7,376-acre drainage area (see map below). The ratio of drainage area to lake is 211:1. With this large ratio and shallow average depth, the lake likely retains water for only 0-14 days (Shaw *et. al.*, 2004). The Rockford Park District has written a short article on history of Levings Lake which can be read in Appendix B.

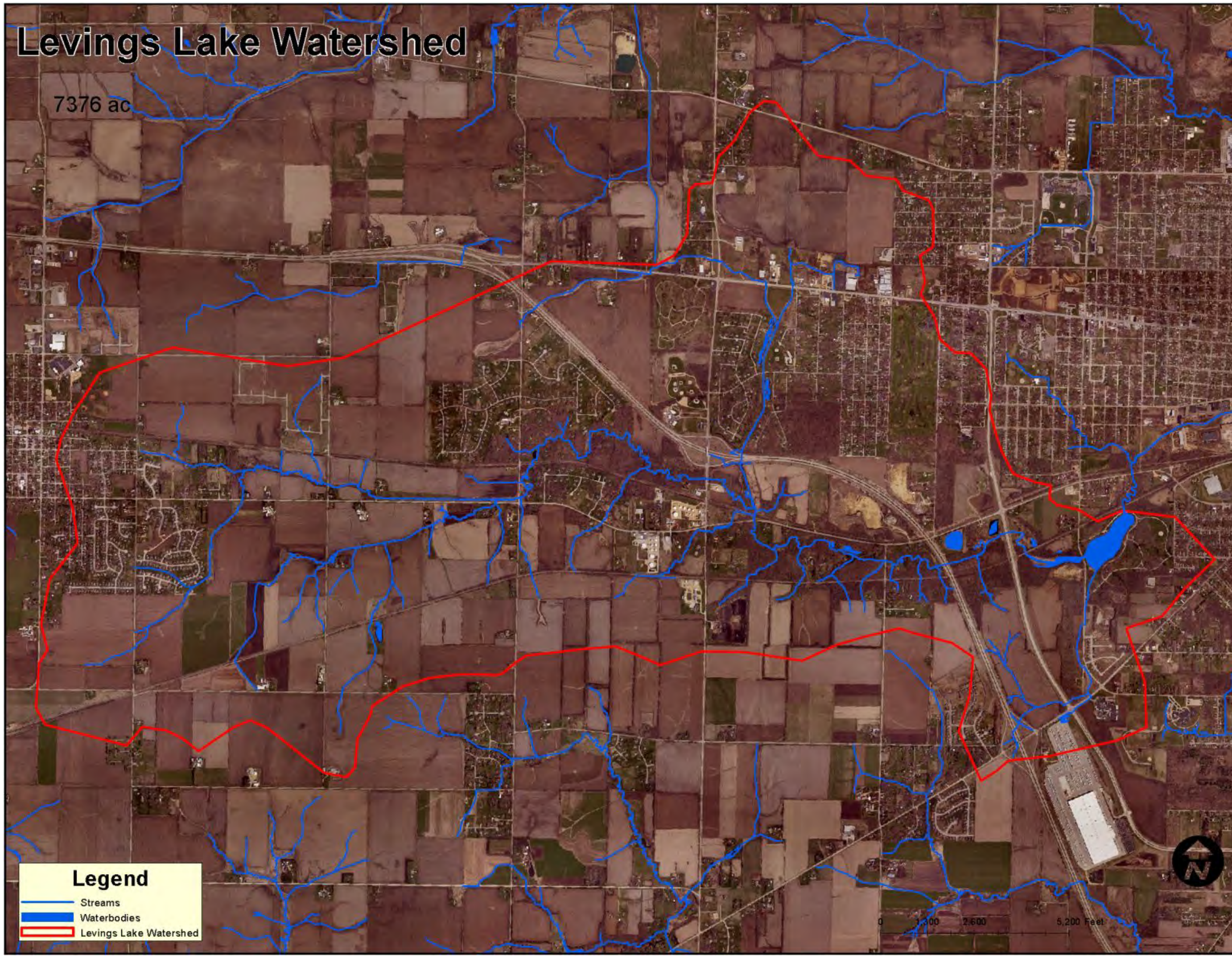
A picture of spadderdock *(nuphar advena)* located upstream depicts dried sediment deposits on the leaves, which would have occurred during high-water flow events. The sediment accumulated on the leaves is solid evidence of a high sedimentation rate entering Levings Lake from Kent Creek.

Current Conditions

Upstream Land Use Assessment

The 7,376-acre watershed is largely in agricultural production (48%) and rural forest, grassland, and wetland (39%). It also includes residential (7%) and associated grassland (6%) east of Meridian Rd and part of the Lowe's warehouse parking lots.

The main tributary, Kent Creek, consists of 6,885 acres. A second tributary, to which we refer as the "southern tributary," includes 499 acres: 8 acres of Levings Park and 491 acres of private land. There are also 127 acres that drain directly into the lake: 107 acres of Levings Park and 20 acres of private residential land.



(Map by Nathan Hill, 2016)

Levings Lake
Southern Tributary
491-acre* watershed

*Note: The watershed of the southern tribuatary is 499 acres.
Levings Park contributes 8 acres next to the tributary not shown.

Upstream Causes and Sources of Pollutants

Kent Creek is an impaired water according to the Illinois Environmental Protection Agency. Upstream nonopoint sources are contributing an estimated 2,000 lbs of total phosphorous (TP) and 1,208,900 lbs of total suspended solids (TSS) to Levings Lake annually. Upstream agricultural and residential land uses contribute elevated amounts, while forests and grasslands contribute natural amounts. Efforts to drain wet ground for farming and keep residential lawns dry, combined with lack of buffer along streams and other best management practices contribute to increased volume and velocity of water in Kent Creek and the southern tributary, causing streambank and gully erosion, expediting the eutrophication processes of the lake.

Pollutant Loading to Levings Lake in 2017

Drainage Area	Pollutant	Pollutant Loads
Southern Tributary	TP (lb/yr)	145
	TSS (lb/yr)	100,276
	TN (lb/yr)	1,324
Levings Park	TP (lb/yr)	49
	TSS (lb/yr)	30,400
	TN (lb/yr)	295
Kent Creek	TP (lb/yr)	1,805
	TSS (lb/yr)	1,078,227
	TN (lb/yr)	14,195
Totals	**TP (lb/yr)**	**1,999**
	TSS (lb/yr)	**1,208,903**
	TN (lb/yr)	**15,814**

In-Lake Water Sampling

On August 4th, 2016 JadEco collected field data and water quality data for Levings Lake. Weather conditions were light south winds and sunny with an air temperature of 28.8°C (83.8°F). The purpose of this data collection was to understand current physical, chemical, and biological conditions within Levings Lake. This data collection provides a point in time perspective. However, the system can have seasonal and annual variations in water chemistry and biological composition such as algae, and therefore conditions can be variable between seasons and years. A better understanding of the system would require more sampling and analysis over time.

Earlier in the summer, the wake park owner observed a bloom of clumps of brown material floating on the surface of the lake. The brown scum caused concern it was a toxin producing blue-green algae. Therefore, we planned to sample and ship for analysis to better understand the bloom. Prior to our arrival August 4th, we were notified by the wake park that another ‘bloom’ of brown clumps was on the surface of Levings Lake. We were prepared to sample and ship for analysis.

Along with physical observation of lake conditions, JadEco collected physical data at two sites and water quality and algae composition samples at one site (Site 1). Site 1 was near the wake park, while Site 2 was near the dam. The following parameters were reviewed at two sites: Water clarity, temperature and dissolved oxygen profiles, and total depth. Along with these parameters, water samples were collected near the wake park (Site 1) and analyzed for alkalinity, chloride, pH, chlorophyll, ammonia nitrogen, nitrate and nitrite, Kjeldahl nitrogen, total phosphorus, reactive phosphorus (orthophosphorus), volatile suspended solids, and total suspended solids. A collection for algae, identification, classification and biomass was also performed at this site and repeated in October at the inlet of Kent Creek.

JadEco made observations regarding plant and aquatic life. No rooted macrophytes were found within the lake. However, several species of native macrophytes were located in the tributary coming into Levings Lake. These consisted of *Nuphar sp.* (Spadderdock), *Ceratophyllum demersum* (Coontail), *Elodea canadensis* (Common Waterweed), and *Potamogeton sp.* (Pondweed sp.). *Lemna sp.* (Duckweed) was also floating in the creek. Duckweed, while native, can be a nuisance for recreational activity if it becomes too dense. However, the low density observed and the flowing conditions appeared it wasn’t a nuisance for Levings Lake at this time. There was a heavy carp population in the shallow creek area directly upstream of the lake. The feeding nature of common carp can create turbid water by rooting in bottom sediments and they are known to uproot native plants that are trying to establish.

Water sampling locations at
Levings Lake, August 2016

NORTHERN LAKE SERVICE, INC.
Analytical Laboratory and Environmental Services
400 North Lake Avenue - Crandon, WI 54520
Ph: (715)-478-2777 Fax: (715)-478-3060

ANALYTICAL REPORT

WDNR Laboratory ID No. 721026460
WDATCP Laboratory Certification No. 105-330
EPA Laboratory ID No. WI00034
Printed: 08/31/16 Page 1 of 1

Client: JadEco, LLC
Attn: Joe Rush
314 S. Chestnut Street
P.O. Box 445
Shannon, IL 61078

NLS Project: **264788**
NLS Customer: **108656**
Phone: 815 543 5695

Project: Surface Water Testing

Site 1 Leving's Lake NLS ID: 937294
COC: 199195:1 Matrix: SW
Collected: 08/04/16 11:44 Received: 08/05/16

Parameter	Result	Units	Dilution	LOD	LOQ	Analyzed	Method	Lab
Algae identification, classification, and Biomass	see attached					08/26/16	10200F.2.C.1	NA
Alkalinity, tot. as CaCO3 (unfiltered)	240	mg/L	2	2.0	4.0	08/10/16	2320 B-1997	721026460
Chloride, as Cl (unfiltered)	77	mg/L	10	2.5	5.0	08/15/16	EPA 300.0, Rev 2.1	721026460
Chlorophyll, all species	See Attached					08/15/16	10200-H	721026460
Nitrogen, ammonia as N (unfiltered)	[0.073]	mg/L	1	0.025	0.075	08/09/16	4500-NH3 G-1997	721026460
Nitrogen, NO2 + NO3 as N (unfiltered)	3.9	mg/L	1	0.019	0.062	08/10/16	4500-NO3 F-2000	721026460
Nitrogen, Kjeldahl as N (unfiltered)	0.89	mg/L	1	0.10	0.33	08/15/16	EPA 351.2, Rev 2	721026460
pH, Lab	8.33	s.u.	1			08/05/16	4500-H+B-2000	721026460
Phosphorus, tot. as P	0.027	mg/L	1	0.0070*		08/09/16	4500-P E-1999	721026460
Phosphorus, tot. react. as P	0.018	mg/L	1	0.0070*		08/05/16	4500-P E-1999	721026460
Solids, susp. volatile (water)	9.8	mg/L	1	5.0*		08/11/16	EPA 160.4	721026460
	Sample analyzed in duplicate to verify result.							
Solids, tot. susp. (TSS)	15	mg/L	1	1.0*		08/08/16	2540 D-1997	721026460
Lab filtration for Chlorophyll	yes					08/08/16	NA	721026460

Values in brackets represent results greater than or equal to the LOD but less than the LOQ and are within a region of "Less-Certain Quantitation". Results greater than or equal to the LOQ are considered to be in the region of "Certain Quantitation". LOD and/or LOQ tagged with an asterisk(*) are considered Reporting Limits. All LOD/LOQs adjusted to reflect dilution and/or solids content.

ND = Not Detected (< LOD) LOD = Limit of Detection LOQ = Limit of Quantitation NA = Not Applicable
DWB = Dry Weight Basis %DWB = (mg/kg DWB) / 10000 1000 ug/L = 1 mg/L
MCL = Maximum Contaminant Levels for Drinking Water Samples. Shaded results indicate >MCL.

Reviewed by:

Authorized by:
R. T. Krueger
President

Physical Analysis

Dissolved Oxygen (D.O.) & Temperature

Dissolved Oxygen (D.O.) is needed for aquatic life to survive and grow. It is of particular interest to provide a fishery for recreational users of the lake. A healthy environment for fish would require a D.O. level above 5 mg/L. At or above this level, active growth can be observed. D.O. levels below 5 mg/L may cause stress in some species, and lower than 3 mg/L for extended periods can cause some species of fish to begin to die. D.O. levels at both sites were well above 5 mg/L; Site 1 had surface D.O. readings at 15.3 mg/L and Site 2 had 18.3 mg/L at the surface. Both sites did not stratify, and adequate D.O. was available at all depths recorded. Water temperatures at Site 1 ranged from 27.0°C (80.6°F) at the surface to 24.5°C (76.1°F) at the bottom. Water temperatures at Site 2 ranged form 27.4°C (81.3°F) at the surface to 26.7°C (80.1°F) at the bottom. The shallow nature of the lake most likely allows for easy mixing and does not allow the lake to stratify during summer months. Typically, cooler water holds more D.O. than warmer water; therefore D.O. tends to be higher in the spring and fall than during the summer months. D.O. also varies diurnally. During the day, oxygen-producing organisms, such as green algae and aquatic plants, produce oxygen. At night, oxygen is consumed, but no production occurs due to the lack of photosynthesis by the algae and plants. Therefore, oxygen levels are typically at their lowest before first light in the morning.

pH

pH measures the acidity and alkalinity of the water. A pH of 7 is neutral (neither acid or alkaline). Below 7 is acidic, and above 7 is alkaline. Most lakes in this area have a pH greater than 7, and often in the 8 range, with the median pH of 8.35. The pH scale is logarithmic, therefore a change of 1 unit of pH can be very significant. The lab analysis of pH for site 1 water samples was 8.33.

Alkalinity

Normal alkalinity in this area is between 90-250 mg/L. Alkalinity measures the buffering capacity of a pond. This buffering capacity can help keep the lake from rapid changes in acidity. Site 1 samples provide alkalinity readings of 240 mg/L.

Secchi Depth

A Secchi disc is a standardized disc that allows us to monitor the clarity of the water. High secchi depth indicates the water is very clear and free of algae and suspended sediments. Low secchi depth (less than 3 feet) indicates low water clarity (high turbidity). High turbidity can be a product of high planktonic algae biomass or suspended sediments. Secchi depth readings were 26” at Site 1 and 33” at Site 2.

Chemical Analysis

Trophic State Index (TSI)

The scale for classifying lakes is known as the Trophic State Index (TSI). This index was developed in 1977 by R.E. Carlson in an attempt to provide a single quantitative index for ranking and classifying lakes. It is defined as the total weight of living biological material (biomass) in the lake at a specific location and time. Most often, it is used in assessing water quality. Several water quality measures are used to develop the lake's classification. These measurements include: transparency or turbidity (water clarity), chlorophyll-a concentrations (algal biomass in the water), and total phosphorus levels (as previously stated, it generally is the limiting nutrient for plant and algal growth). The TSI scale ranges from 0 to 100 and is a based on the relationship between the three monitoring measurements previously described (transparency, chlorophyll-a, and phosphorus).

The word 'eutrophication' is used to describe a lake's aging process, and is caused by excessive nutrients in a lake or body of water. Runoff of nutrients from the land are controlling factors in this aging process. Lakes are classified by the extent to which eutrophication has occurred. The following defines the classification ranges:

oligotrophic - Nutrient poor and low productivity lakes with high transparency (water clarity). There is low chlorophyll-a (plant and algae biomass) and low phosphorus.

mesotrophic - Moderately productive lakes with intermediate clarity, chlorophyll-a, and phosphorus concentration.

eutrophic - Very productive and fertile lakes with low water clarity and high chlorophyll and phosphorus concentrations.

hypereutrophic - Extremely productive lakes with noxious surface scums of algae, generally dominated by blue green algae blooms.

In Midwest farm country, having an oligotrophic lake isn't normal. They exist in Illinois, just not commonly, and are normally natural lakes, not man-made lakes or impoundments like Levings Lake. These types of lakes would be more synonymous with Northern Wisconsin, or Canadian lakes.

The TSI for Levings Lake would be 58, and the classification would be Eutrophic, a common problem for Midwest lakes.

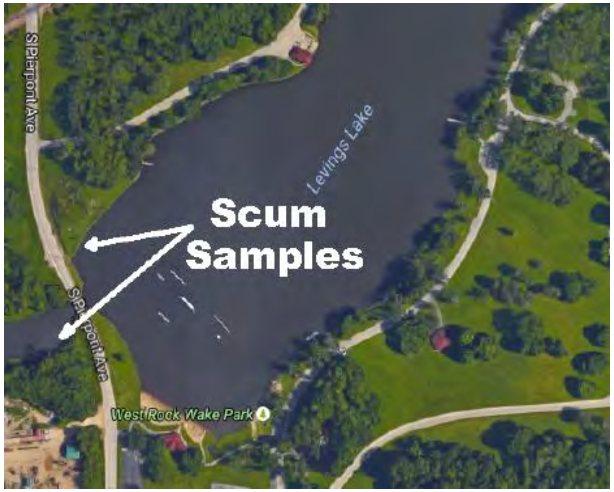
<u>Algae and Phosphorous</u>

Levings Lake is currently experiencing occasional diatomic algae blooms. These are benign but unsightly. We identified the algae on two occasions in August and October 2016. Fortunately at this time, we did not find any sign of toxic blue-green algae, as shown by the chlorophyll measurements below. The algae floats into the lake from Kent Creek and originates in the lake. Conditions may change suddenly, so the report below gives a snapshot of conditions in August 2016.

Chlorophyll a, found in all photosynthesizing plants, estimates the amount of planktonic algae suspended in water. More than 55 µg/L could "highly impair recreational lake use" and 7 to 20 µg/L could cause slight impairment (Hudson, 1998). Levings Lake has a count of 21 µg/L, suggesting that the algae could cause slight impairment, which is a good description of actual occurrences.

An algae sample was collected to determine the classification and biomass of algae within Levings Lake, which can help us understand the composition of the algae community. The algae sample was dominated by Chlorophyta (green algae) at 76.6% of the biomass, followed by 9.2% Euglenophyceae (flagellates), 7.2% Pyrrophycophyta (dinoflagellates), 6.7% Bacillariophyceae (diatoms), 0.2% Cyanobacteria (blue-green algae), and 0.1% Cryptophyceae (cryptomonads).

The wake park has witnessed several blooms that appeared as brown clumps floating on the surface. Two samples were collected and shipped for identification. One sample was on the east side of the Pierpont Bridge by the wake park's turn-around area, and the other was upstream of the bridge where it was accumulating on the bridge piling area. While on site, we witnessed the bloom floating up from the creek bottom and floating downstream towards Levings Lake. The lab results indicated a 99% dominance of diatoms, in particular genus Nitzchia sp. and Navicula sp. The lab also performed a microcystin stick test on the samples, which indicated no measureable toxin was present (Abraxis, recreational test, 0-10 ug/L).



Chlorophyll Results

Customer: JadEco, LLC
Project: 264788
Surface Water Testing

Sample	Description	CC a	Pheo a	TC a	TC b	TC c
937294	Site 1 Leving's Lake	21	2.9	24	4.5	1.3

CC a = Corrected Chlorophyll a
Pheo a = Pheophytin a
TC a = Trichromatic Chlorophyll a
TC b = Trichromatic Chlorophyll b
TC c = Trichromatic Chlorophyll c
Units = ug/L for Water, ug/cm² for periphyton samplers

*: The complex calculations used to differentiate the various chlorophyll species magnify error at low concentrations and sometimes produce negative values, which are reported as 0.0 on this report.

Algae is caused by an over-abundance of nutrients in the water. In Levings Lake, we have identified phosphorous as the nutrient responsible for limiting plant and algae growth. If we can control the amount of phosphorous in the lake, we can control nuisance algae blooms.

The measurement of total phosphorus is represented by the sum of all of the different forms of phosphorus available in the water column, both dissolved and particulate that include orthophosphorus, phosphorus contained within organisms (zooplankton and algae), and phosphorous attached to sediments. Very small amounts of phosphorous are needed to stimulate algae growth. In most freshwater systems, phosphorous is the limiting factor for plant and algae growth.

In August 2016, phosphorous in the lake measured 0.027 mg/L. This reading is statistically similar to 0.03 mg/L, which is enough phosphorous to stimulate nuisance algae growth and less than the State of Illinois' General Water Use Quality Standard of 0.05 mg/L. This standard is under scrutiny, as various agencies have differences of opinion about the phosphorous reading most meaningful in terms of water quality (Hudson, 1998). For instance, the US EPA suggests a total phosphorous level be less than 0.038 mg/L.

Orthophosphorus, also known as reactive phosphates, are main constituents in fertilizers used for agricultural and residential purposes. Orthophosphorus found in natural water provide a good estimation of the amount of phosphorus available for plant and algae growth dissolved into the water. Frequently, levels of Orthophosphorus above 0.01 mg/L can cause algae blooms. Orthophosphorus can be carried into streams and lakes through run-off. At Site 1, orthophosphorus was recorded at 0.018 mg/L.

Turbidity and Total Suspended Solids

TSS are "filterable" solids suspended in the water that contribute to turbidity. Levings Lake receives total suspended solids from Kent Creek, the southern tributary, and runoff from the park, leading to sedimentation. TSS can be subdivided into volatile suspended solids (VSS) and nonvolatile suspended solids (NVSS). VSS consist of all organic solids (algae cells, small particles of plant material, zooplankton, etc.) suspended in the water. NVSS include inorganic, "mineral" substances like sediment particles. High levels of TSS can be the result of algae blooms, sediment re-suspension, and the inflow of turbid waters. Typically, lakes with high TSS are correlated with high phosphorus levels, low water clarity, and a lack of aquatic plant diversity. TSS for Site 1 was at 15 mg/L (as a reference, dredging standards are less than 15 mg/L).

There are no state standards for TSS, but Illinois Environmental Protection Agency's general lake assessment criteria suggest that NVSS above 15 mg/L could "highly impair recreational lake use" while NVSS of 3 to 7 mg/L might cause slight impairment (Hudson, 1998). At Levings Lake, TSS reads 15 mg/L, including 9.8 mg/L of VSS and 5.2 mg/L NVSS. The NVSS reading suggests slight impairment, which is an accurate description of water clarity and sedimentation issues experienced at Levings Lake.

The Illinois Department of Public Health suggests 48" of clarity for swimming safety (Hudson, 1998). In sediment studies at Levings Lake over the years, water clarity has not met this suggestion and ranged from 17" to 32". Specifically, it measured 18" in October 2000, 22" in November 2000, 24" in November 2001, and 17" to 32" in June 2007. The first three were taken during cool conditions and the last was taken during a dry period (Muench).

(Photo by Floating Island International)

Silty Lake Bottom and Sediment

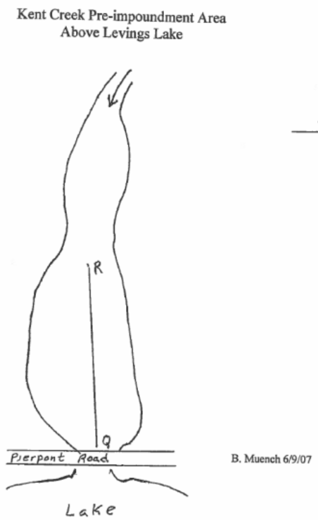
Levings Lake has a soft, silty bottom made up of TSS that have settled to the bottom of the lake. If these materials stay at the bottom, they will not cause a problem. However, they continue to circulate through the water column any time the bottom is stirred, bringing phosphorous and other pollutants with them. In a shallow lake like Levings, this can occur from carp, swimming, and boating.

The lake was dredged in 1989, at the same time that the existing silt basin was created (Olivencia, 2016). At that time, Jim Reid, the design and construction supervisor for the Rockford Park District, said that the existing silt basin could easily be dredged every three to five years and if it wasn’t, then the lake would need to be dredged extensively again in 30 to 40 years. That was 30 years ago (Peterson, 1987). The upkeep of dredging the existing silt basin did not happen, and now the lake has accumulated a significant amount of sediment.

JadEco was unable to find depths greater than 5 feet in the observed areas, including what was previously described by RPD representatives as recently dredged. OES plans to conduct a study of sediment depths in the lake and existing silt basin near the mouth of Kent Creek in the same manner that has been conducted before by Bruce Muench in 2000, 2001, 2004, and 2007. Until then, OES used Muench’s data to extrapolate assumptions and predict the amount of sediment currently settled in these two locations.

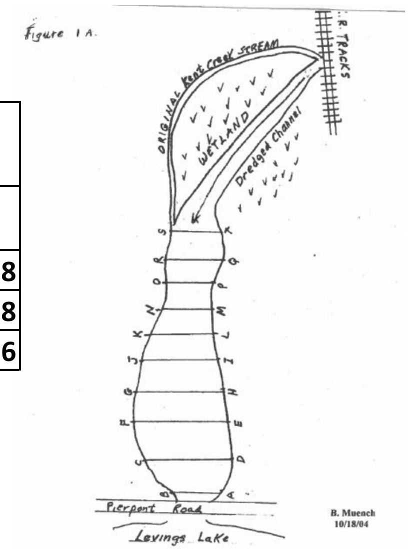
(Photo from West Rock Wake Park)

Muench studied the siltation of Levings Lake and the existing silt basin in 2000, 2004, and 2007. OES analyzed this data and extrapolated that the existing silt basin is at capacity, as the average depths of water and sediment have remained relatively consistent between 2000 and 2007, each averaging 1.8' for a total depth of about 3.6 '. The remainder of TSS floated past the existing silt basin, and most or all of it settled in Levings Lake, as the lake acts as a settling basin for the Kent Creek river system. (Sediment basins typically capture 60% of TSS.) The highest average sediment depth within the existing basin was reported in 2007 at 28.2". At this sediment depth and basin dimensions of 360' long and 110' wide, the existing silt basin may currently be holding about 3,000 cy of sediment. OES will confirm these conclusions by replicating Muench's study in the spring of 2017.

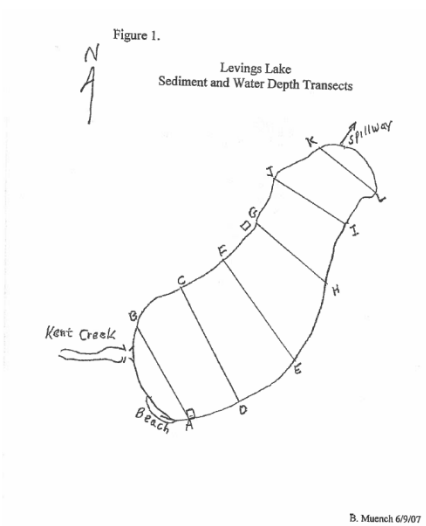


Depth estimates for existing silt basin (averaged from Muench's data in 2000, 2004, 2007 reports)

Summary	2000	2004	2007	AVG
Water depth (ft)	2.0	1.68	1.8	**1.8**
Sediment depth (ft)	1.61	1.63	2.1	**1.8**
Total depth (ft)	**3.6**	**3.3**	**3.9**	**3.6**



OES also analyzed and extrapolated the data from Muench's studies to estimate the amount of sediment in Levings Lake. Doing so suggested increasing sediment depths and inconsistent sedimentation rates. OES concluded that the lake is continuing to collect sediment at an unknown rate; therefore, we do not have enough data to estimate current sediment depths. We will measure these depths in the spring of 2017. In the meantime for planning purposes, we have made some assumptions to provide a possible range of sediment depths. We know that in 2007, Muench reported the average sediment depth in the lake as 14.5". For a 23.4-are lake, that is about 45,600 cy of sediment. The slowest accumulation of sediment occurred between May 2001 and October 2004, when 0.9" of sediment accumulated over 3.5 years. At this rate, there might currently be 17" of sediment in the lake (14.5" + (0.26"/yr x 10 years) = 17.1"). The fastest rate of sedimentation occurred between October 2004 and June 2007. During this 2.5 years, 3.5" of sediment accumulated. At this rate, there may be 28.5" of sediment in the lake now (14.5" + (1.4"/yr x 10 yrs) = 28.5"). These two extrapolations suggest that there is somewhere between 17" and 28" of sediment depth in the lake currently, which translates to 53,500 cy to 90,000 cy, or 25% to 40% of the lake's volume. OES calculated slightly different averages than Muench based on the same data. Both are reported below. Muench's averages were used for calculations of sediment depths. Water depth averages and natural lake bottom depth averages were not reported by Muench; therefore OES estimates were used.



Depth estimates in Levings Lake
(extrapolated from Muench's data in 2007, 2004, 2001, 2000 reports)

Summary	2007	2004	2001	2000	AVG
Water depth (ft)	4.9	5.21	5.81	5.68	**5.4**
Sediment depth (ft)	1.0	0.73	0.65	0.58	**0.7**
Total depth (ft)	5.9	5.9	6.5	6.3	**6.1**

Comparison with prior surveys

Sediment Surveys of Levings Lake

	2000	2001	2004	2007
Ave. sediment depth (inches)	7.2	8.4	9.2	14.5
Impounded area above lake:	16.9	16.2	20.4	28.2

(Muench, 2007)

Beach Closings and Pathogens

Pathogens found in Levings Lake cause occasional beach closings. A pathogen is a bacterium, virus, or other microorganism that can cause disease. Fecal coliforms, including Eschericia coli *(E. coli),* are bacterial types of pathogens that are commonly found in the intestinal tract and fecal material of humans and animals. The presence of fecal coliforms indicate the contamination of water by the feces of warm-blooded animals. Canada geese, along with other waterfowl, are significant non-point sources of fecal contamination in water and are known carriers of several potential pathogens including *E. coli.* In addition to bacteria and other microbes, there is organic waste, nitrogen, and phosphorus in fecal material (Swallow and Huffman, 2009).

The Rockford Park District occasionally closes Stanfield Beach at Levings Lake due to high counts of fecal coliform, and West Rock Wake Park follows suit. Standards to date have been based on Illinois Department of Public Health bathing beach requirements. Section 820.400 Minimum Sanitary Requirements for Bathing Beaches states:

> *e) Bathing Beach Operation*
>
> *"A fecal coliform count of 500 colonies/100 ml or an E. coli count of 235 colonies/100 ml in any single sample of a two-sample set shall require the submission of two additional samples to be collected on the same day within 24 hours after notification by the Department. If either of the two follow-up samples exceeds a fecal coliform count of 500 colonies/100 ml or an E. coli count of 235 colonies/100 ml, the beach shall be closed and not reopened until two additional samples collected on the same day are both less than 500 fecal coliform/100 ml or 235 E. coli/100 ml."*

Potential sources of fecal coliform at Levings Lake include failing, upstream septic systems; livestock operations; wildlife; and most notably, resident Canada geese. Geese defecate from 28 to 92 times per day, with wet weights of the fecal material averaging from 1 to 3 lbs. There are an estimated 30 to 50 resident geese at Levings Lake.

Studies have shown that goose feces can contain up to 10^4 colony-forming units (CFUs) of fecal coliforms per gram of feces. Large numbers of geese can quickly increase the load of fecal material and nutrients into a body of water, resulting in a decrease in water quality (Post et al. 1998). Although geese do not normally defecate directly into the water, runoff from rainfall events transports fecal material from shorelines to water (Swallow and Huffman, 2009). If each goose produces 1-3 lbs of feces per day and goose feces contains up to 10,000 CFUs/g, then each goose produces 4,536,000 to 13,608,000 CFUs of fecal coliforms per day. The feces falls directly in the lake and washes into the lake with runoff from storm events. The 30 to 50 resident geese are contributing an estimated 136,080,000 to 680,400,000 CFUs of fecal coliforms to the lake and surrounding land each day. Multiplied by 365 days, this translates to 4 billion to 34 billion CFUs per year. Geese spend much of their time foraging for food on land, so a portion of these amounts make their way to the lake.

In addition to fecal coliform, the decomposition of organic materials from the feces reduces dissolved oxygen levels when in water. Each goose excretes 1.15 - 3.11 lbs of Kjeldahl nitrogen and 0.36 - 1.41 lbs of phosphorus per year. The nitrogen and phosphorus act as fertilizers, which can cause eutrophication in a body of water (Swallow and Huffman, 2009). Collectively, the 30 to 50 resident geese excrete 34.5 lb (1.15 lb/goose x 30 geese) to 155.5 lb (3.11 lb/goose x 50 geese) of Kjeldahl nitrogen and 10.8 lb (0.36 lb/goose x 30 geese) to 70.5 lb 1.41 lb/goose x 50 geese) of phosphorous each year.

(Photos from Pixabay)

Nitrogen

Nitrogen is a nutrient utilized by plants for growth, and is known as a non-point source pollutant, as a little nitrogen comes from each area and concentrates in the water. Nitrogen levels in a lake are usually dependent on the local land uses, and high levels of nitrogen are commonly found in agricultural areas where fertilizers or animal waste occur. It also occurs through lawn fertilization practices, waterfowl, and atmospheric deposition during thunderstorms. Nitrogen has several forms that are particularly important in lake evaluations. Inorganic forms of nitrogen [nitrate (NO_3^-), nitrite (NO_2^-), and ammonium (NH_4^+)] can be used as food for aquatic plants and algae. Organic nitrogen is nitrogen that occurs in living organisms, and ammonium nitrogen occurs from human and animal waste products and decomposing organic matter. Two common measurements are Kjeldahl nitrogen and total nitrogen. Kjeldahl nitrogen includes organic nitrogen plus ammonium, and total nitrogen is the sum of nitrate, nitrite, and Kjeldahl nitrogen.

Nitrogen levels vary throughout the season. Nitrogen levels are typically higher in the spring and fall when plants are not actively taking up nutrients, and levels can be seasonally variable based on rain events and watershed runoff. The potential for algae blooms occurs when the inorganic nitrogen (nitrate and nitrite + ammonia) is above 0.3 mg/L. Seasonal turnover of a lake can also impact nitrogen levels as nutrients are cycled back to the surface from bottom sediments.

Analysis of the samples collected at Site 1 provided insight into nitrogen levels within Levings Lake at that point in time. Results were as follows:

- ammonia nitrogen was 0.073 mg/L (Illinois state standards are 0.10 mg/L),
- nitrate + nitrite nitrogen was 3.9 mg/L (Lake Michigan standards: 10 mg/L),
- Kjeldahl nitrogen was 0.89 mg/L (no available standard), and
- total nitrogen was 4.79 mg/L [EPA acceptable range is 2 mg/L to 6 mg/L (2013)].

N:P Ratio

Comparing the amount of total nitrogen (Kjeldahl nitrogen + nitrate/nitrite) to total phosphorus provides the N:P ratio. The N:P ratio provides insight into which nutrient is limiting algae and plant growth. In most cases, freshwater is limited by phosphorus. Lakes above 15:1 are limited by phosphorus, while lakes below 10:1 are limited by nitrogen. Lakes in between 10:1 and 15:1 can vary between which nutrient is limiting. Site 1 N:P ratios were 177, indicating it is a phosphorus limited system.

Chloride

Chloride can be an indicator of human activity around a body of water. Sources of chloride include agricultural chemicals, human and animal waste, and road salts. Natural waters away from human influence generally have chloride levels below 20 mg/L. Typically, lake concentrations in modern landscapes are less than 100 mg/L. Site 1 chloride was at 77 mg/L.

Discussion

Overall water quality indicated a eutrophic system with high turbidity and dominated by planktonic algae. However, total phosphorus levels were lower than expected. The orthophosphorus (readily available phosphorus for algae growth) was a high portion of the total phosphorus, and can stimulate nuisance algae blooms, such as the diatom blooms observed by the wake park staff. The high turbidity is likely due to high biomass in algae and easy mixing of the water and sediments in the shallow Levings Lake. Some re-suspension of sediments is most likely occurring due to the use of the wake park, common carp, and tributary influences from upstream. Algae biomass was high, as indicated by the chlorophyll a results. The planktonic algae biomass was dominated by beneficial green algae. This high algae biomass most likely contributed to the relatively high dissolved oxygen readings. Seasonal dissolved oxygen may be quite different once the algae population has crashed, or if it becomes over-grazed by zooplankton.

The scum bloom causing much of the concern for the wake park was sampled and determined by the lab to be a diatom bloom. Personal observations provided insight that the streambed upstream of Levings Lake is providing a large amount of the biomass of diatoms forming the bloom. Wake park staff indicated that the bloom is coming from the bottom of the lake as well. Freshwater diatoms are not known to produce toxins or provide human health concerns.

Vision Statement

We envision Levings Lake as a recreational attraction with clear water and a healthy aquatic ecosystem.

Goals

Goal #1: Free Levings Lake from unnatural algae blooms.

Nuisance algae blooms are unsightly and interrupt recreational use of the lake, such as wake park use, swimming, boating, and fishing. Algae is fed by the same nutrients that feed other plant life. In the absence of other plant life and with an over-abundance of nutrients, algae can grow out of control in "blooms." These blooms usually happen during hot summer months in shallow, warm-water lakes and ponds with little circulation. This happens occasionally in healthy natural systems but not frequently as in eutrophic lakes. We want to decrease algae blooms to naturally occasional occurrences by trapping phosphorous, the nutrient feeding the algae, before it gets in the lake and decreasing the amount of phosphorous in the lake.

Goal #2: Free Levings Lake of beach closings.

Beach closings are caused by high counts of fecal coliform or *e. coli*, a specific strain of fecal coliform, in the water. A small amount of fecal coliform from wildlife waste is natural in the water. Elevated levels are caused by failed septic systems and waste of nuisance goose populations, dogs, and livestock. We want to address the sources of unnatural levels of fecal coliform in the lake and trap fecal coliform before it enters the lake.

Goal #3: Restore the natural lake bottom of Levings Lake.

Total suspended solids deposited in the lake from runoff during storm events settle on the natural bottom of the lake as sediment. This soft, silty layer is made up of mostly organic matter and some mineral material. It does little to no harm when it is settled at the bottom of the lake, but when it is stirred up by fish and people swimming or wake boarding in the lake, nutrients, pathogens, and solids re-suspend in the water and lead to algae blooms, beach closings, and turbid water. To restore the natural bottom, we want to remove existing sediment from the bottom of the lake and capture sediment-producing solids before they enter the lake.

Goal #4: Improve the water clarity throughout the lake.

Total suspended solids cause turbidity of the water. This is exacerbated by fine sediment being kicked up off of the lake bottom by swimmers, boaters, wake boarders, and carp. Clear water is an important component in rehabilitating the lake's natural ecosystem. We want to improve water clarity by removing sediment from the bottom of the lake and trap suspended solids before they get into the lake.

Goal #5: Improve wake park operations by dissipating wave action and preventing algae blooms within the wake park expansion area.

The experience using the wake park is best when water is calm, but multiple riders create wave action. We plant to interrupt and dissipate waves with strategically placed structures. We aim to control algae blooms throughout the lake. If they occur on occasion, especially prior to the establishment of preventative measures, we plan to relocate the algae away from the course.

Goal #6: Improve fish quantity and quality within designated fishing areas.

Levings has historically been a fishing lake, and we intend for this tradition to continue. While improving the health of the lake, we also want to improve the quantity and quality of fish by providing more food and shelter at designated fishing areas and removing heavy metals from the water. People currently fish from the shoreline anywhere around the lake. We intend to improve habitat within designated areas and provide access to those areas with paths, as the entire shoreline will no longer be open once actions are taken to meet the other goals.

Objectives for Goals #1 through #6: The following objectives collectively address all six goals. Since the actions needed to address each goal are tied to benefits for other goals, these objectives are not listed per goal.

Objectives

1. To capture and treat phosphorous, pathogens, and total suspended solids before they enter the lake:
    a. Restore 5.6 acres of wetlands on hydric soils near the inlet of Kent Creek, and route the first flush of stormwater through the wetlands on its way to the lake.
    b. Restore 2.5 acres of wetlands on hydric soils near the inlet of the southern tributary, and detain stormwater prior to it flowing into the lake.
    c. Create a sediment and algae trap at the Kent Creek inlet, continuing along the north shoreline, with 21 BioHaven treatment wetlands combined with 210' of silt barriers.
    d. Create a sediment and algae trap at the inlet of the southern tributary with 5 BioHaven treatment wetlands combined with 50' of silt barriers and 5 without.
    e. Remove an estimated 3,000 cubic yards of sediment from the existing sediment basin just upstream of the Kent Creek inlet so that it will function properly.
    f. Interrupt pollutants coming from Levings Park by planting filter strips of native vegetation surrounding the lake (excluding the dam management area) with a minimum width of 20' for a total area of 2.1 acres.

2. To remove phosphorous, pathogens, and total suspended solids that have already settled in the lake:
    a. Digest the known quantity of free-floating phosphorous (2,000 lb/yr) in the lake by installing a total of 51 BioHaven treatment wetlands, each 100 sf in area and 10" thick, planted with wetland vegetation in areas of high circulation (31 near the two inlets and 20 within the center of the wake park as mentioned in other objectives).
    b. Digest the known quantity of total suspended solids (1,208,900 lb/yr) by installing 6 additional BioHaven treatment wetlands (each 100 ft^2 and 10" thick) and 7,520 ft^3 of Leviathan treatment wetlands within the lake.
    c. Create a littoral zone, a zone of aquatic vegetation hugging the shoreline, by planting 3,000 ft^2 of emergent and submergent native vegetation within the lake and seeding emergent vegetation within 2' of the water's edge around the perimeter of the lake.
    d. Remove the estimated 53,500 to 90,000 yd^3 of sediment from the bottom of the lake.

3. To discourage nuisance geese from utilizing Levings Lake and Park:
    a. Provide a visual barrier for geese between land and water by planting rigid, native vegetation at least 4’ in height into the filter strips mentioned above.
    b. Harvest existing geese humanely, such as with the goose round-up program.
    c. Addle eggs during nesting season.
    d. Provide scare tactics regularly, such as harassment from dogs.
    e. Provide reproductive inhibitor to adult geese each year prior to breeding season.

4. To improve wake park operations:
    a. Strategically place 20 of the 51 BioHaven treatment wetlands in an “X” or star formation to dissipate waves.
    b. Move algae blooms from wake park operations using 3 water movers.

5. To improve fishing opportunities and fish habitat:
    a. Create 6 designated fishing areas by mowing zigzagged paths through the filter strips. Alter number of designated areas to meet fishing demand.
    b. Provide food and shelter for fish within designated fishing areas by installing at least one BioHaven treatment wetland (100 ft^2 each) per fishing area and locating designated fishing areas near emergent and submergent vegetation.

Milestones

The Rockford Park District plans to implement the objectives over a period of time that will be dictated by funding availability. The objectives will be accomplished in an order that will achieve milestones along the way. We hope that funding will be available to complete “Milestone 1” in 2017.

Milestone 1: Alleviate algae blooms and beach closings, improve wake park operations, and designate fishing areas.

The first milestone will improve the current recreation opportunities at the lake, namely wake park operations and fishing, and it will improve lake health by alleviating the algae blooms and beach closings while treating other issues. This milestone will be accomplished by completing the projects listed in the “Milestone 1” section below. Excess phosphorous, identified as the limiting nutrient for algae and plant growth at Levings, is responsible for the algae blooms and is therefore the main target of this milestone. Phosphorous binds to sediment and can be released when sediment is kicked up from the bottom by fish and people. Therefore, if reaching this milestone doesn’t bring relief of algae blooms, relief should come when Milestone 2, focused primarily on sediment removal, is reached.

Milestone 2: Restore the natural bottom of the lake, alleviate turbidity, prevent new sedimentation, and improve fishing opportunities.

The second milestone will restore the natural bottom of the lake by alleviating solids from accumulating in the lake and removing the existing sediment with the projects listed in the “Milestone 2” section below. These suggested projects can be accomplished on RPD property, with limited involvement of a neighboring landowner. If preferred, some of these suggestions could be accomplished upstream on private lands instead, and grouped with “More Milestones” as explained below.

More Milestones

The milestones above include projects and programs that can be accomplished on Rockford Park District property. Beyond the scope of this report, future milestones should be developed to suggest projects and programs to be conducted upstream on private property. These recommended projects and programs will be at the landowner’s voluntary will, based on a watershed-based plan, and developed in conjunction with the farmers, landowners, residents, governing bodies, environmental organizations, and industry within the watershed.

Milestone One

Alleviate algae blooms and beach closings

1. Filter 2,000 lb/yr of phosphorous in the lake by installing 51 BioHaven treatment wetlands in the lake (Objective 2a).
2. Trap 475 cy of sediment and floating algae entering the lake by combining 21 of the 51 BioHaven treatment wetlands with 210’ of silt barriers near the Kent Creek inlet (Objective 1c) and placing 5 of the 51 BioHaven treatment wetlands combined with 50’ of silt barriers and 5 without at the inlet of the south tributary (Objective 1d) in such a manner as to create forebays that can be easily accessed and dredged.
3. Restore the function of the existing sediment basin just upstream of the Kent Creek inlet by removing 3,000 cy of sediment (Objective 1e).
4. Filter runoff from Levings Park by installing 2.1 acres of filter strips surrounding the lake (Objective 1f).
5. Discourage nuisance geese by planting the filter strips with rigid, native vegetation at least 4’ in height that will create a visual barrier (Objective 3a), harvesting geese humanely (Objective 3b), addling eggs and providing reproductive inhibitor (Objective 3c), and regularly providing scare tactics (Objective 3d).
6. Create a littoral zone by planting 3,000 ft^2 of emergent and submergent native vegetation within the lake (Objective 2c).

Improve wake park operations

7. Dissipate waves at the wake park by placing 20 of the 51 BioHaven treatment wetlands in an “X” or star formation in the center of the wake park expansion area (Objective 4a).
8. Move algae blooms away from operations by installing 3 water movers in strategic corners of the wake park (Objective 4b).

Designate fishing areas

9. Create 6 designated fishing areas by mowing zigzagged paths through the filter strips (Objective 5a).
10. Locate designated fishing areas near planted submergent native vegetation (Objective 2c).

Efficacy and Cost Estimates for Milestone One

Milestone 1 Efficacy and Cost Estimates										
BMP Name	Area		Cost Estimates		Pollution Reduction Estimates			% of Lake & Basin Sediment	% Pollution Reduction of Watershed	
			Low	High	Sediment (cy/yr)	TSS (lbs/yr)	P (lbs/yr)	Sed-iment	TSS	P
BioHavens	5100	ft^2	$ 160,000	$ 185,000	N/A	110058	1990	N/A	9%	100%
Silt Barriers	260	ft	$ 1,430	$ 3,432	Incl. w/Remove silt, SB Area			N/A	N/A	N/A
Remove Silt from Silt Barrier Area	475	cy	$ 3,900	$ 5,800	475	3009	4	1%	0.2%	0.2%
Remove Silt from Existing Basin	3000	cy	$ 14,000	$ 26,000	3000	8704	11	5%	0.7%	0.5%
Filter Strip	2.1	ac.	$ 3,150	$ 5,250	N/A	22192	22	N/A	1.8%	1.1%
Goose Deterrents	3	pro-grams	$ 1,000	$ 5,000	N/A	N/A	20	N/A	N/A	1%
Littoral Zone	3000	ft^2	$ 15,000	$ 24,000	Incl. w/FS & BH			Incl. w/FS & BH		
Water Movers	3	movers	$ 5,600	$ 6,720	N/A	N/A	N/A	N/A	N/A	N/A
Designated Fishing Areas	6	areas	$ -	$ -	N/A	N/A	N/A	N/A	N/A	N/A
Total Milestone 1			**$ 204,080**	**$ 261,202**	**3,475**	**143,963**	**2047**	**6%**	**12%**	**102%**

Milestone Two

Alleviate total suspended solids from accumulating in the lake from upstream sources

1. Construct an extended wetland detention area on 5.6 acres of hydric soil upstream of the Kent Creek inlet with a sediment forebay. Route the first flush of stormwater through it to filter total suspended solids and other pollutants (Objective 1a).
2. Construct an extended wetland detention area on 2.5 acres of hydric soil upstream from the inlet of the south tributary with a sediment forebay and water control structure in order to detain water (Objective 1b).

Restore the natural bottom of the lake

3. Digest 1,208,900 lb/yr of total suspended solids in the lake by installing an additional 600 ft^2 of BioHaven treatment wetlands and 7,520 ft^3 of Leviathan treatment wetlands within the lake (Objective 2b).
4. Remove the estimated 53,500 to 90,000 yd^3 of sediment from the bottom of the lake (Objective 2d).

Improve fishing opportunities

5. Provide food and shelter for fish within designated fishing areas by locating at least one BioHaven treatment wetland (each 100 ft^2) per 6 fishing areas. These BioHavens are not additional to those digesting the total suspended solids (Objective 5b).

Efficacy and Cost Estimates for Milestone Two

Milestone 2 Efficacy and Cost Estimates										
BMP Name	Area		Cost Estimates		Pollution Reduction Estimates			% of Lake & Basin Sediment	% Pollution Reduction of Watershed	
			Low	High	Sediment (cy/yr)	TSS (lbs/yr)	P (lbs/yr)	Sed-iment	TSS	P
Extended Wetland Detention - Kent Cr.	5.6	ac.	$ 215,000	$ 454,000	N/A	92,728	124	N/A	8%	6%
Extended Wetland Detention - S. Tributary	2.5	ac.	$ 82,500	$ 175,000	N/A	43,119	50	N/A	3.6%	2.5%
Leviathan	7,520	ft^3	$ 340,000	$ 340,000	N/A	977,575	17672	N/A	81%	884%
Remove Lake Sediment	53,500-90,000	cy	$ 234,000	$ 770,000	53,500	N/A	N/A	94%	N/A	N/A
BioHavens	600	ft^2	$ 18,840	$ 21,780	N/A	12,950	234	N/A	N/A	12%
Total Milestone 2			**$ 890,340**	**$1,760,780**	**53,500**	**1,126,372**	**18,080**	**94%**	**92%**	**904%**

Efficacy and Cost Estimates for Milestones One and Two Combined

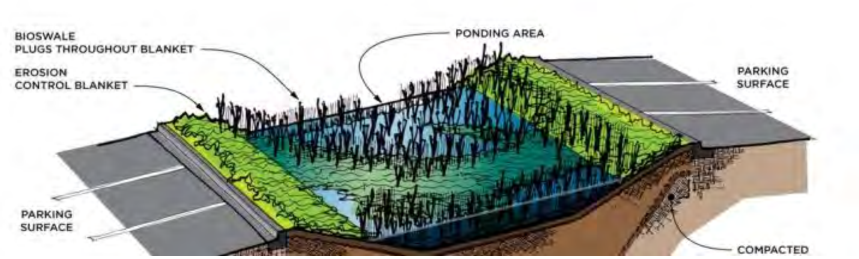
By the end of the project, we will have addressed all of the known sediment and total suspended solids, and we will have the capacity to remove 10x the amount of phosphorous.

Milestone 1 and 2 Combined Efficacy and Cost Estimates								
BMP Name	Cost Estimates		Pollution Reduction Estimates			% of Lake & Basin Sediment	% Pollution Reduction of Watershed	
	Low	High	Sediment (cy/yr)	TSS (lbs/yr)	P (lbs/yr)	Sed-iment	TSS	P
Total Milestone 1	$ 204,100	$ 261,200	3,475	143,963	2,047	6%	12%	102%
Total Milestone 2	$ 890,400	$1,760,800	53,500	1,126,372	18,080	94%	92%	904%
Total Milestone 1&2	**$1,094,500**	**$2,022,000**	**56,975**	**1,270,335**	**20,127**	**100%**	**104%**	**1007%**

Already Implemented Projects

Projects have already been implemented north of the lake and at the confluence of Kent Creek, including an expanded vegetated swale on the east side of Pierpont Road, a vegetated filtration area on the west side of Pierpont Road, and a silt basin where Kent Creek enters Levings Lake.

A vegetated swale is a broad, shallow channel with a dense stand of vegetation covering the side slopes and bottom. Swales can be natural or manmade, and are designed to trap particulate pollutants (suspended solids and trace metals), promote infiltration, and reduce the flow velocity of storm water runoff (EPA). A silt basin is defined on the next page.



General vegetated swale

Vegetated Swale
To the north of Levings Lake on the east side of Pierpont Road, the Rockford Park District maintains an expanded vegetated swale filtering runoff from about 4 acres of park land and the road. The swale seems to be functioning properly and is sized appropriately, so we recommend to continue its use in its current formation.

Vegetated Filtration Area
To the north of Levings Lake and on the west side of Pierpont Road, runoff from a horse farm is channeled under the railroad tracks and into a triangle of naturalized vegetation. This swale also seems to be functioning properly, and its size seems to fit the drainage area. Other projects are recommended below within the triangle, and we recommend to re-asses the functionality of this swale if such project is chosen.

Existing Silt Basin
Just before Kent Creek runs under the Pierpont Road Bridge and into Levings Lake, a silt basin has been created by widening the creek. This silt basing is very small and, to the knowledge of the Rockford Park District, hasn't been dredged in recent years. It is likely not functioning, as suggested by sediment studies.

North drainage vegetated Swale

Newly Recommended Projects and Practices

Overview and Summary

There are many ways to improve the lake by improving the quality of water as it moves through the watershed. With a watershed of this size, long-term care of the lake would need to involve the watershed community members and construction of best management practices on private lands. In the meantime, we propose projects that can be accomplished on Rockford Park District property and provide some relief to the lake. Many of the projects are long lasting, preventative solutions. The following pages outline each project recommendation, providing estimates of cost and effectiveness in reducing pollutant loading. Efficiency predictions are estimated using the Environmental Protection Agency's Region 5 Pollutant Load Reduction models and models from Floating Island International. The EPA's model assists in prioritizing pollution prevention projects. Because not all recommended projects have reliable modeling it is not possible to use this tool on all projects. Therefore, to compare all recommended projects, professional opinion plays a role in recommending projects. Models specific to BioHaven and Leviathan treatment wetlands were provided by Floating Island International.

The aerial photograph below illustrates the constructed stormwater wetlands and their buffers, filter strips surrounding the lake, and BioHaven treatment wetlands and silt barrier forebays within the lake.


Levings Lake Best Management Practices Concept
Prepared for the Rockford Park District by Olson Ecological Solutions
Native Vegetation 5.75 ac.
Floating Treatment Wetlands
Forebay
Marsh
Micropool
Constructed Wetland 5.66 ac.
Native Vegetation 2.11 ac.
Micropool
Native Vegetation with path 2.0 ac.
Marsh
Constructed Wetland 2.4 ac.
Road with culvert
Forebay - Fenced
N
1000 ft
Google earth

Install BioHavens within the Lake

Milestone: 1.1 and 1.7

Purpose: Reduce phosphorous available for algae growth. Nitrogen will also be reduced, but phosphorous is decidedly the target.

Design Considerations: BioHaven treatment wetlands are essentially wetlands floating in the water. These floating wetlands create enormous amounts of surface area on the island's parent material. As well, the roots quickly grow into the water. The bulk of the work of cleaning the water is the uptake of the nutrients by the microbes and their residue growing on all that surface area, collectively called biofilm, something on which fry and fingerlings thrive. BioHavens quicken the process of the food web, eating the nutrients and turning the phosphorus into biomass, which then sinks to the bottom of the lake as sediment. With added aeration, the process is increased immensely.

The specific design considerations for Levings Lake are calculated in one of two ways: (1) flow rate, which we assume to be 2 ft^3/sec (900 gal/min) and average summer water temperatures of 20°C, or (2) phosphorous load estimates to the creek (lbs/yr), which our models estimated based on upstream land uses and average phosphorous loads per land use. We used the second method, and estimated that 2,000 pounds of phosphorous are entering Levings Lake each year with runoff via Kent Creek, the southern unnamed tributary, and land surrounding the lake.

Floating Island International used the annual pollutant loading estimates to determine that we will need 4,233 ft^3 (5,100 ft^2 at 10" thick) of their BioHavens to treat that amount of phosphorous. Instead of one island, we recommend 51 islands at 100 ft^2 (10 ft x 10 ft) per island.

The islands will need to be anchored with a mixture of spiral helix and conventional anchors as follows:

-Kent Creek inlet: At each end of the row of islands, use a spiral helix anchor. Within the row, tether three or four islands together and anchor them with one conventional anchor per 3-4 island set.

-South tributary inlet: Tether several islands together and use a conventional anchor per set of islands, for a total of about 3 conventional anchors.

-"X": Each island in the "X" will need to be anchored separately because they are spaced 20 ft apart. We will need to determine if we are using conventional or spiral helix anchors based on flow conditions. There are 20 islands in the "X," so we will need 20 anchors.

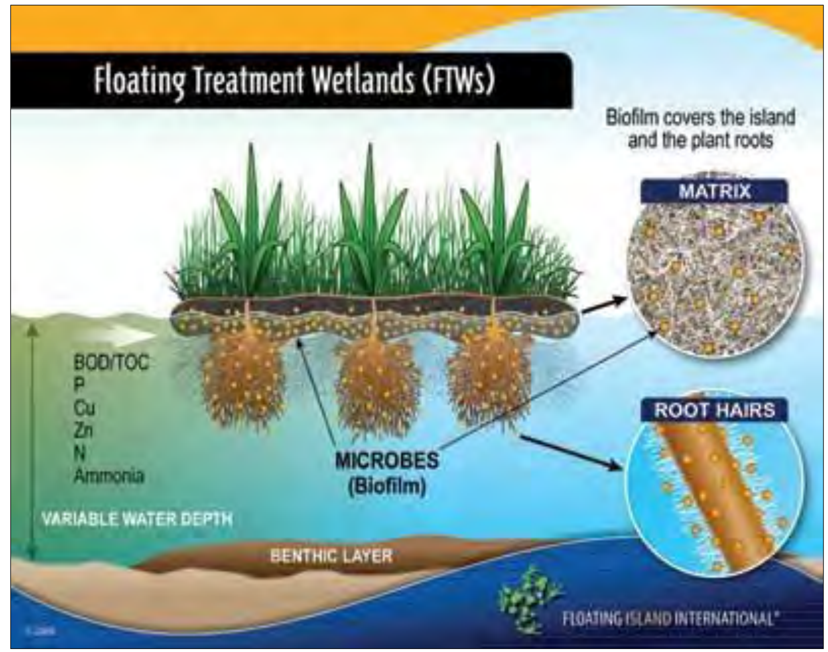
Floating treatment wetlands like BioHavens are most effective when placed in front of inlets where nutrient-rich water is entering the lake (Lubnow, 2014). Therefore, place 21 islands near the inlet of Kent Creek and 10 islands near the inlet of the southern tributary. Place the other 20 islands in the middle of the wake park expansion area for wave attenuation (see drawing).

Efficiency: According to Floating Island International and other sources, floating treatment wetlands like BioHavens can remove 95% of total suspended solids and 90% of phosphorous. Floating treatment wetlands are most cost effective in lakes when the total phosphorous is 0.1 mg/L or greater (Lubnow, 2014). We estimate that the islands will remove 100% of the phosphorous (2,000 lb/yr) and 9% of the TSS (110,058 lb/yr) entering the lake.

Maintenance: Floating Island International suggests weekly inspections as the only maintenance needed. To maintain a healthy native plant population, we also recommend semi-annual weed control. Small weed issues can be handled by hand-pulling or clipping. There may be some issues that are better handled with herbicide, but it should be used sparingly as it is harmful to life in the lake.

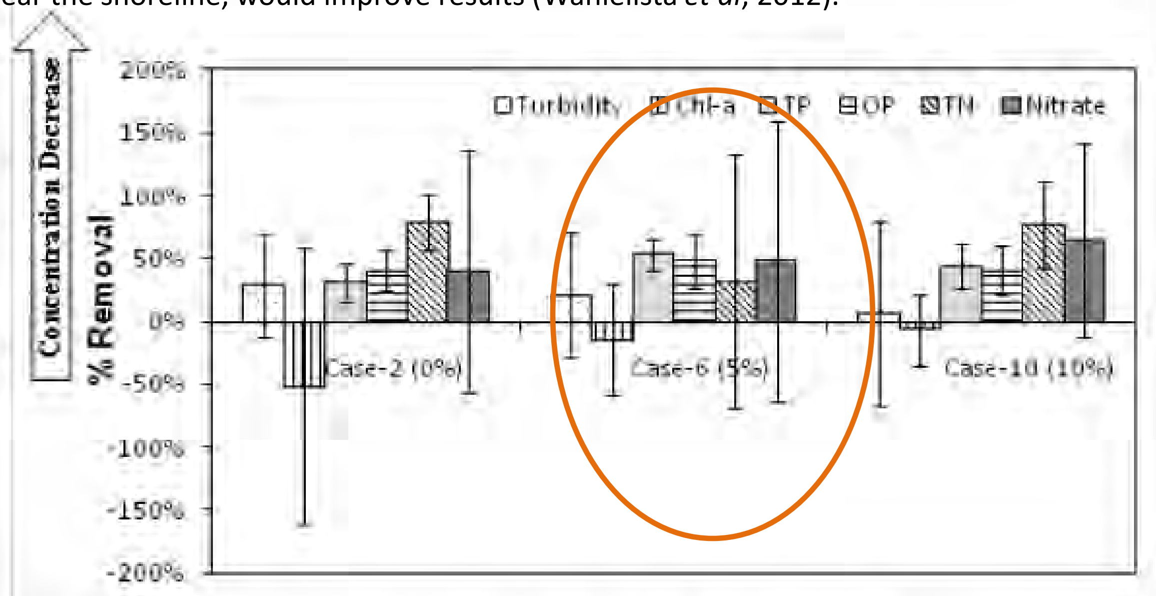
Costs: We estimate the cost of 51 islands at 100 ft^2 per island to be $160,000 to $185,000. This includes all accessories, such as plant material, anchors, and installation.

Life Cycle; The estimated life cycle is 15 years, although this estimate was recently increase from 10 years (Lubnow, 2014), and floating treatment wetlands are relatively new and therefore have not been in existence longer than their estimated life cycle.



Timing of Results

There are many variables that make it difficult to predict when we will see results. Two experiments agree that the results happen relatively quickly. After one week, one experiment reported 57-67% reduction in turbidity, 28-58% reduction in total phosphorous, and 65-75% reduction in copper (Tanner, 2011). In another experiment, the University of Florida reported that after 15 days, about 50% of the total phosphorous had been removed, and long-term effects included 58% phosphorous removal after 3 months, 68% after 5 months, and 100% after 7 months. The second experiment concluded that creating a littoral zone, a zone of aquatic plantings near the shoreline, would improve results (Wanielista *et al*, 2012).



Effect of percent area coverage with a littoral zone (15 days removal efficiency)

(Wanielista *et al*, 2012)

The second experiment mimicked a scenario that will be similar to Levings Lake after Milestone 2 has been reached, represented by "Case 6" in the chart above. "Case 6" has a shallow depth (90cm), littoral zone, and floating treatment wetlands on 5% of the pond. At 23.4 acres, 5% of Levings Lake is 51,000 ft^3, or 510 BioHavens each 100 ft^2 and 10" thick, which matches the recommendation for "Milestone 2" targeting sedimentation.

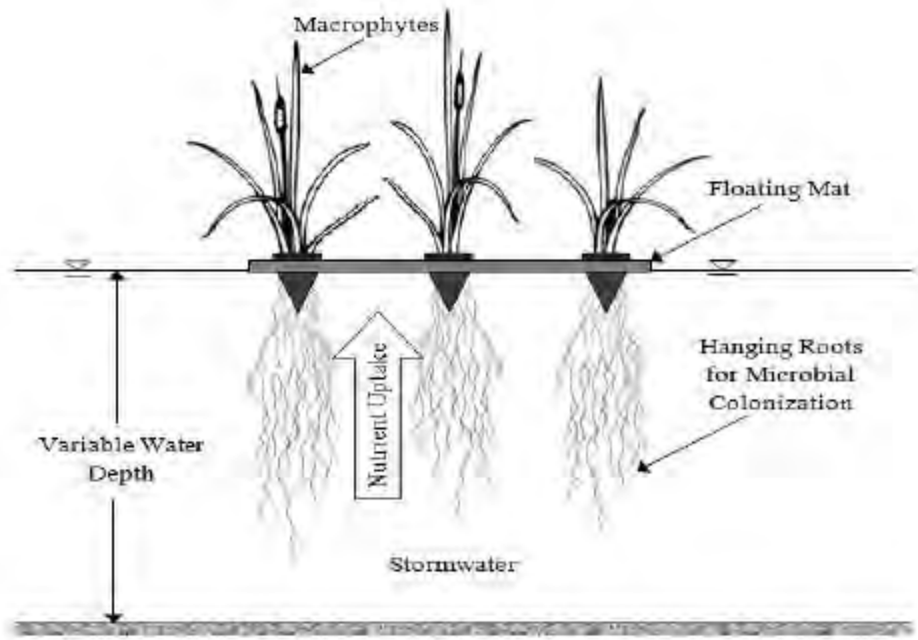
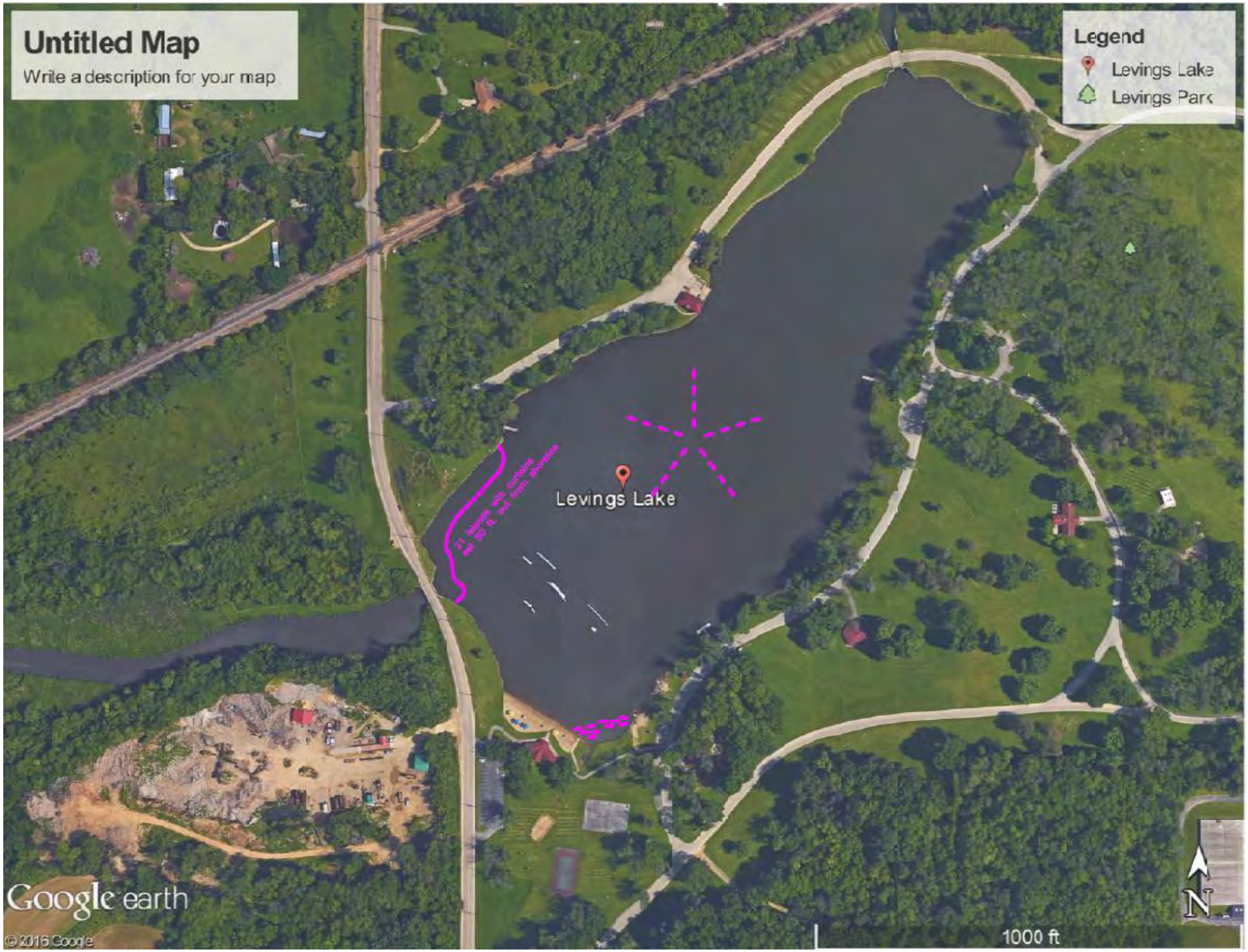


Figure 2: Cross section of a typical Floating Treatment Wetland

(Wanielista *et al*, 2012)

Placement of 51 BioHavens



Combine BioHavens with Silt Barriers

Milestone: 1.2

Purpose: Along with the benefit of excluding wind-blown surface accumulation (diatom scum, creek runoff debris, etc.), the silt barriers may help contain total suspended solids including silt and organic matter. By containing these solids in forebays to the lake, we create a small area to be frequently dredged more easily and effectively than dredging the entire lake. Water clarity may also increase, helping to establish rooted aquatic plants.

Design Considerations: Silt barriers hang from the floating treatment wetlands. Near the Kent Creek inlet, 21 islands, each 10' long, create a barrier length of 210'. Near the southern tributary inlet, five islands in a row, each 10' long, create a barrier length of 50'. The total barrier length needed is 260'.

Diatomic algae blooms compete for nutrients and space with potentially harmful cyanobacteria (blue-green algae). When managing the diatom 'scums,' consideration should be given to use mechanical means such as barriers instead of chemical so as to not displace beneficial algae for harmful cyanobacteria.

Efficiency: The silt barriers will likley capture 475 ft^3 of sediment before it enters the lake (1% of the known sediment in the lake and existing silt basin). This should also reduce 0.2% of the TSS (3,009 lb/yr) and 0.2% of the phosphorous (4 lb/yr) in the watershed.

Maintenance: Regularly inspect barriers to ensure that they are still in place and in working order without tears or holes. Inspect after dredging occurs.

Cost: At $5 to $12/ft for 260' of barrier, depending on strength needed, plus 10% buffer for creative affixing to islands, the estimated cost for silt barriers is $1,400 to $3,400. Each time these areas are dredged, we estimate a cost of $4 to $8/$yd^3$ for a total of $3,900 to $5,800 per dredging event.

Restore the Function of the Existing Silt Basin

Milestone: 1.3

Purpose: Restore the ability for the existing silt basin to capture total suspended solids as they travel down Kent Creek.

Design Considerations: Continue to use the existing silt basin in its current configuration.

Efficiency: Prevent 3,000 yd^3 of sediment from entering Levings Lake per dredging event plus 8,704 lb/yr of total suspended solids and 11 lb/yr of phosphorous.

Maintenance: The basin is likely to fill quickly. Determine the frequency of dredging by monitoring monthly, then dredge accordingly.

Cost Estimates: We estimate \$4-\$8/yd^3 plus \$2,000 mobilization fees for a total of \$14,000 to \$26,000 per dredging event.

Filter Runoff with Filter Strips

Milestone: 1.4

Purpose: Filter stormwater runoff sheeting over park lands into the lake, control erosion, and deter nuisance resident geese.

Design Considerations: A taller strip of vegetation around the lake has a better infiltration rate than mowed grass and also deters geese from the lake. Native species have extensive root systems to improve infiltration and control erosion. A filter strip of native species around the lake would total about 4,804'. If the filter strip were to be 20' wide it would equal approximately 2.1 acres. The lake shoreline associated with the dam (750') is not available for filter strip planting.

Efficiency: Filter strips are expected to remove 73% of the total suspended solids and 45% of the phosphorous coming from adjacent park lands. This represents 1.8% of the total suspended solids (22,192 lb/yr) and 1.1% of the phosphorous (22 lb/yr) in the watershed.

Maintenance: Encourage native species establishment by controlling non-native species with mowing, hand-pulling, spot-herbicide treatments, and prescribed burning. Professional knowledge of native plantings by staff or a contractor is required. Stewardship visits will most likely number four to six per year.

Filter Strips Around the Lake

Estimated Load and Load Reductions

Type of Nutrient	Load before BMP (lbs/yr)		Load after BMP (lbs/yr)		Load Reduction (lbs/yr)		Load Reduction %
TSS	30,400		8,208		22,192		73%
TN	295		177		118		40%
TP	49		27		22		45%

Cost Estimate: To prepare the site, plant a native seed mix, and provide one year of maintenance, costs are estimated to be $1,500 to $2,500 per acre for a total of $3,150 to $5,250 for 2.1 acres.

Life Expectancy: Native plants are perennial and reseed themselves readily. With proper maintenance, the filter strip could remain indefinitely.

Levings Lake Native Vegetation Concept
Prepared for the Rockford Park District by Olson Ecological Solutions, LLC
Levings Lake
Native Vegetation 2.11 acre
Google earth
© 2016 Google
N
700 ft

Deter Nuisance Geese

Milestone: 1.5

Purpose: Deter geese from depositing fecal coliform directly into the lake.

Design Considerations:

Egg Addling and Reproductive Inhibitor

Oil eggs with food grade corn oil. This suffocates the eggs, but the mother will continue to incubate them. Simply destroying the eggs will cause the mother to lay another clutch. In addition to addling, have a licensed specialist administer a reproductive inhibitor to each adult goose prior to breeding season each year. This will ensure that female geese will lay fewer eggs. OvoControl, manufactured by Innolytics, can be administered in bait form (Swallow and Huffman, 2009).

Harassment or Round-Up

Harass geese regularly with dogs, pyrotechnics, strobe lights, lasers, or other means. If these tactics do not work within three years, consider a goose round-up, where geese are netted, removed, and humanely euthanized. A round-up could be conducted immediately to avoid the need for harassment (Swallow and Huffman, 2009).

Habitat Alteration

Geese prefer short grass so that they can see predators in any direction. Since they also live around water, short grass to the water's edge is ideal habitat for geese. Interrupt their line of sight from land to water with the filter strips described in the "Filter Strips" section of this report. The width exceeds the 6' necessary to be effective for goose control. Plant native vegetation that is at least 4' in height and has rigidity, such as switchgrass *(Panicum virgatum)*, cord grass *(Spartina pectinata),* and bulrushes *(Bolboschoenus* and *Schoenoplectus species).*

Efficiency: Pathogen counts attributed to goose feces are astounding and beyond estimating. The feces will also likely reduce 1% of the phosphorous in the watershed (20 lb/yr).

Maintenance: Programs are ongoing. Maintain filter strips as described above.

Cost Estimates: $1,000 to $5,000

Create Littoral Zone

Milestone: 1.6

Purpose: To filter pollutants suspended within the lake's water column that currently feed algae blooms and improve the productivity of the floating treatment wetlands. Rooted emergent and submergent vegetation are important components of a healthy lake ecosystem. They stabilize soils and shorelines, provide much needed oxygen, and utilize nutrients in the water that would otherwise be available for planktonic algae blooms. Along with these benefits, a diverse native plant community will also improve the fishery by providing nursery areas for juvenile fish and feeding grounds for adults. The macro invertebrate community would also increase in a diverse plant community, providing added forage to young fish and improving growth and condition of desired game species in Levings Lake.

Design Considerations: Plant submergent and emergent wetland plant material (either plugs or bare root) along the shoreline with depths of approximately 18 inches or less and 6 inches or less, respectively. If the planting beds are of significant size, protect the plants from fish, goose, deer, and other predation with submerged, anchored silt or deer fencing and a criss-cross pattern of Kevlar or fishing wire across the open top. Space plants 2' on center around the edge of the lake.

Emergent wetland plants that tolerate conditions above and below the water level can be included in the filter strip mix and allowed to populate on their own. We also encourage deliberate plantings, due to the obstacles present on-site to plant establishment from the filter strips. Plants that spread by rhizomes would have the best chance of spreading into the water, as plants that spread from seed may not find a mud flat on which to germinate. Include emergent wetland species in a seed mix and overseed it within a 2' band along the water's edge.

Efficiency: Estimates of efficiency are included in the estimates for BioHavens and filter strips.

Maintenance: Maintain emergent wetland plants along with and in the same manner as the filter strips. Check protective fencing and plant survival rates of submergent vegetation and replant as necessary.

Costs: At \$5 to \$8 per ft^2, a 3,000 ft^2 area would cost \$15,000 to \$24,000.

Move Algae Blooms Away from Operations

Milestone: 1.8

Purpose: To deter wind-blown, floating algal mats from accumulating within the wake board park.

Design Considerations: Install 3 water movers in strategic locations to blow nuisance algae blooms out of the way of operations. This is a "band-aid," not a solution to algae blooms. Until algae blooms are under control, water movers will offer more insurance for uninterrupted operations. They could be turned on and off as necessary, and they can be moved as conditions change. If water movers are used, power supplies would need to be installed.

Efficiency: N/A

Maintenance: Low

Cost Estimates: Three movers would cost between $5,600 and $6,720. The lower estimate represents 3 water movers at $850 each, plus $3,050 for installation. The higher estimate adds 20% for unknown conditions and needs regarding power.

Photo courtesy of kascomarine.com

Example of water mover working in a pond.

Create Designated Fishing Areas

Milestone: 1.9 and 1.10

Purpose: Encourage fishing as a major recreation activity at Levings Lake and make fishing compatible with filter strips.

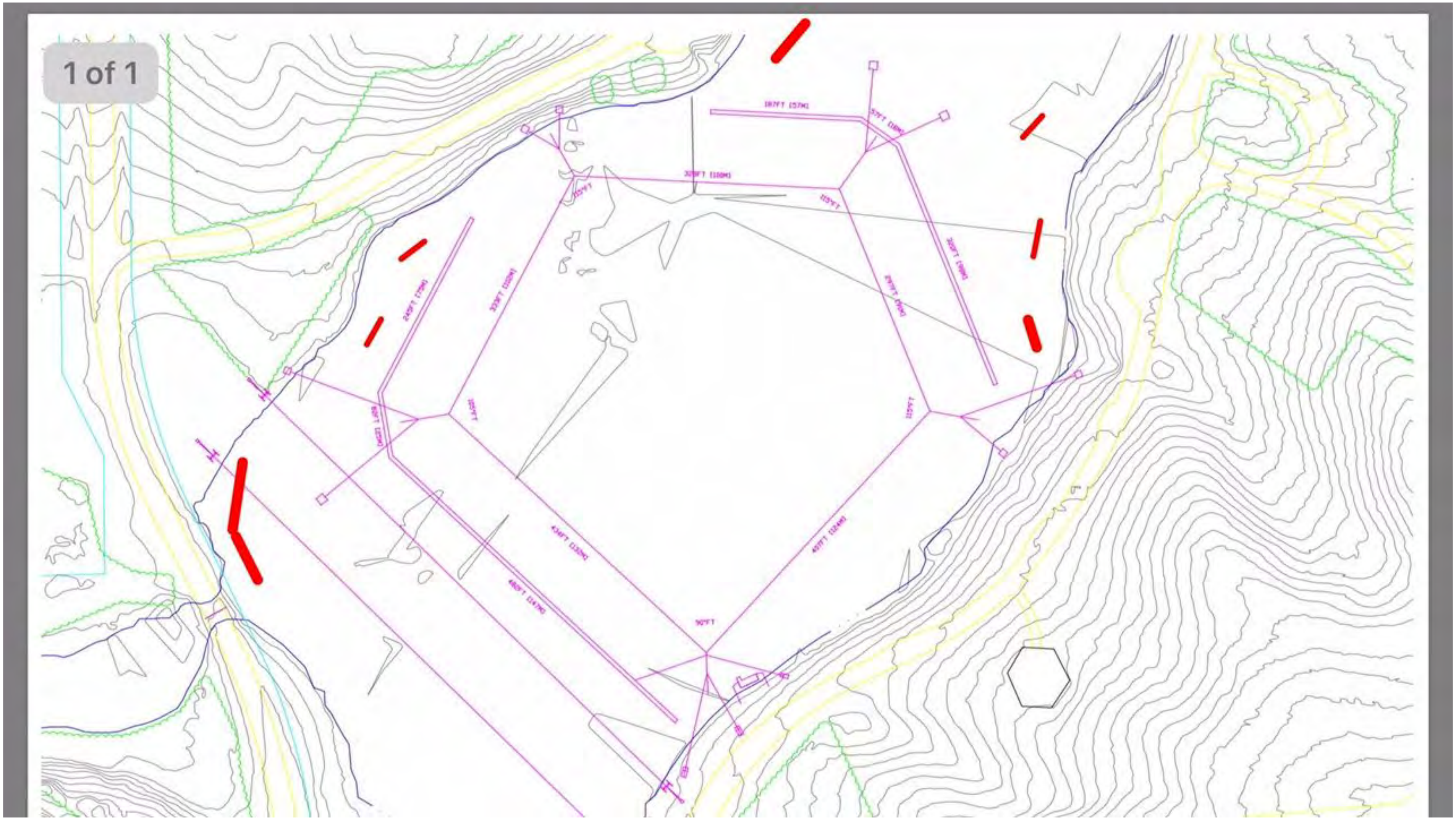
Design Considerations: Zigzag paths through tall vegetation will allow people to pass through but not geese. Geese will not wander into the area unless they can see the water and all around them so that they can look for predators. Start with 6 designated areas and adjust to meet fishing demands. Locate fishing areas near planted emergent and submergent vegetation.

Efficiency: N/A

Maintenance: Continue to mow paths. All other maintenance is included in filter strip and littoral zone discussions.

Cost Estimate: No additional cost was estimated, since mowing is a regular activity at Levings Lake. All other costs are discussed with filter strips and littoral zone plantings.

Most suitable locations for designated fishing areas



(Illustration provided by West Rock Wake Park)

Construct Extended Wetland Detention Upstream in Kent Creek

B. Extended Detention (ED) Wetland

Not to scale (EPA, 1999)

Milestone: 2.1

Purpose: Improve quality of stormwater runoff and control runoff volume.

Design Considerations: It is likely physically possible to re-route the first flush of storm events through the low lands of the triangle to catch the majority of pollutants. The stormwater could travel through a constructed stormwater wetland and outflow back into Kent Creek prior to running under the bridge and into the lake. Proper permitting and adjacent landowner cooperation would be necessary to complete this project.

Wetlands are known as "nature's kidneys," for their ability to filter pollutants from the ecosystem. Wetlands can be constructed as a reliable and effective way to filter stormwater, as we recommend for the stormwater entering Levings Lake. We have considered several stormwater best management practices for this area, and conclude that the most appropriate choice for the site would be extended detention wetlands, a type of constructed stormwater wetland that detain storm water for 12 to 24 hours. Others considered include shallow marsh, pond/wetland system, and pocket wetland. An extended detention wetland contains deep, extended detention zones on either side of the wetland, plus shallow extended detention throughout the wetland during storm events.

Also consider (1) a minimum length to width ratio of 2:1 and use baffles, islands, and peninsulas to achieve it if necessary, (2) sediment forebays of 4 to 6 ft. deep that can contain 10% of the treatment volume separated from wetlands by an earthen berm, (3) a micropool just prior to the outlet to prevent clogging, (4) gate controlled drain in micropool to dewater the wetland within 24 hours, (5) adding organic matter to the soil prior to planting, (6) a 25-ft. buffer (EPA, 1999), (7) flocking device at the outflow, and (8) planting at least five different species of native wetland plants for optimum water quality benefits (20 species or more for additional habitat benefits).

Efficiency: According to the EPA's Region 5 pollutant load reduction models, an extended detention wetland provides greater pollutant load reductions than other options appropriate for the site, including a settling basin, dry detention, wet pond detention, wetland detention, or grass swale. Of those appropriate for the site, size requirements were similar (EPA, 1999 and EPA, 1999b).

As a rule of thumb, fully functioning extended detention wetland would cover 1 acre for every 100 acres of watershed area. More precise sizing depends on flow rates, soil infiltration rates, and the amount of impervious surface in the watershed (EPA, 1999). Since we have about 6,885 acres drain into this area, the wetland would need to be about 69 acres in size. We have roughly 6.5 acres available on Rockford Park District property, less than 1/10th of the size needed for full efficiency. This allows removal of 9% of the total suspended solids (92,700 of 1,078,200 lb/yr), 5% of the total nitrogen (781 of 14,195 lb/yr), and 7% of total phosphorous (124 of 1,805 lb/yr). Allowing for full performance would require an additional 62.4 acres upstream on private lands. Then the extended detention wetland would remove about 86% of the total suspended solids, 55% of the total nitrogen, and 69% of the total phosphorous. It will also reduce biological oxygen demand by 72%, lead by 39%, and zinc by 20% (EPA Region 5 PLR Model). Therefore, consider working with upstream landowners to address the remaining pollution reduction potential. Necessary size could be decreased by adding features that boost efficiency, like BioHavens or Leviathans.

Extended Wetland Detention at 10% Efficiency			
	Load before BMP (lbs/yr)	**Load after 10% BMP (lbs/yr)**	**10% Load Reduction (lbs/yr)***
BOD	32,717.19	30,361.55	2,355.64
COD	291,313.24	U	U
TSS	1,078,226.77	985,499.26	92,727.50
LEAD	196.64	188.78	7.87
COPPER	67.11	U	U
ZINC	770.41	755.00	15.41
TDS	1,647,795.82	U	U
TN	14,194.78	13,414.07	780.71
TKN	7,748.26	U	U
DP	647.15	U	U
TP	1,805.35	1,681.68	123.67
CADMIUM	2.67	U	U
U = Removal Efficiency for the particular BMP and constituent unavailable.			
*10% efficiency is a general extrapolation based on 10% of size needed for full efficiency (6.5 acres for 6,885-ac watershed).			

Maintenance: Inspect after major storms for bank stability, erosion damage, flow channelization, and sediment accumulation. Maintain sediment levels and native plantings. Sediments will accumulate in the sediment forebay, constructed wetland, and micropool. Clean out forebay as necessary; either remove sediments from the wetland or raise the water level by adjusting the outlet to a higher discharge elevation. There is a small chance of metal accumulation crating toxicity, so check toxicity levels of the soils and dispose of the dredged material appropriately. If non-toxic, the dredged material can be spread out on nearby upland sites. Provide professional stewardship (staff or contractor) to encourage native species establishment by controlling non-native species.

Cost Estimates:

Permitting and design is estimated to be 25% of construction costs $42,250 - $89,500

Construction is estimated to be $26,000-$55,000/ac x 5.6acres $169,000 - $357,500

Maintenance is estimated to be 2% of construction costs per year $3,500 - $7,250 / yr

Construction costs include clearing, erosion and sediment control, excavating, grading, staking, and planting (EPA, 1999). The total cost for permitting, design, construction, and the first year of maintenance is about

$215,000 - $454,000.

Life Expectancy: With proper maintenance, the life expectancy is at least 20 years.

Orange soil types depict hydric soils, developed under wetland conditions and therefore historically wetland. Hydric soils are eligible for constructed stormwater wetlands.


Kent Creek Constructed Wetland Concept
Prepared for the Rockford Park District by Olson Ecological Solutions, LLC
Native Vegetation 5.75 acres
Marsh
Forebay
Micropool
Constructed Wetland 5.66 acre
Google earth
© 2016 Google
600 ft
N

Construct Extended Wetland Detention Upstream in South Tributary

Milestone: 2.2

Purpose: Improve quality of stormwater runoff and control runoff volume.

Design Considerations: General design considerations and alternative treatments are the same as stated above for extended wetland detention. Specific to this site, depth constraints were considered, eliminating other treatment options such as dry detention and settling basin. All stormwater will pass through the site, not just the first flush. The treatment area will likely need to be shallowly excavated to spread water flow throughout the extended detention wetland and the pipe will need to be removed so that water flows over the surface throughout the entire treatment area. Slated path improvements can be altered to also create the berm that will detain stormwater within the treatment area, including a water control structure and a buffer.

The 2.5-acre site available has a high water table, within 6” of the surface when sampled in June. Water is currently routed through a grass swale and into a pipe and outlets into the lake near Stanfield Beach. This summer, Rockford Park District staff stopped mowing the vegetation within the 15’- wide swale.

Efficiency: General efficiency considerations are the same as stated above for extended detention wetland. Specific to this site, a 5-acre extended detention wetland would be necessary to treat a 499-acre watershed at optimum efficiency. We have 2.5 acres available, about half of the needed area. This allows for treatment of 43% of the total suspended solids (43,119 of 100,276 lb/yr), 27% of the total nitrogen (364 of 1,324 lb/yr), and 34% of the total phosphorous (50 of 148 lb/yr). Therefore, consider implementing best management practices upstream with the cooperation of private landowners. Again, consider incorporating BioHavens or Leviathans to decrease the size needed to achieve the predicted results.

Maintenance: General maintenance considerations are the same as stated above for extended detention wetland.

Extended Wetland Detention at 50% Efficiency			
	Load before BMP (lbs/yr)	Load after 50% BMP (lbs/yr)	50% Load Reduction (lbs/yr)*
BOD	3,121	1,998	1,124
COD	22,637	U	U
TSS	100,276	57,157	43,119
LEAD	71	56	14
COPPER	11	U	U
ZINC	84	76	8
TDS	135,814	U	U
TN	1,324	960	364
TKN	528	U	U
DP	66	U	U
TP	145	96	50
CADMIUM	1	U	U
U = Removal Efficiency for the particular BMP and constituent unavailable.			
*50% efficiency is a general extrapolation based on 50% of size needed for full efficiency (2.5 acres for 499-ac watershed).			

Cost Estimates:

Permitting and design is estimated to be 25% of construction costs $16,250 - $34,500

Construction is estimated to be $26,000-$55,000/ac x 2.5 acres $65,000 - $137,500

Maintenance is estimated to be 2% of construction costs per year $1,250 - $2,750 / yr

Construction costs include clearing, erosion and sediment control, excavating, grading, staking, and planting (EPA, 1999). The total cost for permitting, design, construction, and the first year of maintenance is about

$82,500 - $174,750.

Life Expectancy: With proper maintenance, the life expectancy is at least 20 years.


South Catchment Constructed Wetland Concept
Prepared for the Rockford Park District by Olson Ecological Solutions, LLC.
Native Vegetation with path 2.0 acre
Marsh
Constructed Wetland 2.4 acre
Road with culvert
Google earth
© 2016 Google
N
400 ft

Digest Organic Material in Lake Sediment with Leviathans and BioHavens

Milestone: 2.3 and 2.5

Purpose: Reduce the amount of sediment in the lake by digesting the organic portions of the sediment.

Design Considerations: Leviathans have demonstrated the same results as BioHavens with 85% less volume. Therefore, install 7,650 ft^3 of Leviathans for a more cost effective approach than installing 45,300 ft^2 of BioHavens. Install 6 BioHavens, each 10' x 10', to also digest the organic matter and to provide fish habitat at designated fishing areas.

We do not specify locations at this time. Since 51 BioHavens will be operating by the time of this installation, it would be best to determine how they are functioning and adjust future needs accordingly.

Efficiency: The purpose of installing the prescribed amount of Leviathans is to digest the known amount of organic matter in the sediment. Floating Island International provided digestion rates, and we sized the project to handle 81% of the total suspended solids (977,575 lb/yr). This also provides reduction of phosphorous by 884% (17,672 lb/yr), which is a side benefit rather than a target.

Maintenance: Leviathan maintenance is like BioHaven maintenance with a basic electrical component. Monitor and repair or replace as necessary. Maintain native vegetation as specified for BioHavens.

Cost Estimates: At \$45/ft^3, 7,520 ft^3 of Leviathan would cost \$340,000. This estimate includes all necessary components such as the matrix, planting and installing, plant material, and anchors.

Remove Existing Sediment from the Bottom of the Lake

Milestone:2.4

Purpose: To give a fresh start to Levings Lake by removing the existing, problematic sediment and restoring the natural bottom of the lake.

Design Considerations: Hydraulic dredging is generally more cost effective than mechanical dredging. An upland site will need to be identified for deposition of the dredged sediment. In 1989, the quarry was used along with a few other sites around the park. Spoil piles were shaped and seeded into landscape features. Similar considerations should be made prior to dredging.

If dredged and excavated materials are deposited on the uplands west of Pierpont Road, the drainage pattern of stormwater coming from the north will change. Currently, private lands within the watershed and north of this area drain through grass swales until the pass through a culvert under the railroad tracks and into the middle of the potential area for deposited material. This drainage will need to be routed in a manner that will filter pollutants from the stormwater before it reaches Levings Lake. Also, this area will need to be treated as a construction area in terms of stormwater pollution prevention using temporary best management practices like silt fence to protect the constructed wetland beneath it.

Efficiency: We estimate that removing the estimated 53,500 to 90,000 yd^3 of sediment from the lake will remove 94% of the known sediment in the area (including the lake, existing silt basin, and new forebays).

Maintenance: Dredging will be necessary as a long-term maintenance. As more preventative measures are implemented upstream, the need for dredging will decrease. Monitor to determine a dredging schedule, adjusting with changing land uses and best management practices.

Cost Estimates: We estimate a cost range of \$234,000 to \$770,000 to remove the existing sediment. The low end of the range represents \$4/ft^3 to dredge 53,500 yd^3 with \$20,000 allotted for mobilization costs. The high end of the range represents \$8/ft^3 to dredge 90,000 yd^3 with \$50,000 allotted for mobilization costs. These estimates assume that the dredged material will be deposited on-site, such as the uplands west of Pierpont Road.

Monitor and Adjust

Periodic Sampling and Monitoring

The recommendations within this report are based on the best information available. However, accuracy is limited to planning tools appropriate for a study of this breadth. As projects and programs are implemented, monitor their efficacy and adjust future projects and programs according to the more accurate information gathered.

Monitor physical and chemical parameters as reported in the above analysis. At a minimum, monitor every 2 years and include multiple sampling dates to evaluate seasonal fluctuations in nutrients and algae composition.

Replicate the sediment studies conducted by Bruce Muench on a regular basis. While implementing changes, consider replicating the study every year in order to predict sedimentation rates.

Biology Outdoor Classroom

Consider partnering with a local college or high school for ongoing monitoring. This will provide the Rockford Park District the information that they need to make informed decisions and adjustments while offering educational benefits and career opportunity training to secondary and post-secondary students.

VLMP Program

The Illinois Environmental Protection Agency provides a program known as the "Volunteer Lake Monitoring Program." We recommend the Rockford Park District locate an interested volunteer stakeholder to apply for enrollment in this program. This is a free program but may have limited in enrollment. The program can provide training and equipment for citizen scientists to collect data on Levings Lake. This can provide a baseline as well as long-term comparisons as long as the data is being collected. The following are links to the VLMP program website:

http://www.epa.illinois.gov/topics/water-quality/monitoring/vlmp/index

http://www.epa.illinois.gov/topics/water-quality/monitoring/vlmp/what-is-vlmp/index

Potential Sources of Funding Assistance

Applying for grants can offset costs and provide resources for quality watershed planning and implementation programs. While grants are never guaranteed, they are available and should be utilized. A few examples are listed below.

ComEd Green Region Program

These funds may be used for habitat improvements.

Deadline: March 15, 2017

https://openlandsdotorg.files.wordpress.com/2016/04/comed-green-region-2017-program-guidelines1.pdf

Section 319 Program

This EPA program funds planning and implementation of management practices and projects that address nonpoint sources of water pollution, with priority given to areas with a watershed-based plan.

The typical range for project funding is $50,000 - $1.2M with a 40% match requirement.

Deadline: August 1st annually

http://www.epa.state.il.us/water/watershed/forms/319-rfp.pdf

http://water.epa.gov/grants_funding/cwa319/319Guide.cfm

Partners for Fish and Wildlife

The U.S. Fish and Wildlife Service provides small grants to purchase native seed mixes for prairie, wetland, and woodland restoration that provides wildlife habitat. Some of the recommended projects may qualify, such as constructed wetlands, because they will provide dual purposes of improving water quality and creating wildlife habitat.

http://www.fws.gov/partners/

Wildlife and Sport Fish Restoration Program

The U.S. Fish and Wildlife Service funds 75% of the total cost of sport fish habitat restoration, land acquisition for sport fish habitat, aquatic education, and outreach projects. For more information, visit their website at:

http://wsfrprograms.fws.gov/

Monarch Butterfly Conservation Fund

The grant award is a 1:1 match with funding from $50,000-$250,000 for a two year cycle.

The Monarch Butterfly Conservation Fund focuses on three priority conservation needs to restore the monarch butterfly to a more robust and healthy population:

1. Habitat restoration
2. Increasing organizational capacity
3. Native seed production and distribution.

http://www.nfwf.org/monarch/Pages/2016rfp.aspx

Literature Cited

Environmental Protection Agency. 2013. Total nitrogen. https://www.epa.gov/sites/production/files/2015-09/documents/totalnitrogen.pdf

2004. Lake notes: Water borne pathogens. Springfield, IL: EPA. http://www.epa.state.il.us/water/conservation/lake-notes/waterborne-pathogens.pdf

1999. Stormwater technology fact sheet: storm water wetlands. Washington D.C.: EPA Office of Water.

1999*b*. Stormwater technology fact sheet: wet detention ponds. Washington D.C.: EPA Office of Water.

GEI Works. 2017. Silt Fence Calculations. http://www.silt-barriers.com/silt-fence-calculations.html

Greenway, M. 2005. The role of constructed wetlands in secondary effluent treatment and water reuse in subtropical and arid Australia. Ecological Engineering. 25: 501-509.
http://www.floatingwetlandsolutions.com/pdfs/coliform%20pathogen%20wetland%20removal.pdf

Hudson, H. 1998. Lake notes: common lake water quality parameters. Springfield, IL: Illinois Environmental Protection Agency. http://www.epa.state.il.us/water/conservation/lake-notes/quality-parameters.pdf

Kania, B. 2016. The Three Essential Steps to Regaining Healthy Water. http://www.floatingislandinternational.com/

Keizer-Vlek, H.E; P.F.M. Verdonschot; R.C.M.Verdonschot. D. Deckers. 2014. The contribution of plant uptake to nutrient removal by floating treatment wetlands. Ecological Engineering V. 73, pp. 684-690. http://www.sciencedirect.com/science/article/pii/S0925857414004923

Lake Access. pH: measuring the acidity and alkalinity of lakes. http://www.lakeaccess.org/russ/ph.htm

Lubnow, F. 2014. Using floating wetland islands to reduce nutrient concentrations in lake ecosystems. National Wetlands Newsletter. 36(6): 14-17. http://www.floatingwetlandsolutions.com/pdfs/Lubnow.pdf

Olivencia, J. 2016 *unpublished.* Levings History. Memo to Cindy Bacher, June 16, 2016.

Peterson, E. 1987. Levings Lake dredging to being July 1. Rockford Register Star: June 10, 1987.

Shaw, B.; C. Mechenich; L. Klessing. 2004. Understanding lake data. Madison, WI: University of Wisconsin Extension.

Swallow, M. and J. Huffman. 2009. The effect of goose management on water quality. https://www.aphis.usda.gov/wildlife_damage/nwdp/Publications/10pubs/Swallow%20et%20al%202010.pdf

Tanner, C.C. and T.R. Headley. 2011. Components of floating emergent macrophyte treatment wetlands influencing removal of stormwater pollutants. Ecological Engineering. 37:474-486. http://www.floatingwetlandsolutions.com/pdfs/Tanner%20Headley%20Latest.pdf

U.S.D.A National Agricultural Library. 2017. Sediment and phosphorous removal from simulated storm runoff with compost filter socks and silt fence. https://naldc.nal.usda.gov/catalog/21642

Wanielista, M.P.; N. Chang; M. Chopra; Z. Xuan; K. Islam; Z. Marimon. 2012. Floating wetland systems for nutrient removal in stormwater ponds. Orlando, FL: University of Florida Stormwater Academy, Civil, Environmental, and Construction Engineering Department.