Lower Little Rock Creek Watershed-Based Plan

A Watershed-Based Guide for Protecting and Restoring Watershed Health

By Applied Ecological Services, Inc.
Final Report April 2021

Applied Ecological Services, Inc.

LOWER LITTLE ROCK CREEK
WATERSHED-BASED PLAN
DeKalb & Kendall County, Illinois

A Watershed-Based Guide for Protecting and Restoring Watershed Health

FINAL REPORT

October, 2025 (April 2021)
(AES #18-0105)

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ACKNOWLEDGEMENTS

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Christine Davis acted as project manager for Illinois EPA's Bureau of Water while Tom Horak (Director of Public Works) acted as Watershed Coordinator for the Steering Committee and worked closely with watershed partners and Applied Ecological Services, Inc. (AES) to produce the watershed planning document.

The Steering Committee consists of representatives from various municipal, governmental, private, and public organizations as well as local residents. Key partners include the City of Sandwich, DeKalb and Kendall County Soil & Water Conservation Districts, the DeKalb County Community Foundation, DeKalb and Kendall Counties, City of Sandwich STP, Sandwich Park District, DeKalb and Kendall County Forest Preserve Districts, the City of Plano and the Illinois Department of Natural Resources. These partners played an important role in providing input on plan content, watershed goals & objectives, various planning approaches, and input on potential watershed projects.

Applied Ecological Services, Inc. (AES) conducted analysis, presented at Steering Committee and stakeholder meetings, summarized results, and authored the Lower Little Rock Creek Watershed-Based Plan.

People from the following entities attended and provided input at Steering Committee meetings:

Applied Ecological Services, Inc.: Cecily Cunz, Steve Zimmerman, Maggie Soliz
City of Sandwich: Tom Horak, Rich Robinson, Kevin Kelleher
DeKalb County: Derek Hiland, Rich Robinson
DeKalb County Community Foundation: Teri Spartz
DeKalb County Forest Preserve District: Patrick McCrea
DeKalb County Soil & Water Conservation District: Dean Johnson, Jeff Woodyatt
Engineering Enterprises, Inc.: Tim Paulson
Illinois Department of Natural Resources: Steve Pescitelli, Tristan Widloe
Kane County: Rob Linke
Kendall County Forest Preserve District: Antoinette Meciej
Kendall County Soil & Water Conservation District: Alyse Olson, Megan Andrews
Kendall County: Matt Asselmeier
Kendall-Grundy Farm Bureau: Victoria Wax
Little Rock Township: Richard Wade
Northville-Sandwich-Little Rock Drainage District: Richard Burton
Sandwich Park District: Bill Novicki, Steve Wolf
The Conservation Foundation: Jessica Mino
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EXECUTIVE SUMMARY

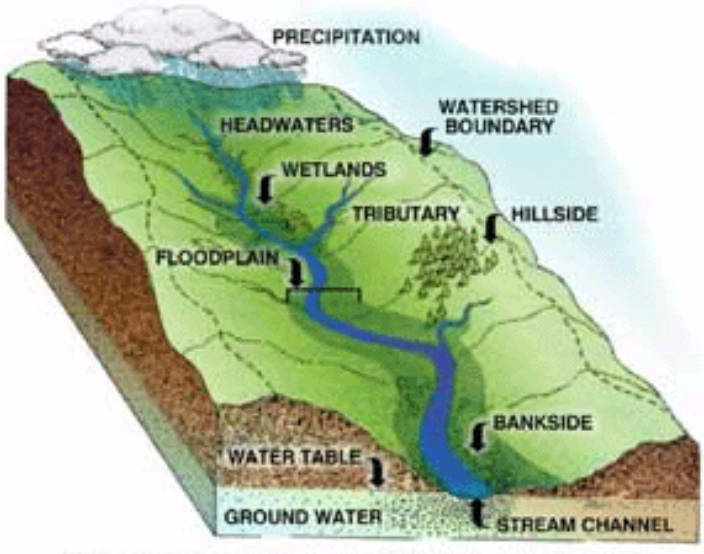
By Applied Ecological Services, Inc.
DRAFT April 2021

Applied Ecological Services, Inc.

INTRODUCTION

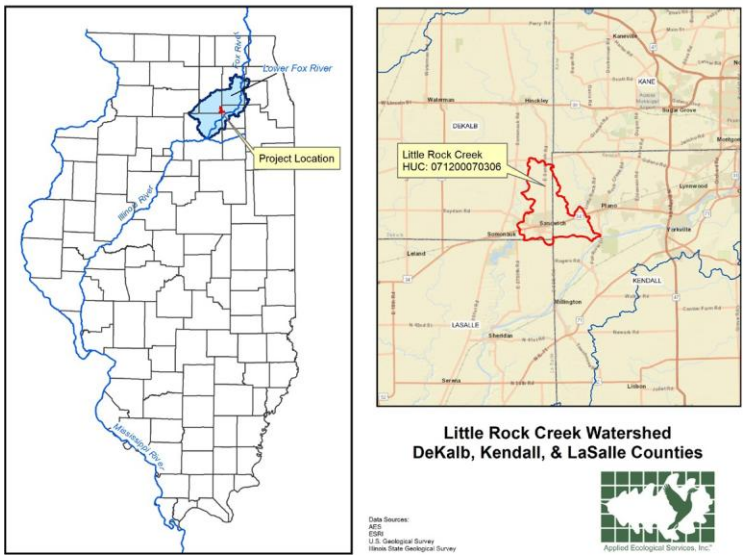
People live, work, and play in their watershed every day. A *watershed* is best described as an area of land where surface water drains to a common location such as a stream, river, lake, or other body of water. The source of groundwater recharge to streams, rivers, and lakes is also considered part of a watershed. Despite the simple definition for a watershed, they are complex in that there is interaction between natural elements such as climate, surface water, groundwater, vegetation, and wildlife as well as human elements such as urban development and agriculture that produce polluted stormwater runoff, increases to impervious surfaces, altered stormwater flows, and degradation or fragmentation of natural areas. Depending on size, other names for watersheds might include basins, sub-basins, and subwatersheds.

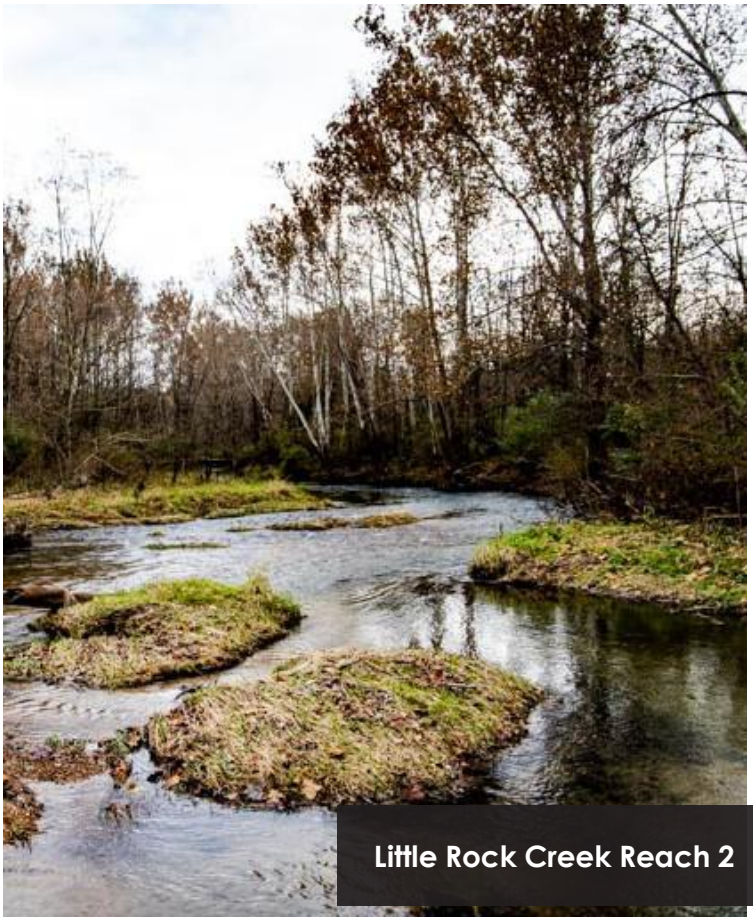
Lower Little Rock Creek watershed, at 10,541 acres (16.5 sq. mi.) in size, is a small watershed located where DeKalb, Kendall, and LaSalle Counties meet. The hydrologic unit code (HUC) for the watershed is 071200070306 (AUID: IL_DTCA-01). This watershed is the downstream-most portion of the much larger Little Rock Creek which flows south and east to its confluence with the Fox River south of Plano before joining the Illinois River. The Illinois River then flows southwest to join the Mississippi near Moline, Illinois.



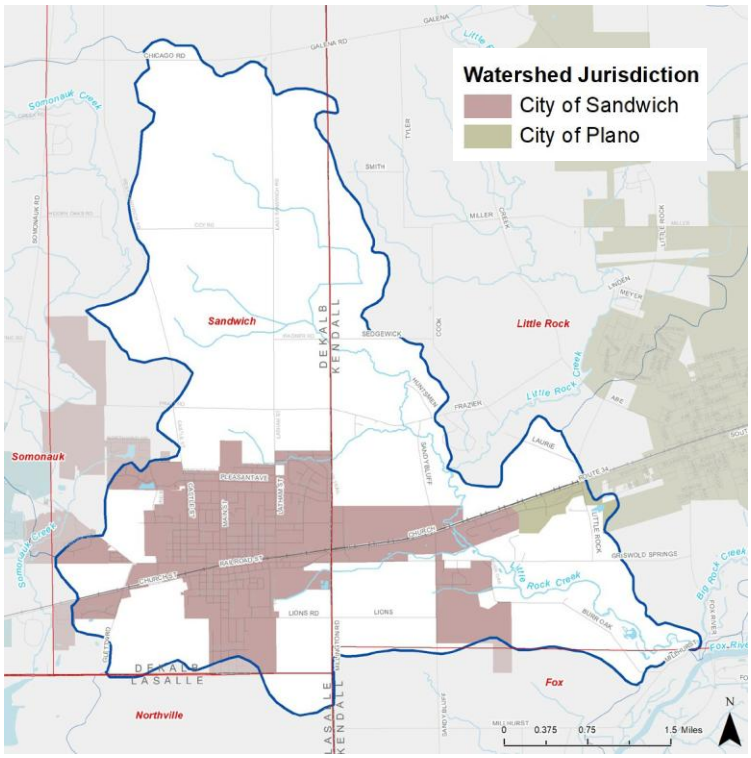
Source: City of Berkley Public Works

Watershed Locator Maps





Little Rock Creek Reach 2



WATERSHED PLANNING

The watershed-based planning process is a collaborative effort involving numerous, voluntary stakeholders. The primary focus is to restore impaired waters and protect unimpaired waters by developing an ecologically-based management plan for the Lower Little Rock Creek watershed that focuses on improving water quality. The plan protects green infrastructure by creating protection policies, implementing ecological restoration, and educating the public. Another important outcome is to improve the quality of life for people in the watershed for current and future generations.

The primary purpose of this plan is to spark interest and give stakeholders a better understanding of the Lower Little Rock Creek watershed and to promote and initiate plan recommendations that will accomplish the goals and objectives. This plan was produced utilizing a comprehensive watershed-based planning approach that involved input from stakeholders, municipal representatives, and analysis of complex watershed issues by Applied Ecological Service's planners, ecologists, GIS specialists, and engineers.

GOALS

A virtual Goals Workshop was held on February 17, 2020, devoted to gathering feedback from the community on the development of the plan and goals. Watershed stakeholders were first presented with information about the character, existing conditions, and quality of watershed resources over the course of several meetings prior to developing goals. Six general goal topics were chosen by the group to address issues that were brought up during those meeting and determined to be important in the Lower Little Rock Creek watershed. Stakeholders were then given the opportunity to prioritize plan goals, which are detailed below.

PLAN MISSION

The Watershed Coordinator, Steering Committee, and stakeholders of the Lower Little Rock Creek watershed developed a mission statement to guide the watershed plan. That mission is as follows:

"The mission of the watershed plan is to improve water quality by reducing nonpoint source pollution and flooding, while improving habitat, along with increasing our knowledge and educating our residents to help improve the health of the Lower Little Rock Creek watershed."

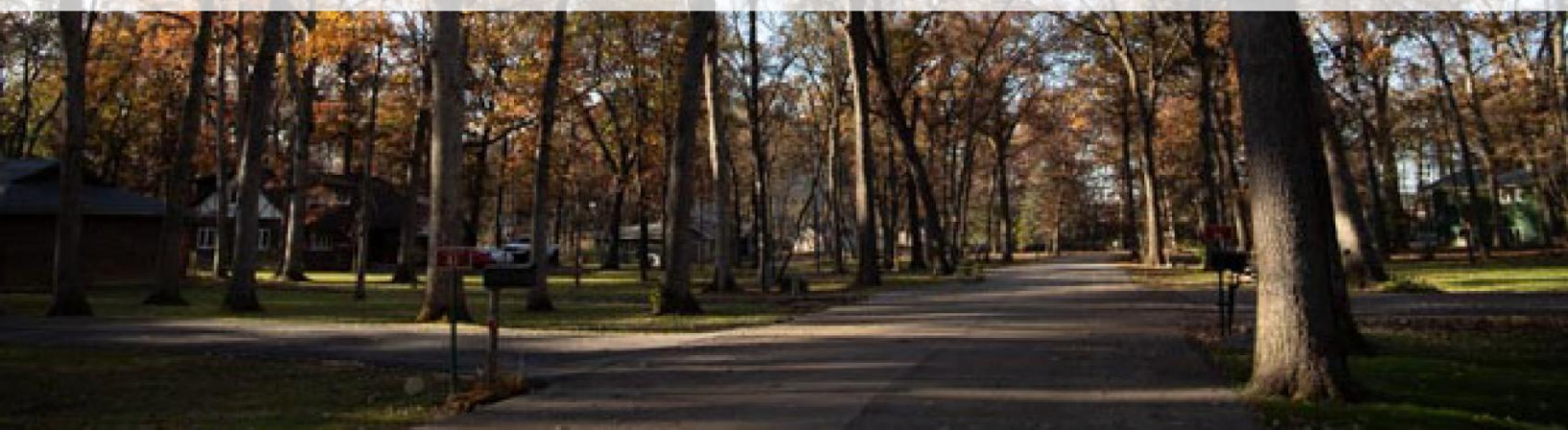
THE PAST

Pre-European settlement ecological communities in Lower Little Rock Creek watershed and the surrounding area were balanced ecosystems with clean water and a diversity of plant and wildlife populations. The mosaic of prairie, woodlands, and savannas mixed with wetlands were largely maintained and shaped by frequent fires ignited by both lightning and the Native Americans that inhabited the area. Herds of bison and elk also helped maintain the ecosystem via large scale grazing. During these times most of the water that fell as precipitation was absorbed in prairie and woodland communities and within the extensive floodplain wetlands that existed along stream and tributary corridors.

"In the broad, billowy prairies, extending as far as the eye can reach, we have the element of vastness as in scarce any other land; we have a luxuriant sward of emerald greenness, clothing the whole land, down to the very margin of the waters; we have meandering streams, clear as crystal, now smooth, quiet and glassy, then ruffled by winds or rapids; we have clumps of trees, charming groves, disposed with an effect of beauty that might baffle a landscape gardener; now crowning the grassy height, now clothing the green slope with their pleasing shade. From the gentle heights of the rolling prairies, the country, even before the hand of man had broken its surface, wore the aspect of cultivated meadows and rich pasture grounds, irrigated by frequent rivulets." -Boies, 1868

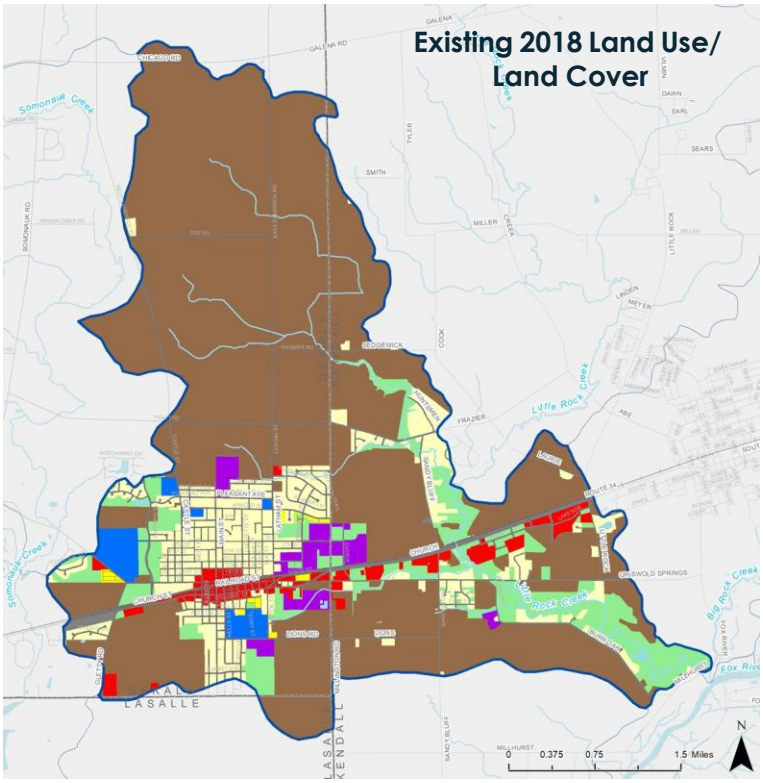
THE PRESENT

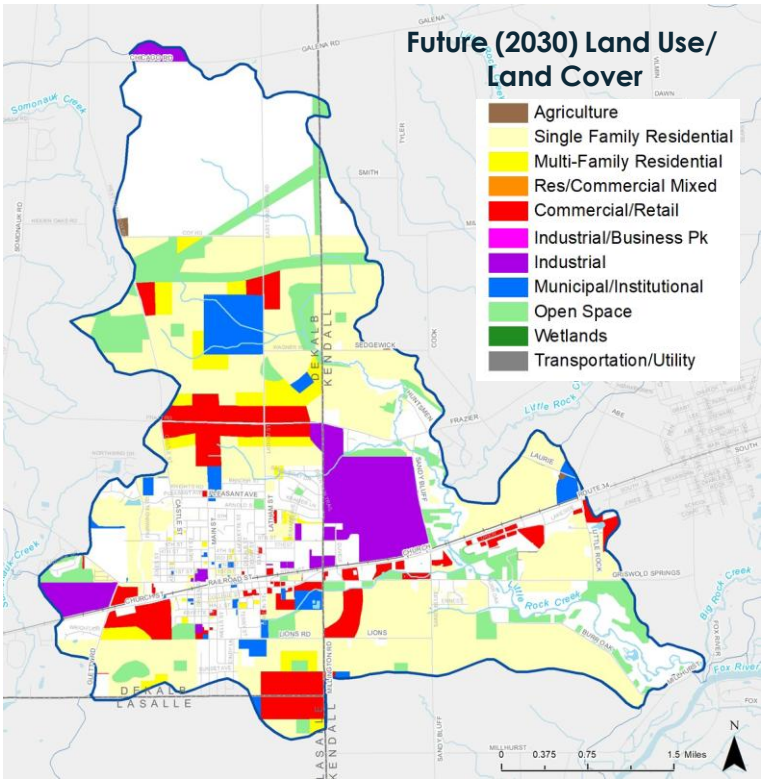
Ecological conditions changed quickly and drastically following European settlement in the mid-1800s. Large-scale fires no longer occurred, and bison and elk were extirpated. Significant portions of woodland communities were cleared and nearly all prairies were tilled. Tile systems were installed to drain wetland areas as farming became the primary land use by the early 1900s. Conversion from farmland to residential and commercial uses in and around the City of Sandwich followed and continues to this day. Lower Little Rock Creek watershed is presently dominated by farmland, residential subdivisions, commercial centers, and forest preserve land.



THE FUTURE

Current (2018) land use is shown on the map below, left. On the Future land use map (below, right), areas in white depict where land use remains unchanged, while the colors represent the predicted future land use. The largest loss of a current land use/land cover is expected to occur on agricultural land where approximately 5,664.5 acres of the existing 7,140.4 acres (53.7% decrease relative to total watershed) is expected to be converted to mostly residential and commercial/retail/industrial land uses. These changes are expected to expand outward from the existing developed land in Sandwich with industrial and commercial/retail land use expanding to areas easily accessed by existing transportation corridors. The largest growth area is Single Family Residential where there is expected to be an expansion of 3,254.5 acres (30.9%), Commercial/Retail (700.9 acres, 6.6%), Industrial (546.7 acres, 5.2%), Multi-family Residential (318.1 acres, 3.0%), and Municipal/Institutional (283.6, 2.7%).





CHALLENGES & THREATS

Surface Water

- According to Illinois EPA's most recent 2018 *Integrated Water Quality Report and Section 303(d) List*, Little Rock Creek (IEPA Segment Code: IL_DTCA-01) is "Fully Supporting" for *Aquatic Life* and for *Aesthetic Quality*; Little Rock Creek was not assessed for *Fish Consumption* or *Primary Contact Recreation*.
- Recent water quality data collected within Lower Little Rock Creek indicates likely overall impairment from elevated total phosphorus and total nitrogen.

Land Use & Habitat

- Cropland areas in the watershed are the single largest *nonpoint source* contributor of nitrogen (70%), phosphorus (79%), and sediment (94%) to streams, followed by urban areas and septic systems.
- Current development policy within the watershed communities can be improved to further protect water quality and green infrastructure.
- Important Natural Areas in the watershed include Little Rock Creek Forest Preserve, Harvey Creek Conservation Area, the riparian areas along LRC Reach 1 & 2, and a dry-mesic oak woodland.

Problematic Flooding

- Problematic flooding within the City of Sandwich is causing multiple challenges for the community.
- Seven potential wetland restoration sites, totalling 355 acres, and 52,428 linear feet of stream, many with the potential to reconnect the floodplain, are considered High Priority/ Critical Area projects.

IMPORTANT NATURAL AREAS

Little Rock Creek Forest Preserve

The Kendall County Forest Preserve District purchased the 133-acre Little Rock Forest Preserve in 2018 and was opened to the public in June of 2019. The preserve sits within a steep valley along Little Rock Creek (Reach 2). The floodplain shelf is comprised of oak, sycamores and hackberry. The steep slopes consist of a mesic-oak woodland with red, white, and chinkapin oak trees, sugar maple, and basswood. The downstream-most 4,600 linear feet of Little Rock Creek Reach 2 through the forest preserve is graded as a *Class B* stream by the Illinois Department of Natural Resources.

Harvey Creek Conservation Area

Harvey Creek Conservation area is a 30-acre park with restored wetlands and prairies owned by Sandwich Park District. A paved circular walking path with interpretive signs and picnic area provides recreational opportunities for visitors *(Photo courtesy Sandwich Park District)*.

Other Open Space

Little Rock Creek Reaches 1 and 2 are located upstream and downstream of Little Rock Creek Forest Preserve and lie within a steep valley with a wide floodplain. The floodplain shelf contains high quality tree species such as sycamore, oak, and hackberry, while slopes contain bur oak, red oak, and chinkapin oak, sugar maple, and basswood. Additionally, a large plot of remnant dry-mesic oak woodland is located west of West Sandwich Road and north of Pratt Road. The woodland is located on private land and consists of old growth oaks.

AGRICULTURAL LAND MANAGEMENT

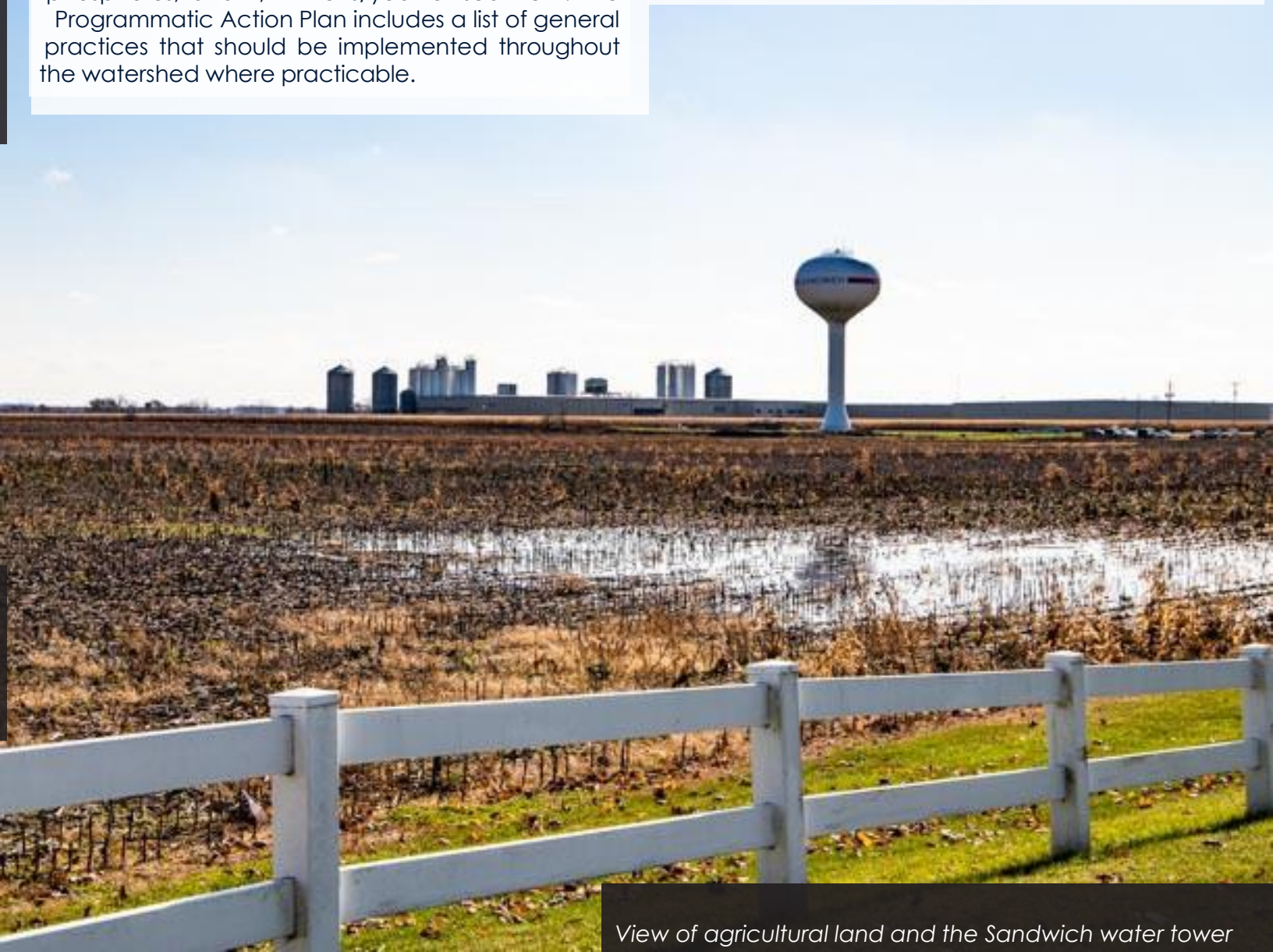
Agriculture is an integral part of Lower Little Rock Creek watershed and is by far the most dominant land use, covering a total of 7,140 acres or 68% of the watershed. Agricultural land is also a significant contributor of nutrients and sediment to local streams when agricultural best management practices are not in place. As such, watershed-wide changes to agricultural practices can have a dramatic effect on pollutant loading in the watershed.

Additional conservation practices and increases in the extent of reduced tillage practices in the Lower Little Rock Creek watershed are necessary to reduce cropland pollutant loading. Within the Programmatic Action Plan, recommendations include encouraging an additional 19% (1,357 acres) or more of agricultural landowners utilize more intensive Conservation Tillage practices (leaving at least 60% residue) on their lands. This change alone could reduce watershed-wide pollutant loads by 5,022 lbs/year of nitrogen, 1,989 lbs/year of phosphorus, and 1,214 tons/year of sediment. The Programmatic Action Plan includes a list of general practices that should be implemented throughout the watershed where practicable.

Some of the recommended agricultural best management practices outlined in the plan include:

- Conservation tillage
- Vegetated swales
- Filter strips
- Principals of soil health
- Regenerative agriculture
- Subsurface (tile) drainage best management practices and bioreactors

Fortunately, there are numerous agricultural measures and funding sources that can be utilized by farmers to implement practices on their land to improve water quality and soil health, while reducing soil and nutrient losses. Many recommended programs are offered through the DeKalb and Kendall County Soil and Water Conservation Districts, U.S. Department of Agriculture (USDA), Natural Resource Conservation Program (NRCS), and the Farm Service Agency (FSA).



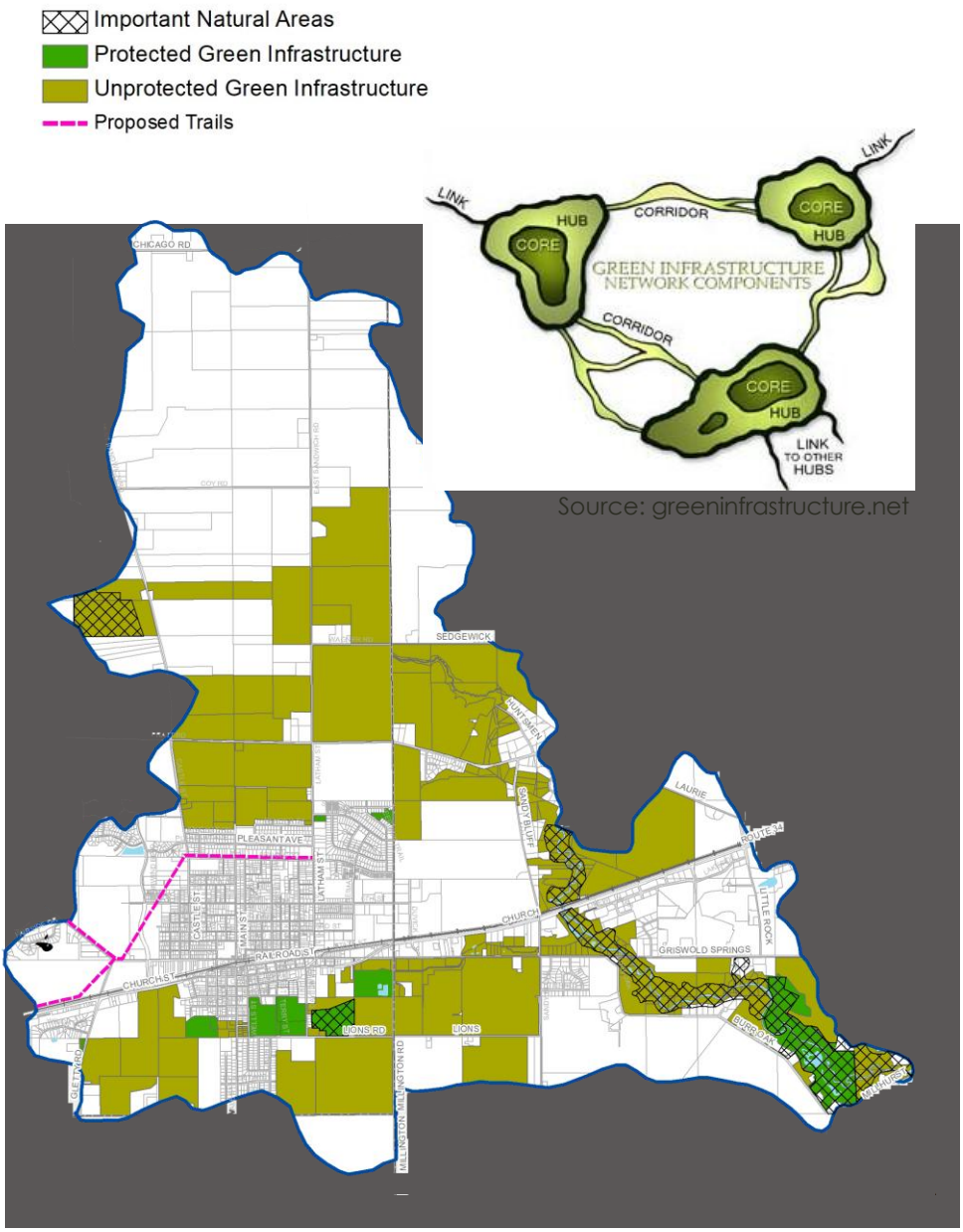
View of agricultural land and the Sandwich water tower

GREEN INFRASTRUCTURE & YOUR BACKYARD

A Green Infrastructure Network is a connected system of natural areas and other open space that conserves ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to wildlife and people. The network is made up of hubs and linking corridors. Hubs generally consist of the largest and least fragmented areas such as Little Rock Creek Forest Preserve and Harvey Creek Conservation Area. Corridors are generally formed by private parcels along Little Rock Creek and its tributaries. Corridors are extremely important because they provide habitat conduits between hubs. However, most parcels forming corridors are not ideal green infrastructure until landowners embrace the idea of managing stream corridors or creating backyard habitats.

Any property owner can improve green infrastructure. Create a safe place for wildlife by providing a few simple things such as food, water, cover, and a place for wildlife to raise their young. The National Wildlife Federation's Certified Wildlife Habitat® and The Conservation Foundation's Conservation@Home programs can help you get started.

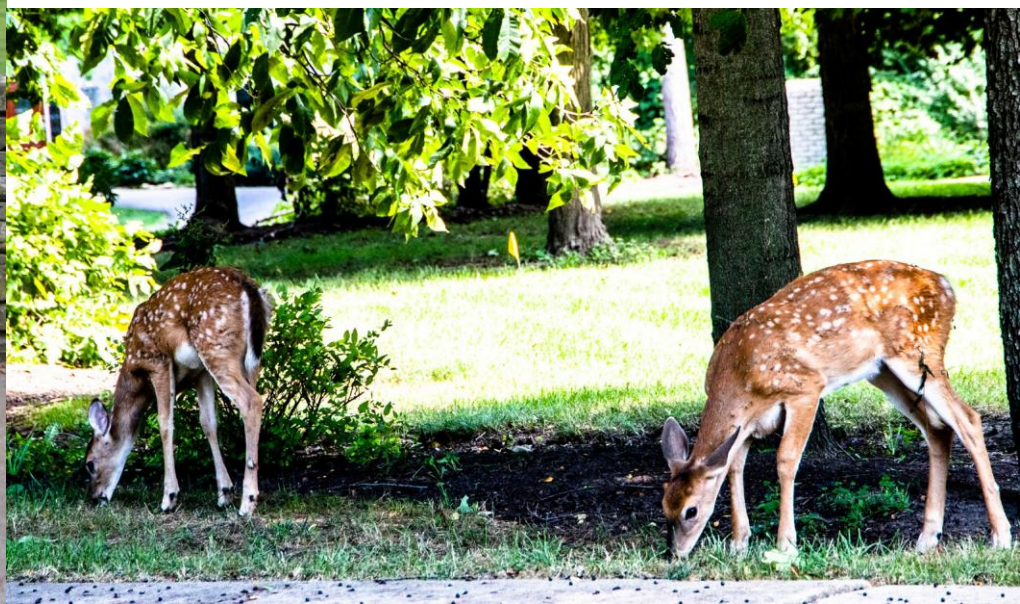
GREEN INFRASTRUCTURE NETWORK



Source: greeninfrastructure.net

RAIN BARREL

Source: Rainbarrelsource.com



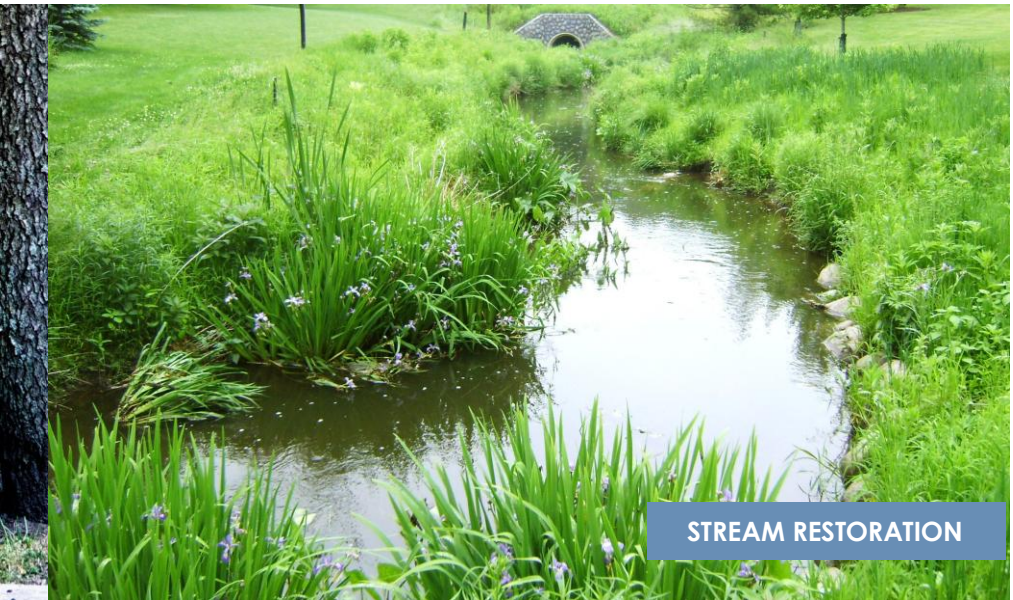
RAIN GARDEN

Creating a rain garden, or a small vegetated depression, to capture water is another way of promoting infiltration while beautifying your yard and providing additional habitat. Disconnecting your roof downspouts and capturing that runoff in rain barrels not only reduces the amount of runoff entering streams, but also serves as a great source of water for irrigating your yard.

If a portion of a stream runs through your backyard, here are some tips to help manage your piece of the green infrastructure network:

1. A NATURAL, MEANDERING STREAM IS A HAPPY STREAM
   Work with experts to restore degraded streams.
2. REMOVE NON-NATIVE SPECIES
   Identify and remove plants out of place (see photo guide, right).
3. PLANT NATIVE BUFFERS
   Plants adapted to the Midwest climate can help control erosion by stabilizing banks, while buffers protect the health of streams.
4. NO DUMPING
   Avoid dumping yard waste and clear heavy debris jams.
5. MANAGE CHEMICAL USE
   Avoid over fertilizing lawns or spilling chemicals near waterways.

For more detailed information, check out the Lake County Stormwater Management Commission's booklet, "Riparian Area Management: A Citizen's Guide," at www.lakecountyil.gov/stormwater.



STREAM RESTORATION

REMOVE THESE NON-NATIVE AND INVASIVE SPECIES

COMMON REED

BUCKTHORN

Source: Loras.edu

REED CANARY GRASS

PURPLE LOOSESTRIFE

GARLIC MUSTARD

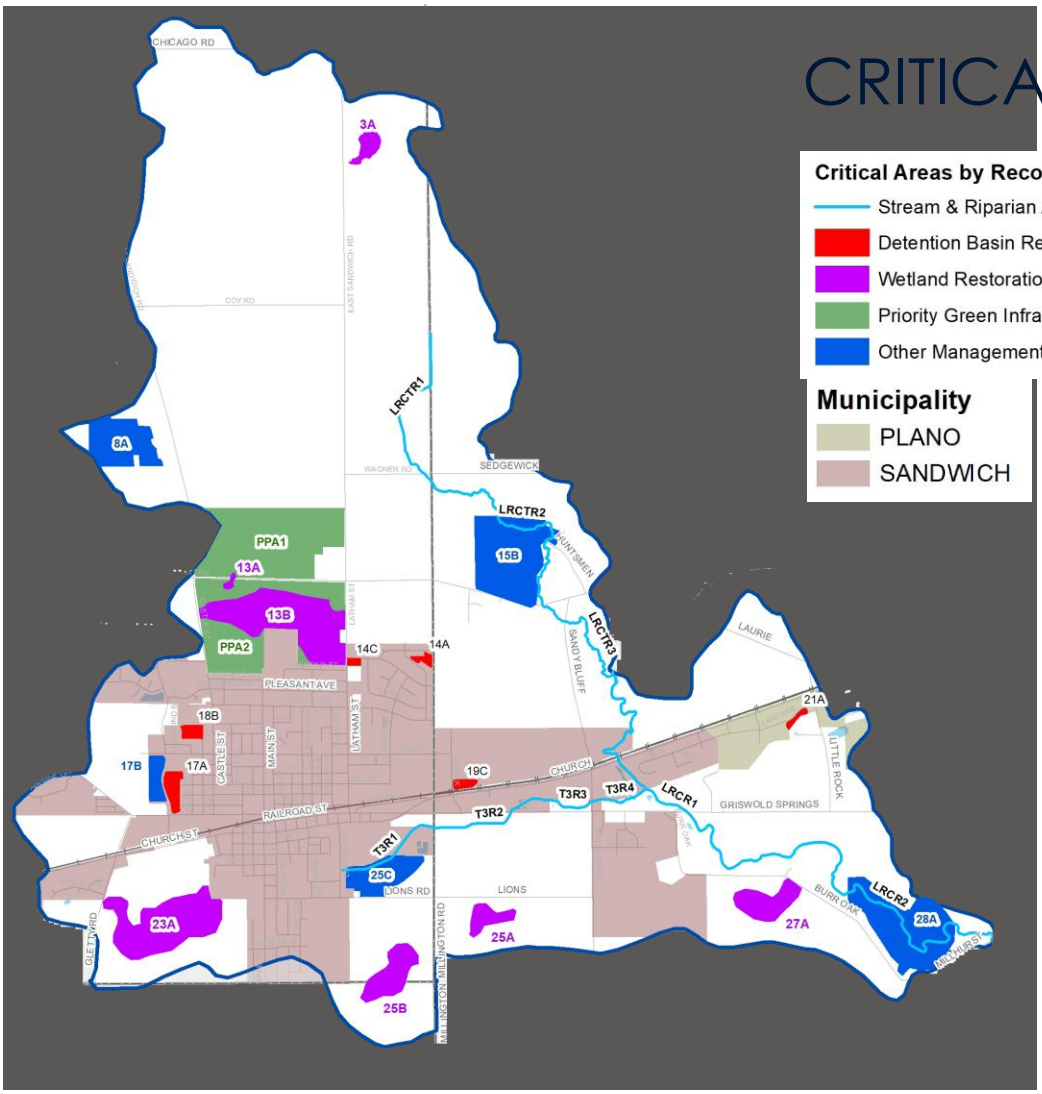
TEASEL

STREAM & RIPARIAN AREA RESTORATION

DETENTION BASIN RETROFITS

WETLAND RESTORATION

CRITICAL AREAS



ACTION PLAN

The Lower Little Rock Creek Watershed-Based Plan includes an Action Plan developed to provide stakeholders with recommendations to address plan goals. The Action Plan includes programmatic and site-specific recommendations. Programmatic recommendations are general watershed-wide, preventatitve, and regulatory actions. Site-specific recommendations include actual locations where projects could be implemented to improve water quality, green infrastructure, and habitat.

Programmatic recommendations include...

- Ordinance and Policy Recommendations
- Rainwater Harvesting & Re-use
- Native Landscaping
- Street Sweeping
- Septic System Maintenance
- Green Infrastructure Network Planning
- Conservation Design & Low Impact Development
- Water Quality Trading & Adaptive Management

Site-specific recommendations include...

- Detention Basin Retrofits
- Stream & Riparian Area Restoration
- Wetland Restoration
- Prioirty Green Infrastructure Protection
- Other Management Measures

The management measures provide a solid foundation for protecting and improving watershed conditions over time, and should be updated using the Report Cards established for each goal as projects are completed or other opportunities arise. Key implementation stakeholders are encouraged to organize partnerships and develop various funding arrangements to help delegate and implement the recommended actions. More details on the action plan and implementation can be found in the full waterhsed plan document.

MEASURING PLAN PROGRESS & SUCCESS

A water quality monitoring plan is an essential part of any watershed plan to evaluate plan implementation outcomes. Physical, chemical, and biological data will be collected over time to track progress towards acheiving water quality improvements and will include total phosphorus, total nitrogen, total suspended solids and biological monitoring. Monitoring partners include Illinois EPA, Illinois Department of Natural Resources, RiverWatch, and the Steering Committee.

The Information & Education (I&E) Plan recommends campaigns that are designed to enhance understanding of the issues, problems, and opportunities within Lower Little Rock Creek watershed. The intention is to promote general acceptance and stakeholder participation in selecting, designing, and implementing recommended Management Measures to improve watershed conditions. The first step in understanding the issues, problems, and opportunities within Lower Little Rock Creek watershed is to gain a better perspective on how the watershed evolved over time into what exists today. The goal of the I&E Plan is to equip municipal staff, elected officials, and other key stakeholders with the tools necessary to establish watershed-based practices and create changes in behaviors that will improve the overall health of the watershed.

HOW CAN YOU HELP LOWER LITTLE ROCK CREEK WATERSHED?

The degradation of water resources seen today in the Lower Little Rock Creek Watershed was brought about over almost 200 years of landscape changes. Fortunately, there are actions outlined in the plan that can be taken to mitigate existing issues and improve water quality over time. The future health of the watershed is largely dependent on how stormwater and natural resources are managed. That includes implementing proven and environmentally-sensitive practices and approaches to restoration, such as those identified in this executive summary and the watershd plan, to improve water quality and stream health in the watershed. You can help the Lower Little Rock Creek watershed by starting in your own backyard and supporting local water quality improvement efforts.

There is no single fix for the water quality and flooding problems in the watershed. These problems are the cumulative result of decisions made since people moved to the watershed in the 1800s. It will take all stakeholders and actions at every scale in order to positively impact watershed resources. This watershed-based plan is the first step in helping watershed residents and stakeholders understand what can be done to restore the valuable resources of the Lower Little Rock Creek Watershed.

For more information on how you can help, contact the City of Sandwich.

Tom Horak: city.engineer@sandwich.il.us
144 E. Railroad Street, Sandwich, IL 60548; 815-786-8802 ext. 1
or visit the City website at: http://www.sandwich.il.us/

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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

Applied Ecological Services, Inc.™

All photos by AES unless otherwise noted.

1.0 INTRODUCTION

1.1 Lower Little Rock Creek Watershed Setting

People live, work, and play in areas of land known as "watersheds." A watershed is best described as an area of land where surface water drains to a common location such as a stream, river, lake, or other body of water (Figure 1). The source of groundwater recharge to streams, rivers, and lakes is also considered part of a watershed. Despite the simple definition for a watershed, they are complex in that there is interaction between natural elements such as climate, surface water, groundwater, vegetation, and wildlife as well as human elements such as agriculture and urban development that produce polluted stormwater runoff, increase impervious surfaces thereby altering stormwater flows, and degrade or fragment natural areas. Other common names given to watersheds, depending on size, include basins, sub-basins, subwatersheds, and Subwatershed Management Units (SMUs).

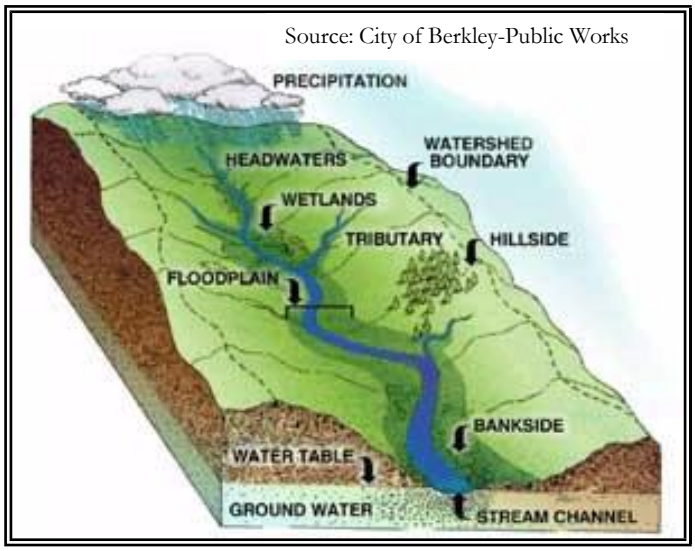


Figure 1. Hypothetical Watershed Setting.

Lower Little Rock Creek watershed, at 10,541 acres (16.5 sq. mi.) in size, is a small watershed located where DeKalb, Kendall, and LaSalle Counties meet (Figure 2). The hydrologic unit code (HUC) for the watershed is 071200070306 (AUID: IL_DTCA-01). This watershed is the downstream-most portion of Little Rock Creek which flows south and east to its confluence with the Fox River south of Plano before joining the Illinois River. The Illinois River then flows southwest to join the Mississippi near Moline, IL.

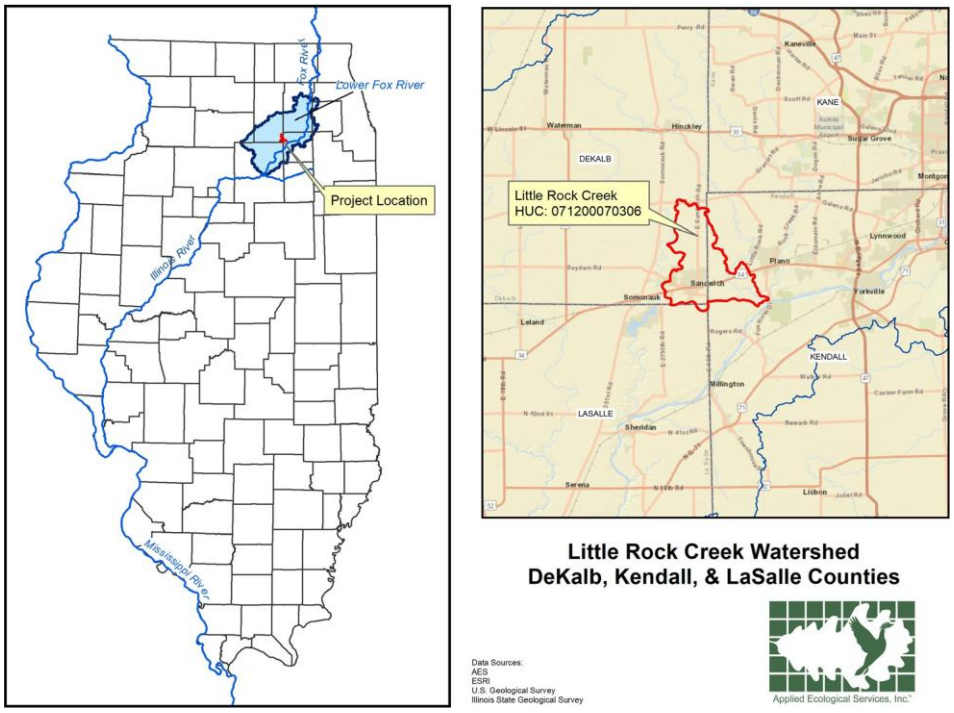


Figure 2. Watershed locator maps.

Confluence of Fox River and Little Rock Creek

Pre-European settlement ecological communities in Lower Little Rock Creek watershed and surrounding area were balanced ecosystems with clean water and diverse with plant and wildlife populations. The mosaic of prairie, woodlands, and savannas mixed with wetlands were largely maintained and shaped by frequent fires ignited by both lightning and the Native Americans that inhabited the area. Herds of bison and elk also helped maintain the ecosystem via large scale grazing. During these times most of the water that fell as precipitation was absorbed in prairie and wooded communities and within the extensive floodplain wetlands that existed along stream and tributary corridors.

Ecological conditions changed quickly and drastically following European settlement in the mid-1800s. Large scale fires no longer occurred, and bison and elk were extirpated. Significant portions of wooded communities and nearly all prairies were tilled, and tile systems were installed to drain wetland areas as farming became the primary land use by the early 1900s. Conversion from farmland to residential and commercial uses in and around the City of Sandwich followed and continues to this day. Lower Little Rock Creek watershed is presently dominated by farmland, residential subdivisions, commercial centers, and forest preserve land.

With ongoing "Traditional" development and landscape change in the watershed comes negative impacts to the environment. Impervious surfaces greatly reduce the ability of precipitation to infiltrate into the ground and instead cause stormwater runoff to quickly reach streams and tributaries. This in turn results in downcutting, widening, and bank erosion causing sediment and nutrient loading downstream. Meanwhile, invasive species established in adjacent floodplain wetlands are causing loss of wildlife habitat and reduced floodplain function. In addition, nutrients from residential lawn fertilizers and effluent from wastewater treatment plants is negatively impacting the biological communities in Lower Little Rock Creek. Discharged water from various sources that is not properly filtered is referred to as "non-point source pollution" and is the primary focus of this plan. The City of Sandwich (Sandwich) became concerned over the health of Lower Little Rock Creek watershed when it began showing signs of degradation.

Noteworthy- Watershed at a Glance

- Lower Little Rock Creek and its tributaries drain 16.5 sq. mi. of land in DeKalb, Kendall, and LaSalle Counties, IL.
- Lower Little Rock Creek is the most downstream portion of the larger Little Rock Creek watershed.
- Municipalities in the watershed include the Cities of Sandwich and Plano.
- Lower Little Rock Creek is moderately impacted by nutrients.
- 72% of streams and tributaries are naturally meandering; 28% are moderately to highly channelized.
- 53% of streams and tributaries exhibit minimal bank erosion; 47% are moderately eroded.
- 42% of the riparian areas are in good condition, 29% are of average quality; 29% are in poor condition.
- Prairies, woodlands, and wetlands were the primary ecological communities prior to European settlement in the 1830s.
- There were 1,776 acres of wetlands prior to European settlement; 309 acres or 17% remain.
- The dominant land uses in 2018 include agriculture, single family residential, and open space.
- The population of the watershed in 2015 was approximately 13,222 and expected to increase to over 16,546 by 2025.
- In total, the Green Infrastructure Network for Lower Little Rock Creek watershed encompasses 3,501 acres (239 parcels), of which 291 acres (8%) are protected.
- Important Natural Areas in the watershed include Little Rock Creek Forest Preserve, Harvey Creek Conservation Area, the riparian areas along LRC Reach 1 & 2, and a dry-mesic oak woodland.
- Approximately 4,600 linear feet of Little Rock Creek Reach 2 are classified as a Biologically Significant Stream by IDNR.
- Cropland areas account for 37%, 25%, and 67% of phosphorus, nitrogen, and total suspended solids loading, respectively.
- One permitted WWTP accounts for 33% and 20% of phosphorus & nitrogen loading, respectively.
- Upstream portions of Little Rock Creek, beyond the Lower Little Rock Creek watershed, likely contribute 40% of phosphorus, 45% of nitrogen and 28% of total suspended solids loading.
- A 49% decrease in total nitrogen (TN) and a 19% decrease in total phosphorus (TP) are needed in Little Rock Creek to meet targets (total suspended solids levels are well within guidelines).

1.2 Project Scope & Purpose

In 2018, the City of Sandwich (Sandwich), with assistance from the DeKalb County Community Foundation and Applied Ecological Services, applied for and received Illinois Environmental Protection Agency (Illinois EPA) funding in 2019 through Section 319 of the Clean Water Act to undergo a watershed planning effort and produce a comprehensive "Watershed-Based Plan" to act as a **"guidance document"** for stakeholders in Lower Little Rock Creek watershed that would meet requirements as defined by the United States Environmental Protection Agency (USEPA). Ultimately, the intent of 319 funding is to develop and implement Watershed-Based Plans designed to achieve water quality standards. Sandwich hired Applied Ecological Services, Inc. (AES) in September 2019 to develop the plan.

The watershed planning process is a collaborative effort involving voluntary stakeholders with the primary scope to restore impaired waters and protect unimpaired waters by developing an ecologically-based management plan for Lower Little Rock Creek watershed that focuses on improving water quality by protecting green infrastructure, creating protection policies, implementing ecological restoration, and educating the public. Another important outcome is to improve the quality of life for people in the watershed for current and future generations.

The primary purpose of this plan is to spark interest and give stakeholders a better understanding of the Lower Little Rock Creek watershed to promote and initiate plan recommendations that will accomplish the goals and objectives of this plan. This plan was produced via a comprehensive watershed planning approach that involved input from stakeholders and analysis of complex watershed issues by Applied Ecological Service's watershed planners, ecologists, GIS specialists, and environmental engineers.

The City of Sandwich, acting as the Watershed Coordinator, held regular, public meetings from late 2019 through 2021 to guide the watershed planning process by establishing goals and objectives to address watershed issues and to encourage participation of stakeholders to develop planning and support for watershed improvement projects and programs.

Interests, issues, and opportunities identified by Sandwich and stakeholders were addressed and incorporated into the Watershed-Based Plan. The plan acknowledges the importance of managing remaining green infrastructure to meet many of the goals and objectives in the plan and provides scientific and practical rational for protecting appropriate green infrastructure from traditional development and entering into relationships with public, private, and non-profit entities to manage these properties to maximize watershed benefits. In addition, ideas and recommendations in this plan are designed to be updated through adaptive management that will strengthen the plan over time as additional information becomes available. It is important to note that all recommendations in this plan are for guidance only and not required by any federal, state, or local agency.

1.3 USEPA Watershed-Based Plan Requirements

In March 2008, the United States Environmental Protection Agency (USEPA) released watershed protection guidance entitled *Non-point Source Program and Grant Guidelines for States and Territories*. The document was created to ensure that Section 319 funded Watershed-Based Plans and projects make progress towards restoring waters impaired by non-point source pollution. Applied Ecological Services, Inc. consulted USEPA's *Handbook for Developing Watershed Plans to Restore and Protect Our Waters* (USEPA, 2008) and Chicago Metropolitan Agency for Planning's (CMAP's) *Guidance for Developing Watershed Implementation Plans in Illinois* (CMAP, 2007) to create this watershed plan. Having a Watershed-Based Plan will allow Lower Little Rock Creek watershed stakeholders to access 319 Grant funding for watershed improvement projects recommended in this plan. Under USEPA guidance, "Nine Elements" are required in order for a plan to be considered a Watershed-Based Plan.

Noteworthy- USEPA Nine Elements

Element A: Identification of the causes and sources or groups of similar sources of pollution that will need to be controlled to achieve the pollutant load reductions estimated in the watershed-based plan;

Element B: Estimate of the pollutant load reductions expected following implementation of the management measures described under Element C below;

Element C: Description of the BMPs (nonpoint source management measures) that are expected to be implemented to achieve the load reductions estimated under Element B above and an identification of the critical areas in which those measures will be needed to implemented;

Element D: Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement the plan;

Element E: Public information/education component that will be implemented to enhance public understanding of the project and encourage early and continued participation in selecting, designing, and implementing/maintaining nonpoint source management measures that will be implemented;

Element F: Schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious;

Element G: Description of interim, measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented;

Element H: Set of environmental or administrative criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards;

Element I: Monitoring component to evaluate the effectiveness of the implementation efforts over time.

1.4 Planning Process

The Lower Little Rock Creek watershed stakeholders first met in December 2019 to kickoff the watershed planning process. At this meeting, Applied Ecological Services, Inc. (AES) provided stakeholders with an overview of the steps involved in the watershed planning process. The Watershed Coordinator (Sandwich) engaged stakeholders by explaining how their input and participation would benefit the overall outcome of the project. Volunteer stakeholders representing various interests within the watershed met 7 times throughout the planning process. The group generally consisted of representatives from various municipal, governmental, private, and public organizations as well as local residents.

The stakeholder group developed goals and objectives for the watershed and identified problem areas and opportunities. Meetings were initiated by the Watershed Coordinator and generally covered one or more watershed topics. Meetings were devoted to development of goals and objectives, watershed assessment findings, and action plan items. Local experts and watershed residents were also invited to give presentations on specific topics. A list of the meetings is summarized in Table 1. Complete meeting minutes are included in Appendix A.

Table 1. Lower Little Rock Creek watershed meeting schedule.

Date	Agenda	Summary
December 4, 2019	• Kickoff • Watershed Planning Summary • Stakeholder Involvement • Discuss Future Meetings	The Watershed Coordinator detailed the background on why a watershed plan is needed and who helped make it happen. AES summarized the Nine Elements needed in a USEPA approved watershed plan and outlined the planning process.
Jan. 29, 2020	• Watershed Field Inventory Results	AES summarized the results of the "Watershed Resource Inventory" field investigation including the inventory methodology and survey results for the streams, riparian areas, detention basins, drained wetland sites, and natural/open space areas.
Sept. 30, 2020	• Watershed Background: Parts 1 & 2	AES updated stakeholders with watershed information including geology, pre-settlement conditions. Topography, jurisdictions, demographics, existing and future land use, impervious cover, open space parcel prioritization, important natural areas, the green infrastructure network, cropland and agricultural data, and groundwater.
Dec. 9, 2020	• Water Quality • Identification of Impairments • Pollutant Reduction Targets	AES summarized the designated use impairments, wastewater treatment plant, water quality inventory summary, the results of the pollutant loading model, "hot spot" SMU analysis, and impairment reduction targets in the watershed.

Date	Agenda	Summary
Feb. 17, 2021	• Goals Workshop • Goal Prioritization	AES led a virtual goals workshop for watershed stakeholders that began with detailing the existing conditions in the watershed, followed by polling exercises to prioritize the goals and open discussion.
Apr. 14, 2021	• Programmatic Action Plan • Site Specific Action Plan • Critical Areas	AES presented the Programmatic and Site-Specific Action Plans and the Critical Areas to the Steering Committee.
June 9 or 16, 2021	• Water Quality Monitoring Plan • Plan Evaluation Report Cards • Information & Education Campaign	AES first reviewed the water quality monitoring plan for the watershed and the report cards developed for each plan goal/objective. Finally, the Watershed Coordinator reviewed the Information and Education Plan with the Watershed Steering Committee.

1.5 Using the Watershed-Based Plan

The information provided in this Watershed-Based Plan is prepared so that it can be easily used as a tool by any stakeholder including elected officials, federal/state/county/municipal staff, and the general public to identify and take actions related to watershed issues and opportunities. The pages below summarize what the user can expect to find in each major "Section" of the Watershed-Based Plan. **All recommendations in this plan are for guidance only and not required by any federal, state, or local agency.**

Section 2.0: Mission, Goals, and Objectives
Section 2.0 of the plan contains the Lower Little Rock Creek Watershed-Based Plan mission and goals/objectives. Goal topics include protection of green infrastructure, agriculture, reduction in problematic flooding, improved surface water quality, implementation of education opportunities, and updates to watershed policy. In addition, "Measurable Objectives" were developed where possible for each goal so that the progress toward meeting each goal can be measured in the future by evaluating information included in Section 9.0: Measuring Plan Progress & Success.

Section 3.0: Watershed Resource Inventory
An inventory of the characteristics, problems, and opportunities in Lower Little Rock Creek watershed is examined in Section 3.0. Resulting analysis of the inventory data led to recommended watershed actions that are included in Section 6.0: Management Measures Action Plan. Inventory results also helped identify causes and sources of watershed impairment as required under USEPA's *Element A* and found in Section 5.0.

Section 3.0 includes summaries and analysis of the following inventory topics:

Watershed Resource Inventory Topics *Included* in the Plan

- 3.1 Geology & Climate
- 3.2 Pre-European Settlement Landscape & Present Landscape
- 3.3 Topography, Watershed Boundary, Subwatersheds
- 3.4 Hydric Soils, Soil Erodibility, & Hydrologic Soil Groups
- 3.5 Jurisdictions, Roles, & Protections
- 3.6 Existing Policies & Ordinance Review
- 3.7 Demographics
- 3.8 Existing & Future Land Use
- 3.9 Transportation Network
- 3.10 Impervious Cover Impacts
- 3.11 Open Space and Green Infrastructure
- 3.12 Important Natural Areas
- 3.13 Watershed Drainage System
  - Little Rock Creek & Tributaries
  - Detention Basins
  - Wetlands & Potential Wetland Restoration
  - Floodplain & Flood Problem Areas
- 3.14 Agricultural Land
- 3.15 Groundwater and Community Water
- 3.16 Wastewater Treatment Plant & Septic

Section 4.0: Water Quality & Pollutant Modeling Assessment
A summary and analysis of available water quality data for the watershed and pollutant modeling assessment is included in its own section because of its importance in the watershed planning process. This section includes a detailed summary of all physical, chemical, and biological data available for Lower Little Rock Creek. The pollutant loading assessment identifies pollutant loads from various land cover types and the WWTP. Water quality data combined with pollutant loading data provides information that sets the stage for developing pollutant reduction targets outlined in Section 5.0.

Section 5.0: Causes/Sources of Impairment & Reduction Targets
This section of the plan includes a list of causes and sources of watershed impairment as identified in Section 3.0 that affect Illinois EPA "Designated Uses" for water quality and other watershed features. As required by USEPA, Section 5.0 also addresses all or portions of *Elements A, B, & C* including an identification of the "Critical Areas", pollutant load reduction targets, and estimate of pollutant load reductions following implementation of Critical Area Management Measures identified in Section 6.0.

Section 6.0: Management Measures Action Plan
A "Management Measures Action Plan" is included in Section 6.0. The Action Plan is divided into a Programmatic Action Plan and a Site-Specific Action Plan. Programmatic recommendations are described in paragraph format; site specific recommendations are presented in paragraph, figure, and table formats with references to entities that would provide consulting, permitting, or other technical services needed to implement specific measures. The site-specific tables also outline project priority, pollutant reduction efficiency, implementation schedule, sources of technical and financial assistance, and cost estimates. As required by Illinois EPA, this section also contains a watershed-wide summary table of specific information for all recommended site-specific management measures combined including "Units," "Cost," and "Estimated Pollutant Load Reduction". This section addresses all or a portion of USEPA *Elements C & D.* All recommendations in the Action Plan are for guidance only and not required by any federal, state, or local agency.

Section 7.0: Information & Education Plan
This section is designed to address USEPA *Element E* by providing an Information & Education component to enhance public understanding and to encourage early and continued participation in selecting, designing, and implementing recommendations provided in the Watershed-Based Plan.

This is accomplished by providing a matrix that outlines each education objective followed by primary and secondary recommended education activities. For each activity, a target audience, package (vehicle and pathways for reaching audiences), priority/schedule, lead and supporting agencies, what the expected outcomes or behavior change will be, and estimated costs to implement is provided.

Sections 8.0 & 9.0: Plan Implementation & Measuring Plan Progress & Success
A list of key stakeholders and discussion about forming a Watershed Implementation Committee that forms partnerships to implement watershed improvement projects is included in Section 8.0. Section 9.0 includes two monitoring components: 1) a "Water Quality Monitoring Plan" that includes specific locations and methods where future monitoring programs should focus and a set of water quality "Criteria" that can be used to determine whether pollutant load reduction targets are being achieved over time and 2) "Report Cards" for each plan goal used to measure milestones and to determine if Management Measures are being implemented on schedule, how effective they are at achieving plan goals, and need for adaptive management if milestones are not being met. Sections 8.0 and 9.0 address USEPA *Elements F, G, H, and I.*

Sections 10.0 & 11.0: Literature Cited and Glossary of Terms
Section 10.0 includes a list of literature that is cited throughout the report. The Glossary of Terms (Section 11.0) includes definitions or descriptions for many of the technical words or agencies that the user may find useful when reading or using the document.

Appendix
The Appendix to this report is included on the attached CD located on the back cover (hard copies only). It contains Steering Committee meeting presentations and attendance lists (Appendix A), Center for Watershed Protection local ordinance review summary (Appendix B), results of the watershed resource field inventory (Appendix C), the complete STEPL pollutant loading model and assumptions and Site-Specific Action Plan reduction calculations (Appendix D), and a list of potential funding opportunities (Appendix E).

1.6 Prior Studies and Projects

Various studies have been completed describing and analyzing conditions within Lower Little Rock Creek watershed. Several ecological restoration efforts have also been implemented. This Watershed-Based Plan uses existing data to analyze and summarize work that has been completed by others and integrates new data and information. A list of known studies is summarized below.

1. In 1978, the Illinois State Geological Survey compiled a report entitled The Sandwich Fault Zone of Northern Illinois that provided baseline geological data for the watershed.

2. In 2004 and 2013, Illinois Natural History Survey compiled a report entitled *The Freshwater Mussels (Bivalvia: Unionidae) of the Fox River Basin, Illinois and Wisconsin*, detailing the extent of freshwater mussels found in Little Rock Creek.

3. The downstream-most 4,600 linear feet of Little Rock Creek Reach 2 through the forest preserve is graded as a "Class B" stream by the Illinois Department of Natural Resources for Integrity Ratings and Diversity as of a 2008 survey.

4. The Illinois State Water Survey completed a groundwater survey in 2012 entitled *Northeastern Illinois Water Supply Planning Investigations: Opportunities and Challenges of Meeting Water Demand in Northeastern Illinois*.

5. Illinois Tollway supplied studies and best practices guides related to road salt reduction, re-use, and recycling, studies on chlorides, and converting invasive species to energy. They are also developing additional biological water quality monitoring support and advanced research to the Steering Committee.

6. Comprehensive plans and development guidance are available for DeKalb County (2011), Kendall County (2011), the City of Sandwich (amended 2011), and the City of Plano (2017).

7. In 2017, the Illinois Department of Natural Resources completed a report entitled "2017 Status Report of Fish Assemblages and the Sport Fishery in the Fox River Watershed," which included detailed fish survey results for Little Rock Creek.

8. Existing DeKalb County, Kendall County, City of Sandwich, and DeKalb County Soil and Water Conservation District Geographic Information System (GIS) data for Lower Little Rock Creek watershed was obtained and used to analyze various data related to wetlands, soils, land use, demographics, and other relevant information.

9. The DeKalb County Soil and Water Conservation District supplied much valuable insight and leadership on agricultural best management practices and ongoing NRCS programs.

2.0 MISSION, GOALS, AND OBJECTIVES

2.1 Lower Little Rock Creek Watershed-Based Plan Mission

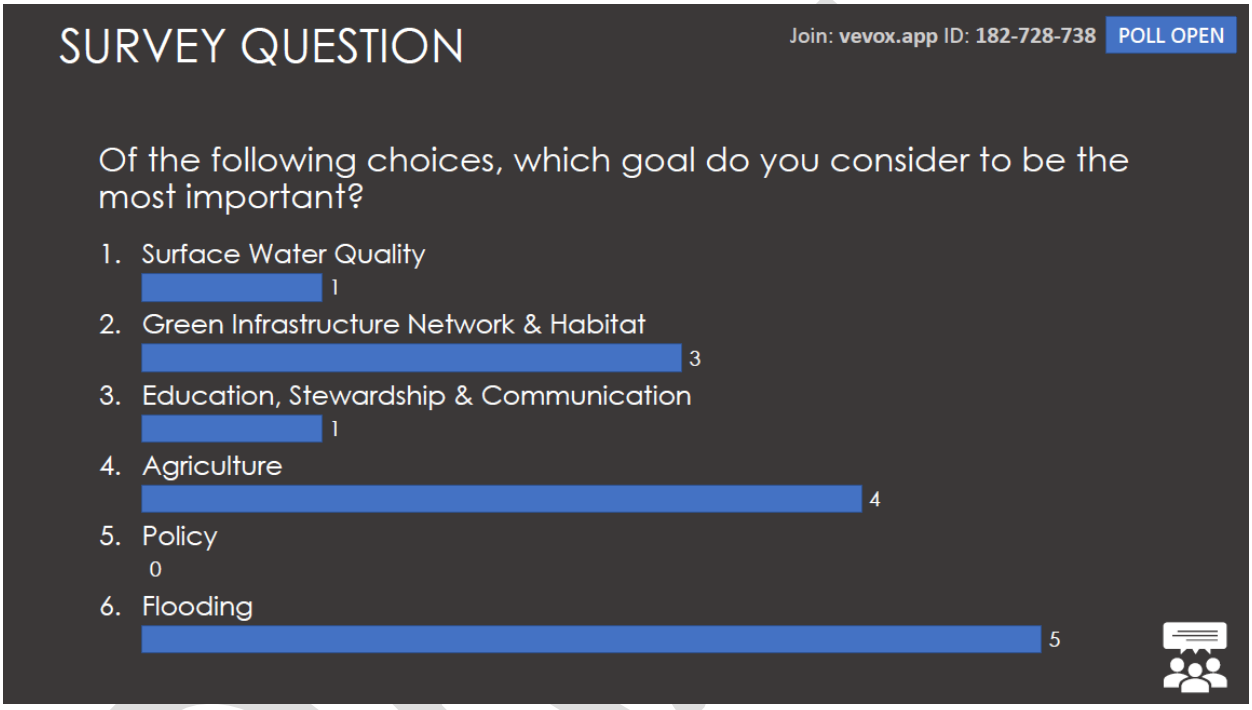
The Watershed Coordinator, Steering Committee, and stakeholders of the Lower Little Rock Creek watershed developed a mission statement to guide the watershed plan. That mission is as follows:

"The mission of the watershed plan is to improve water quality by reducing nonpoint source pollution and flooding, while improving habitat, along with increasing our knowledge and educating our residents to help improve the health of the Lower Little Rock Creek watershed."

Windmill in Lower Little Rock Creek watershed

2.2 Goals and Objectives

A virtual Goals Workshop was held on February 17, 2020, devoted to gathering feedback from the community on the development of the plan and goals. Watershed stakeholders were first presented with information about the character, existing conditions, and quality of watershed resources over the course of several meetings prior to developing goals. Six general goal topics were chosen by the group to address issues that were brought up during those meeting and determined to be important in the Lower Little Rock Creek watershed. Stakeholders were then given the opportunity to vote on goals they felt were most important as a way of prioritizing those goals.



Goal Prioritization results captured during the February 17, 2021 virtual Goals Workshop

The voting process occurred during the Goals meeting held on February 17, 2021 and included 19 stakeholders from the community and representing various local agencies and municipalities. Each stakeholder was asked to prioritize the six goal topics from most important to least important. The voting process helped focus on goals that need to be adequately addressed in the planning process and within this watershed plan report. Each goal was then scored according to how each person ranked those topics with more highly ranked goals receiving a higher weighted result. Weighted results were as follows:

1) Green Infrastructure Network & Habitat– *Received a weighted score of 64*
2) Agriculture – *Received a weighted score of 63*
3) Flooding – *Received a weighted score of 53*
4) Surface Water Quality – *Received a weighted score of 49*
5) Education, Stewardship, & Communication – *Received a weighted score of 47*
6) Policy – *Received a weighted score of 39*

The six topics were used as the basis for the goals for the Lower Little Rock Creek Watershed-Based Plan. Objectives for each goal were also formulated and designed to be specific where feasible and measurable so that future progress toward meeting goals can be assessed. Goals and objectives ultimately lead to the development of action items. The goals reference various sections throughout the plan including the Green Infrastructure Network (Section 3.11), Important Natural Areas (Section 3.12), the Watershed Drainage System and inventory (Section 3.13), Jurisdictions (Section 3.5), Water Quality Assessment (Section 4.1), and the Management Measures Action Plan (Section 6.0). More detail can be found on each of these topics within the referenced sections.

The Management Measures Action Plan section of this report is geared toward addressing watershed goals by recommending programmatic and site-specific Management Measure actions to address each goal. The goals and objectives are examined in more detail in the discussion of the measurement of plan progress and success via milestones and "Report Cards" outlined in Section 9.2.

Goal 1: ***Protect, manage, and restore natural components of the Green Infrastructure Network and improve fish and wildlife habitat.***

Objectives:

1) Include the identified Green Infrastructure Network in all county and municipal comprehensive plans and development review maps.
2) Encourage private landowners with parcels within the Green Infrastructure Network to manage their land for ecological and water quality benefits.
3) Reconnect the stream to the floodplain within the Green Infrastructure Network where possible.
4) Improve habitat in degraded stream reaches using natural and ecological design approaches.
5) Develop and implement restoration and management plans for all Natural Area Restoration sites.
6) Implement conservation design or low impact development standards where new or redevelopment occurs.
7) Ensure adequate funding is in place for future operations and maintenance of natural areas and restorations.

Goal 2: ***Encourage agricultural techniques and soil conservation practices that will protect and conserve topsoil, improve soil health, and protect our water resources.***

Objectives:

1) Educate and inform landowners about federal and state cost-share programs, which provide incentives for landowners to enroll in conservation programs and implement conservation practices.
2) Encourage landowners to utilize existing programs and agencies such as the Natural Resource Conservation Service, the DeKalb and Kendall County Soil and Water Conservation Districts and the Farm Service Agency to install conservation practices that protect soil loss and water quality.
3) Increase support for and develop additional financial assistance programs targeted at increasing the installation of conservation practices.
4) Encourage landowners and farmers to follow the principles of soil health and/or regenerative agriculture on their land.

5) Implement an additional 19% (1,357 acres) of more intensive Conservation Tillage practices (leaving at least 60% residue) on agricultural land identified in the plan.
6) Encourage landowners and farmers to support the Illinois Nutrient Loss Reduction Strategy by implementing practices that reduce annual loading of nitrate-nitrogen and total Phosphorus to the Lower Little Rock Creek by at least 15 percent and 25 percent respectfully by 2025.

Goal 3: ***Manage and mitigate for existing and future structural flood problems.***

Objectives:

1) Implement impervious reduction measures into development that is predicted to occur within Subwatershed Management Units 2, 4, 5, 8, 9, and 10, which are "Highly Vulnerable" to future development changes and associated impervious cover.
2) Limit development in the identified FEMA 100-year floodplain.
3) Mitigate for identified flood problem areas on a case-by-case basis where feasible.
4) Restore 355 acres of potential wetland restoration sites and maintain or improve existing wetland connectivity to streams.

Goal 4: ***Improve surface water quality to meet applicable water quality standards.***

Objectives:

1) Continue existing water quality monitoring programs and implement the Water Quality Monitoring Plan outlined within the plan.
2) Restore 29.4 acres of High Priority/Critical Area detention basin retrofit opportunities.
3) Restore 47,270 linear feet of stream and riparian area restoration along all High Priority/Critical Area stream reaches.
4) Implement 355 acres of High Priority/Critical Area wetland restoration recommendations.
5) Implement 397 acres of High Priority/Critical Area other management measures recommendations.
6) Implement an additional 19% (1,357 acres) of more intensive Conservation Tillage practices (leaving at least 60% residue) on agricultural land identified in the plan.
7) Track changes in water quality over time and make adaptive management changes to the plan as necessary to ensure water quality improvements toward meeting identified pollutant load reductions.

Goal 5: ***Build stakeholder awareness of watershed issues through education and stewardship while increasing communication and coordination among stakeholders.***

Objectives:

1) Implement the Lower Little Rock Creek Watershed-Based Plan Information & Education Campaign.
2) Increase environmental stewardship opportunities and encourage stakeholders to participate in watershed plan implementation and restoration campaigns to increase activism in the watershed.
3) Inform public officials of the benefits of conservation design and low impact development and the importance of ordinance language changes that promote these developments.
4) Leverage targeted educational information developed by DCSWCD for agricultural landowners.
5) Provide educational information to residents on flooding issues, the City's adaptive management of stormwater over time, and the City's work to address flooding where there are recurring flooding issues.
6) Provide homeowner and business associations with the knowledge needed to maintain naturalized detention basins.

Goal 6: ***Assess and improve policies and regulations to protect and support our natural resources.***

Objectives:

1) Local governments adopt, support, and implement recommendations in the Lower Little Rock Creek Watershed-Based Plan.
2) Implement additional policy recommendations that focus on improving watershed conditions by preserving green infrastructure, sustainable management of stormwater, minimizing road salts, minimizing lawn fertilizer, protecting groundwater, and allowances for native landscaping.
3) Local governments include parcels identified in this Plan as Priority Green Infrastructure Protection Areas and High Priority/Critical Area Green Infrastructure Network (see Sections 3.11 and 6.2.4) in their municipal comprehensive plans and development review maps.
4) Encourage local governments to incorporate Conservation Design or Low Impact Development standards where new development is planned on Priority Green Infrastructure Protection Areas and/or within the Green Infrastructure Network identified in this Plan (see Sections 3.11 and 6.2.4).
5) Encourage developers to protect sensitive natural areas, restore degraded natural areas and streams as part of the development process. Encourage donation of highly sensitive natural areas such as high-quality habitat, to a public agency or conservation organization for long term management with dedicated funding such as impact fees, Special Service Areas (SSA's) or a one-time donation.

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3.0 WATERSHED RESOURCE INVENTORY

3.1 Geology & Climate

Geology

The terrain of the Midwestern United States was created over thousands of years as glaciers advanced and retreated during the Pleistocene Era or "Ice Age". Some of these glaciers were a mile thick or more. The Illinois glacier extended to southern Illinois between 300,000 and 125,000 years ago. It is largely responsible for the flat, farm-rich areas in the central portion of the state that were historically prairie. Only the northeastern part of Illinois was covered by the most recent glacial episode known as the Wisconsin Episode that began approximately 70,000 years ago and ended around 14,000 years ago (Figure 3). During this period the earth's temperature warmed and the ice slowly retreated leaving behind moraines and glacial ridges where it stood for long periods of time (Hansel, 2005). A tundra-like environment covered by spruce forest was the first ecological community to colonize after the glaciers

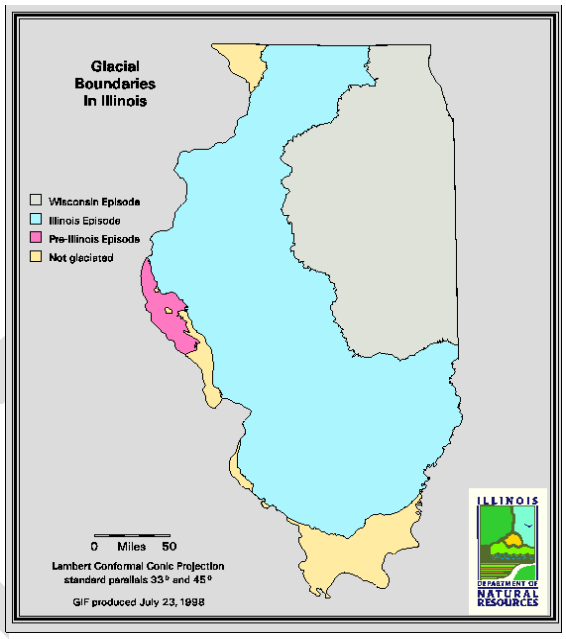


Figure 3. Glacial boundaries in Illinois

Fox River near confluence with Little Rock Creek

retreated. As temperatures continued to rise, tundra was replaced by cool, moist, deciduous forests and eventually by oak-hickory forests, oak savannas, marshes, and prairies.

The Sandwich Fault Zone extends from Will County near Manhattan, 85 miles west through Kendall and Dekalb Counties and ends near Oregon in Ogle County (Figure 4). The fault zone consists of dolomite, limestone, sandstone, and shale with unconsolidated surface deposits of glacial drift, loess, and alluvium (Kolata et. al. 1978)

The Plateville and Galena Systems are located north of the Sandwich Fault and extend north and east into Dekalb County and consists of limestone and dolomite with some outcropping occurring in Kendall County. The Cambrian System occurs in a narrow band within the Lower Little Rock Creek watershed south of the Sandwich Fault and contains sandstone, dolomite, siltstone, and shale (Kolata et. al. 1978). South of the Cambrian System is the Prairie Au Chein and Ancell Systems which are comprised of sandstone and dolomite.

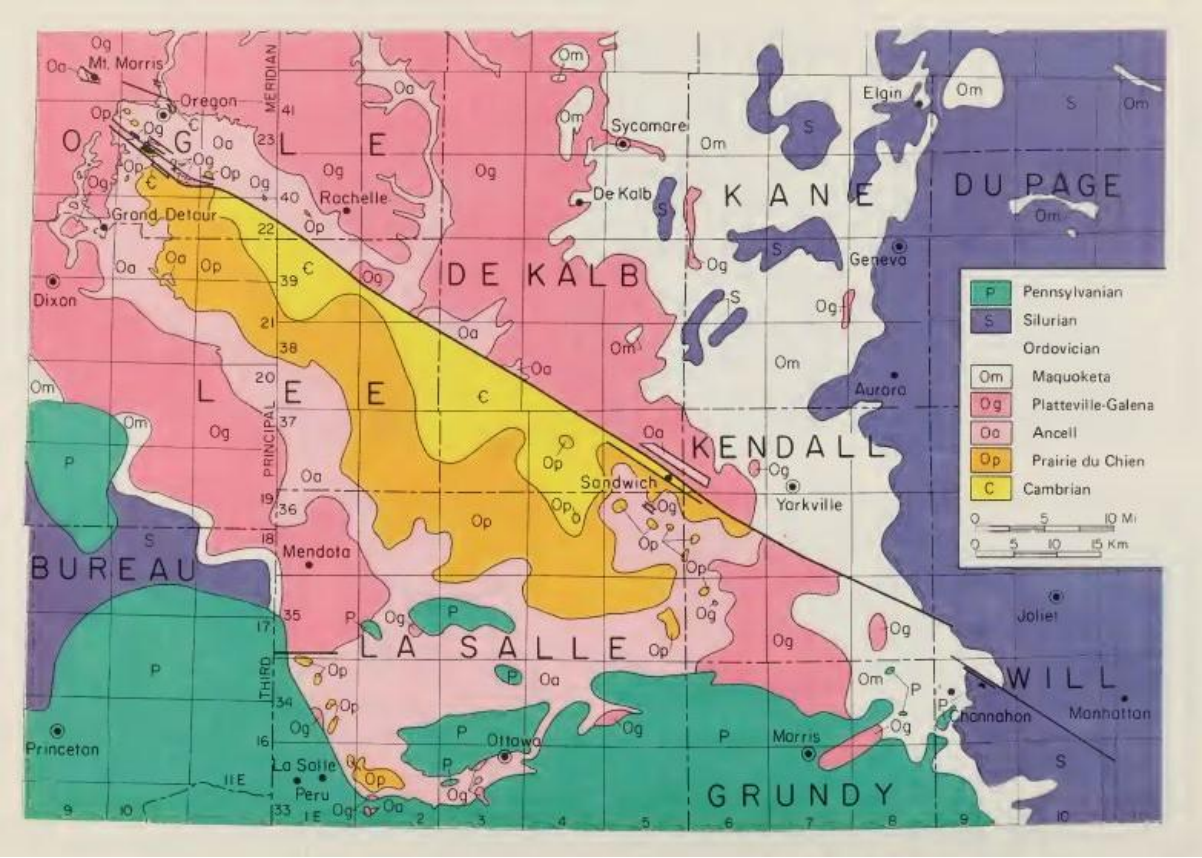


Figure 4. Geologist Map of Sandwich Fault Zone and Adjacent Areas (Kolata et al. 1978)

Climate

The northern Illinois climate can be described as temperate with cold winters and warm summers where great variation in temperature, precipitation, and wind can occur on a daily basis. Surges of polar air moving southward or tropical air moving northward cause daily and seasonal temperature fluctuations. The action between these two air masses fosters the development of low-pressure centers that generally move eastward and frequently pass over Illinois, resulting in abundant rainfall.

Prevailing winds are generally from the west but are more persistent and blow from a northerly direction during winter.

The Weather Channel website (www.weather.com) provides an excellent summary of climate statistics including monthly averages and records for most locations in Illinois. Data for Sandwich represents the climate and weather patterns experienced in Lower Little Rock Creek watershed (Figure 5). The winter months are cold averaging highs around 30° F while winter lows are around 16° F. Summers are warm with average highs around 84° F and summer lows around 65° F. The highest recorded temperature was 111° F in July 1936 while the lowest temperature was -26° F in January 1985.

Fairly typical for the Midwest, the current climate of the Lower Little Rock Creek watershed consists of an average precipitation around 38 inches and snowfall around 29 inches annually. According to data collected in Sandwich, the most precipitation on average occurs in June (4.22 inches) while January receives the least amount of precipitation with 1.68 inches on average.

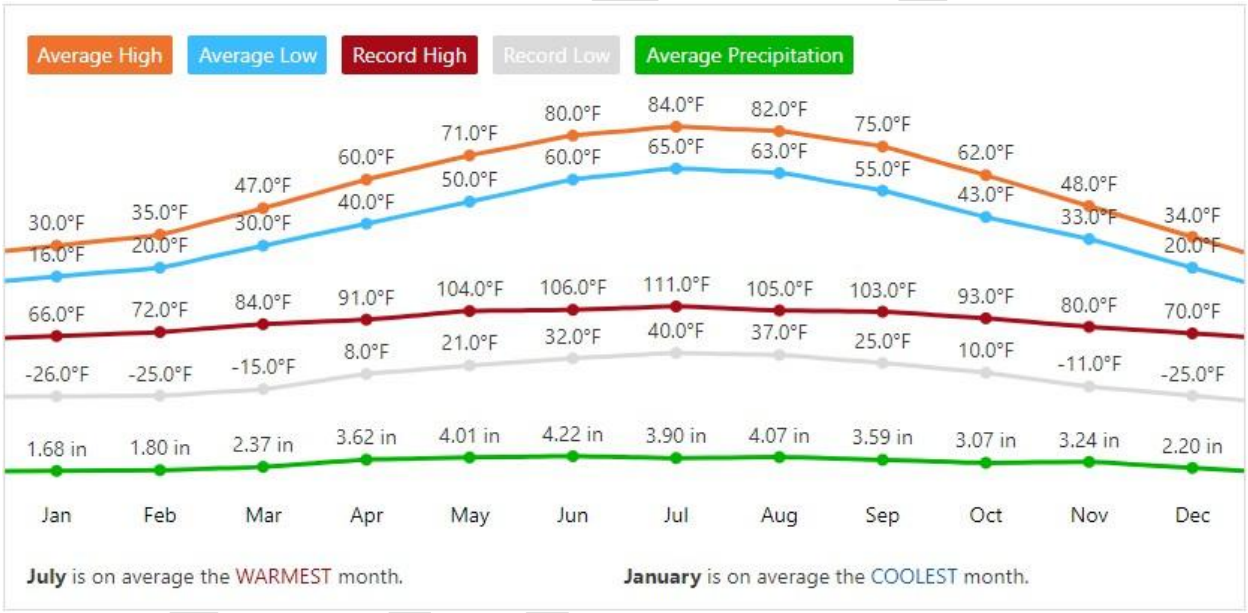


Figure 5. Climate records for Sandwich, IL (Source: The Weather Channel).

3.2 Pre-European Settlement Landscape Compared to Present Landscape

The last Native American Indian tribe to call the area home was the Potawatomie. However, they were removed from the land with the signing of a treaty in 1833. A history book on DeKalb County printed in 1868 details what the land was like prior to settlement:

> *"In the broad, billowy prairies, extending as far as the eye can reach, we have the element of vastness as in scarce any other land; we have a luxuriant sward of emerald greenness, clothing the whole land, down to the very margin of the waters; we have meandering streams, clear as crystal, now smooth, quiet and glassy, then ruffled by winds or rapids; we have clumps of trees, charming groves, disposed with an effect of beauty that might baffle a landscape gardener; now crowning the grassy height, now clothing the green slope with their pleasing shade. From the gentle heights of the rolling prairies, the country, even before the hand of man had broken its surface, wore the aspect of cultivated meadows and rich pasture grounds, irrigated by frequent rivulets."* – Boies, 1868

Sandwich was platted in 1855 as a railroad stop on the Chicago, Burlington, and Quincy Railroad. It was originally one half of the Township of Somonauk. Sandwich and briefly named Almon after the first settler, Almon Cage. It was later renamed Newark Station after the railroad depot and later renamed Sandwich after Congressman John Wentworth's hometown of Sandwich, New Hampshire.

Sycamore in downtown Sandwich

The original public land surveyors that worked for the office of U.S. Surveyor General in the early and mid-1800s mapped and described natural and man-made features and vegetation communities while creating the "rectangular survey system" for mapping and sale of western public lands of the United States (Daly & Lutes et. al., 2011). Ecologists know by interpreting survey notes and hand drawn Federal Township Plats of Illinois (1804-1891) that a complex interaction existed between several ecological communities including prairies, savannas, woodlands, and wetlands prior to European settlement in the 1830s.

The surveyors overwhelming majority of the Lower Little Rock Creek watershed as "Prairie" with stretches of "Forest" along Little Rock Creek and a few pockets of "Swamp" scattered throughout, (Figure 6). Over 75% of the watershed was prairie, with less than 20% forest, and the remainder split between wetlands, water, and agricultural fields. This mixture of "Prairie" and "Forest" across

the landscape was widely described in the mid-1800s as the surveyors and early settlers moved west out of the heavily forested eastern portion of the United States and encountered a much more open environment that ecologists now refer to as "Savanna." Prior to settlement, the prairie-savanna landscape was maintained and renewed by frequent lightning strike fires, fires ignited by Native Americans, and grazing by bison and elk. Fires ultimately removed dead plant material, exposing the soils to early spring sun, and returning nutrients to the soil. Running through the prairie-savanna landscape were meandering stream corridors and low wet depressions consisting of sedge meadow, marsh, and wet prairie. The areas of "Timber" were stretches of continuous forest along the banks of Little Rock Creek comprised of white, red, and burr oaks, interspersed with poplar, maple, butternut, black-walnut and hickory.

During pre-European settlement times most of the water that fell as precipitation was absorbed in upland prairie and savanna communities and within the extensive wetlands that existed along stream corridors.

Pre-European settlement prairie-savanna landscape

European settlement resulted in drastic changes to the fragile ecological communities. Fires no longer occurred, prairie and wetlands were tilled under or drained for farmland or developed, and many channels/ditches were excavated through wet areas to further drain the land for farming purposes. The earliest aerial photographs, taken in 1939 (Figure 7), depict the Lower Little Rock Creek watershed when row crop farming was the primary land use (as it still is) but with less of the residential and commercial development seen around Sandwich today. At the time these aerial photos were taken, the woodland communities bordering Little Rock Creek in the southeastern portion of the watershed and Somonauk Creek west of Sandwich were significantly cleared out. The "seas of grass" and wet prairie communities described by the surveyors of the 1800s were replaced nearly entirely by agricultural fields. With the advent of farming came significant changes in stormwater runoff, leading to the formation of defined channels where ephemeral wet areas once existed. The Little Rock Creek Tributary, which was not present in the 1800's surveys, became a waterway draining the northern reaches of the watershed into Little Rock Creek.

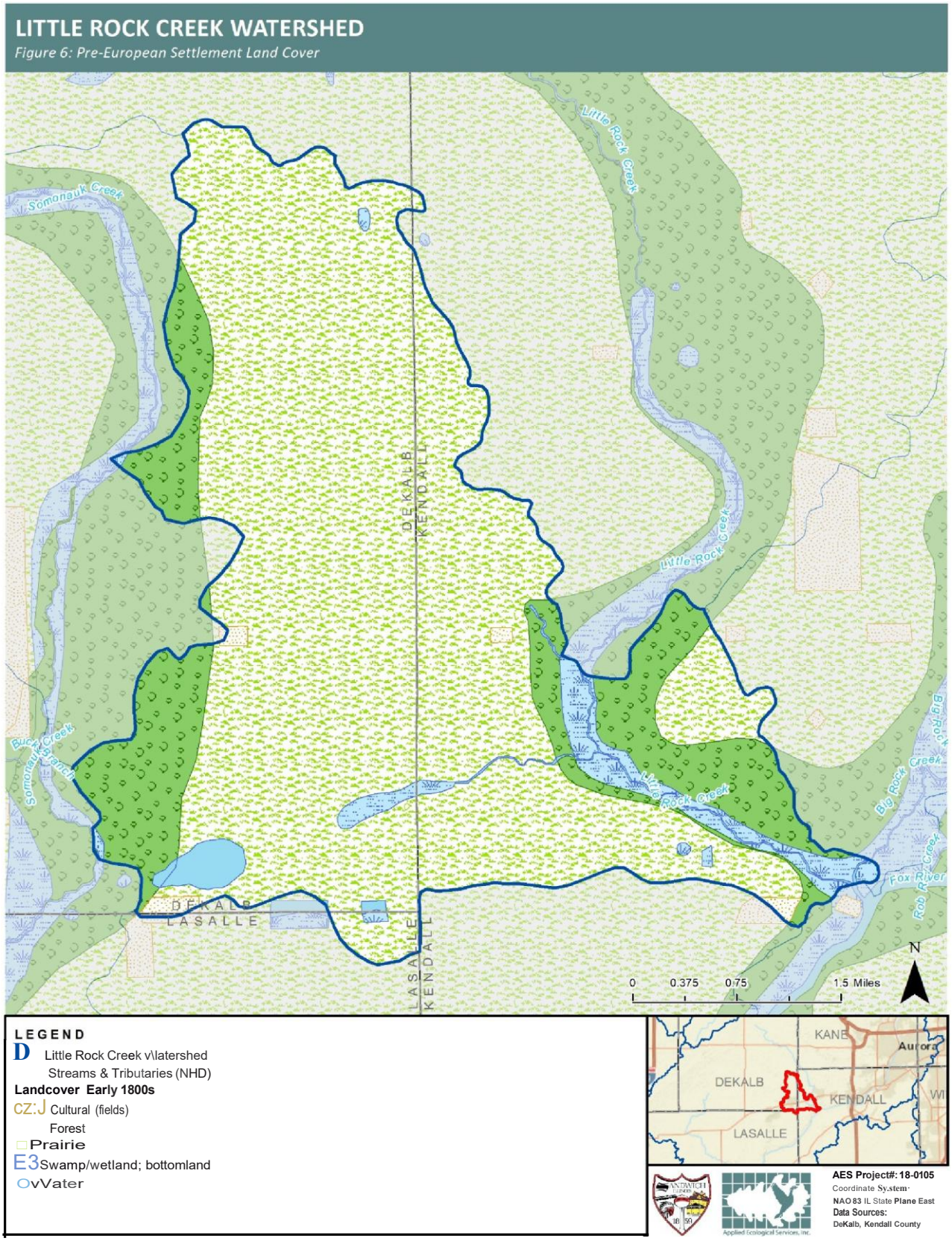
Figure 8 shows a 2017 aerial photograph of the Lower Little Rock Creek watershed. It is clear that residential and commercial development expanded outward from Sandwich into the surrounding farmland, and though the extent of this development is not drastic, it is indicative of future land use. The darker, rounded signatures scattered throughout the watershed correlate closely with the hydric

soils (discussed in Section 3.X). Compared to pre-settlement conditions, very few woodlands

virtually no wetlands remain bordering Little Rock Creek by 2017. As mentioned previously, the Little Rock Creek Tributary has also established itself in lowland, former prairie areas which have seen increased drainage due. The upper reaches of this tributary are largely grassed or ephemeral waterways, and have little to no buffer, wooded or otherwise.

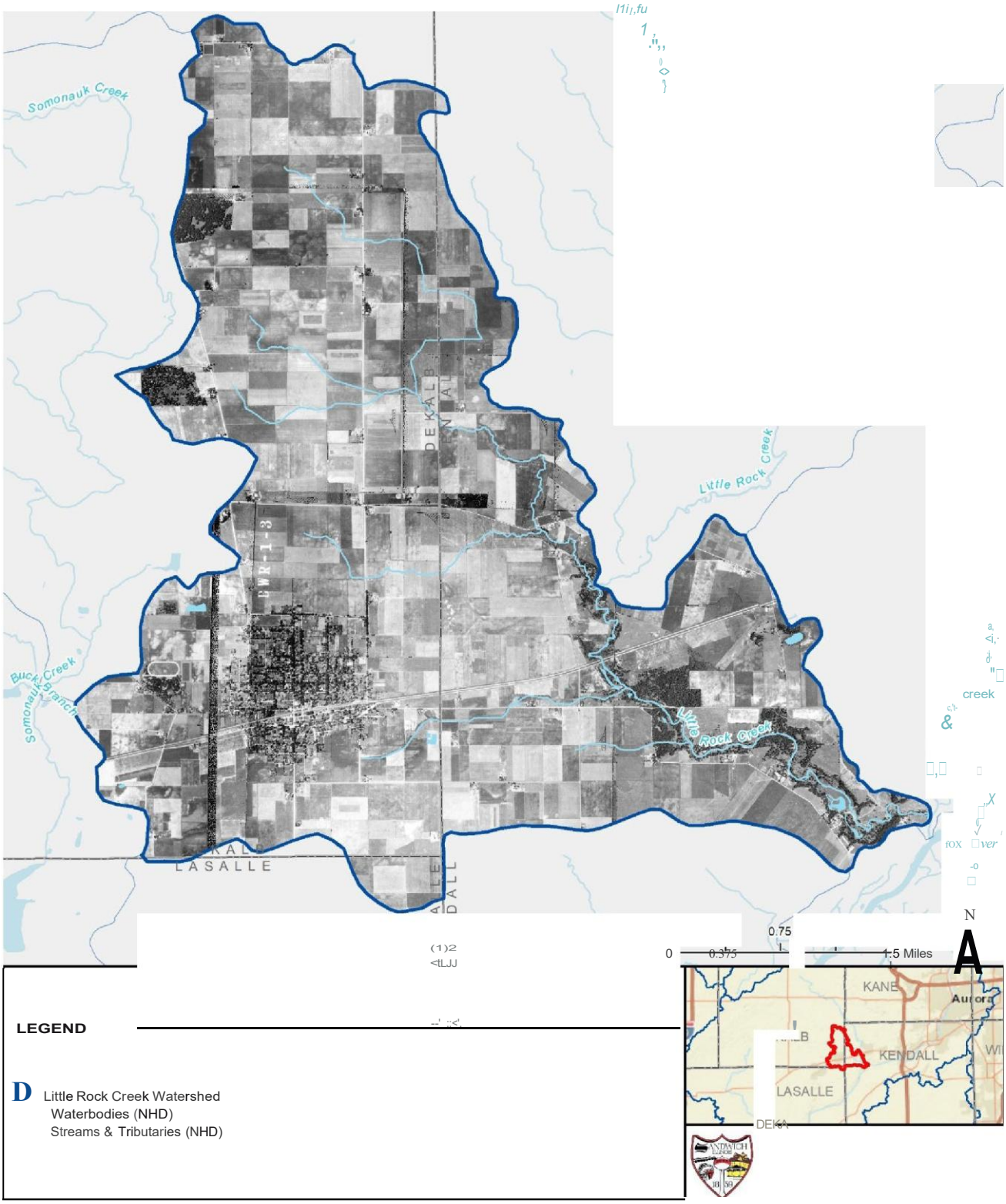
With degraded ecological conditions comes the opportunity to implement ecological restoration to improve the condition of Lower Little Rock Creek watershed. Present day knowledge of how pre-European settlement ecological communities formed and evolved provides a general template for developing present day natural area restoration and management plans. One of the primary goals of this watershed plan is to identify, protect, restore, and manage remaining natural areas.

Red-tailed hawk


LITTLE ROCK CREEK WATERSHED
Figure 6: Pre-European Settlement Land Cover
Somonauk Creek
Little Rock Creek
DEKALB
KENDALL
LASALLE
Big Rock Creek
Fox River
N
0
0.375
0.75
1.5 Miles
LEGEND
D Little Rock Creek v\latershed
Streams & Tributaries (NHD)
Landcover Early 1800s
CZ:J Cultural (fields)
Forest
Prairie
E3 Swamp/wetland; bottomland
OvVater
KANE
Aurora
DEKALB
KENDALL
LASALLE
AES Project#: 18-0105
Coordinate System:
NAO 83 IL State Plane East
Data Sources:
DeKalb, Kendall County

LITTLE ROCK CREEK WATERSHED

Figure 7: 1939 Aerial Imagery

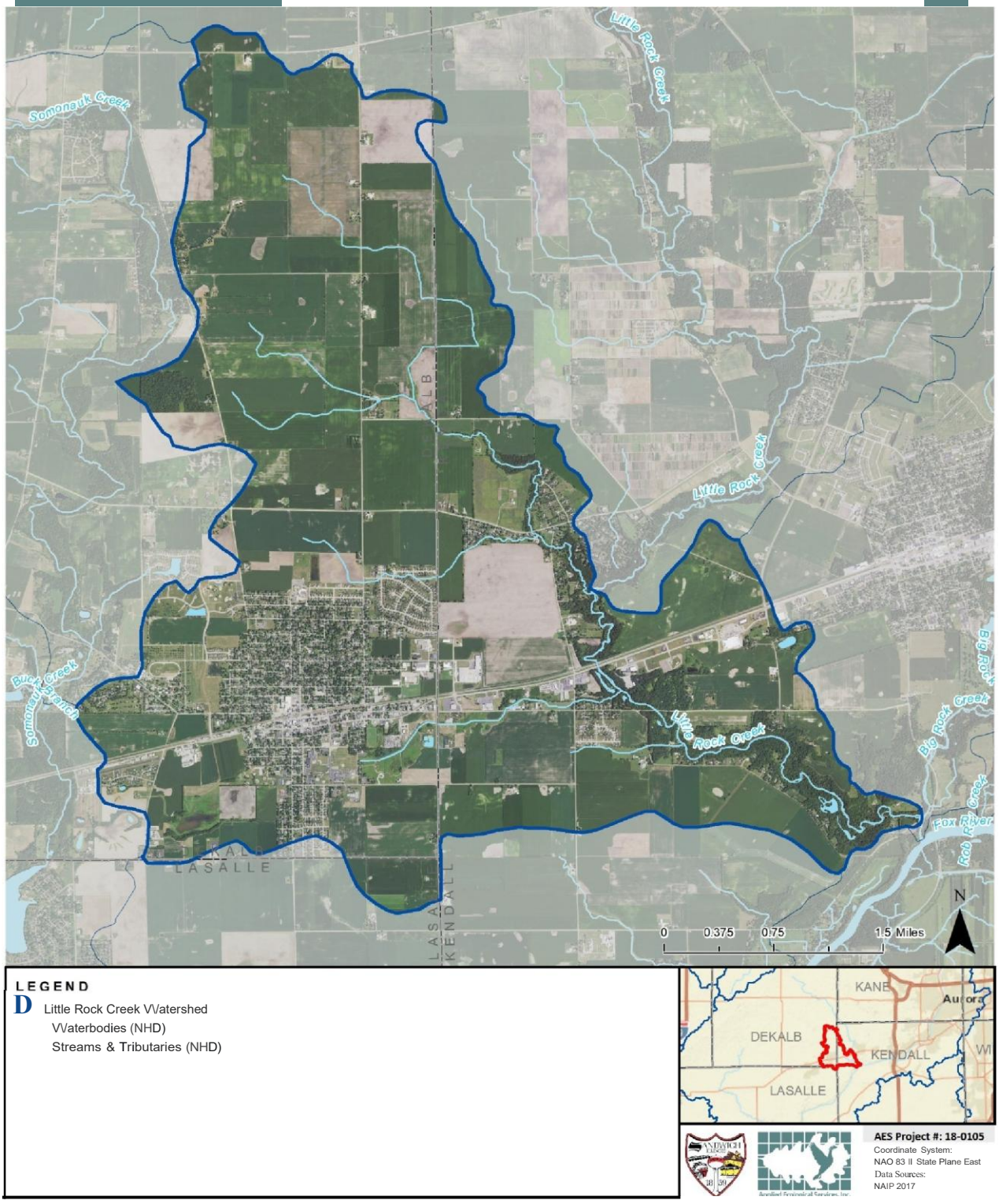


AES Project#: 18-010S
Coordinate System:


NA□83 IL State Plane Ea.SI
Data Sources:
DeKalb, Kendall County

LITTLE ROCK CREEK WATERSHED

Figure B· Current (2017) Aerial Imagery



3.3 Topography, Watershed Boundary, & Subwatershed Management Units

Relatively flat topography around Sandwich with standing water over hydric soils- water tower viewed from the north west.

Topography & Watershed Boundary

The Wisconsin glacier that retreated 14,000 years ago formed much of the topography and defined the Lower Little Rock Creek watershed boundary observed today. Topography refers to elevations of a landscape that describe the configuration of its surface and ultimately defines watershed boundaries. The specifics of watershed planning cannot begin until a watershed boundary is clearly defined.

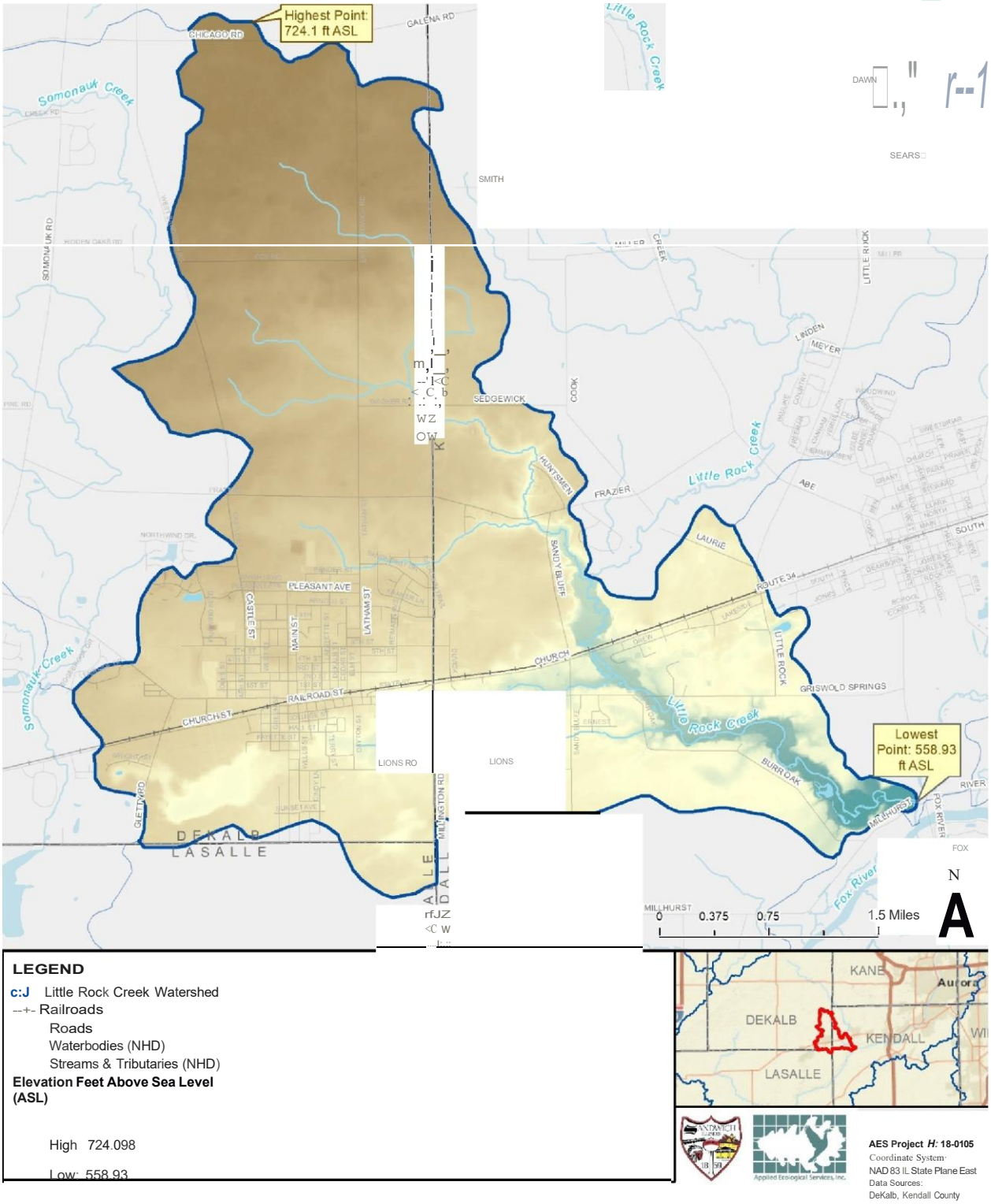
The Lower Little Rock Creek watershed boundary was updated and refined for this study using the most up-to-date 2-foot topography data available on the county level (DeKalb, LaSalle, and Kendall Counties.) The refined watershed boundary was then input into a GIS model (Arc Hydro) that generated a Digital Elevation Model (DEM) of the watershed (Figure 9). The Lower Little Rock Creek watershed is 10,541.1 acres or 16.5 square miles in size.

The Lower Little Rock Creek watershed generally drains from northwest to southeast through grassed waterways and ephemeral streams before joining the Little Rock Creek and eventually entering the Fox River. Elevation within the watershed ranges from a high of 724 feet above sea level (ASL) to a low of 559 feet ASL for a total relief of 165 feet (Figure 9). The highest point is found in the northwestern portion of the watershed east of the intersection of Chicago Rd and Somonauk Rd. As expected, the lowest elevation occurs where the Little Rock Creek enters the Fox River, with other low elevations extending along Harvey Creek. The DEM (Figure 9) depicts the gradual topography that dominates the watershed, with the more dramatic hills and valleys surrounding creek channel and floodplains.

Relatively hilly topography around Little Rock Creek Forest Preserve in the southeast portion of the watershed.

LITTLE ROCK CREEK WATERSHED

Figure 9 Digital Elevation Model



LEGEND

c:J Little Rock Creek Watershed
--+- Railroads
Roads
Waterbodies (NHD)
Streams & Tributaries (NHD)

Elevation Feet Above Sea Level (ASL)

High 724.098

Low: 558.93

AES Project *H:* 18-0105
Coordinate System:
NAD 83 IL State Plane East
Data Sources:
DeKalb, Kendall County

Subwatershed Management Units (SMUs)

The Center for Watershed Protection (CWP) is a leading watershed planning agency and has defined watershed and subwatershed sizes appropriate to meet watershed planning goals. In 1998, the CWP released the "Rapid Watershed Planning Handbook" (CWP 1998) as a guide to be used by watershed planners when addressing issues within urbanizing watersheds. The CWP defines a watershed as an area of land that drains up to 100 square miles. Broad assessments of conditions such as soils, wetlands, and water quality are generally evaluated at the watershed level and provide some information about overall conditions. Even though the Lower Little Rock Creek watershed is significantly smaller than 100 square miles in size, a more detailed analysis of smaller drainage areas must be completed to find site specific problem areas or "Critical Areas" that need immediate attention.

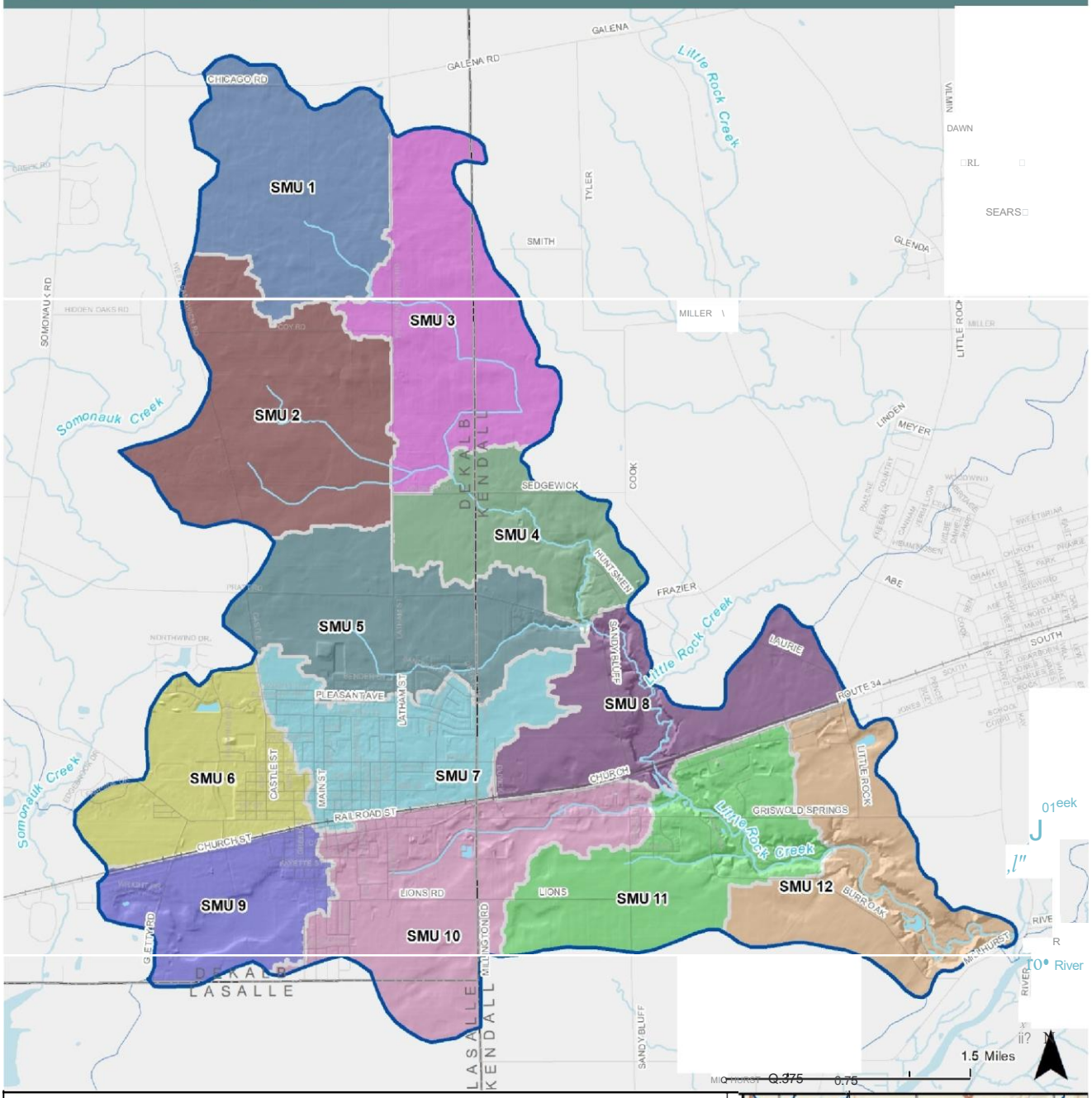
To address issues at a small scale, a watershed can be divided into subwatersheds called Subwatershed Management Units (SMUs). The Lower Little Rock Creek watershed was delineated into 12 SMUs by using the Digital Elevation Model (DEM). Information obtained at the SMU scale allows for detailed analysis and better recommendations for site specific "Management Measures" otherwise known as Best Management Practices (BMPs). Table 2 presents each SMU and size within the watershed. Figure 10 depicts the location of each SMU boundary delineated within the larger Lower Little Rock Creek watershed.

Table 2. Subwatershed Management Units and size.

SMU #	Acres	Square Miles
SMU 1	942.7	1.5
SMU 2	1,188.3	1.9
SMU 3	1,041.8	1.6
SMU 4	631.7	1.0
SMU 5	962.2	1.5
SMU 6	706.5	1.1
SMU 7	749.9	1.2
SMU 8	801.8	1.3
SMU 9	606.8	0.9
SMU 10	1,094.7	1.7
SMU 11	950.2	1.5
SMU 12	864.5	1.4
Total	**10,541.1**	**16.5**

LITTLE ROCK CREEK WATERSHED

Figure 10: Subwatershed Management Units

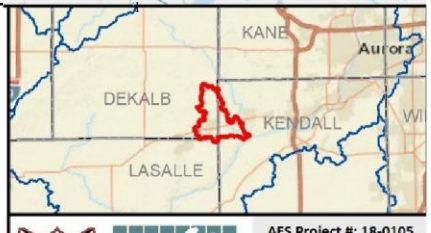


LEGEND

D Little Rock Creek watershed
Railroads
Roads
waterbodies (NHD)
Streams & Tributaries (NHD)

Subwatershed Management Units (SMUs)

2
3
4
5
6
7
8
9
10
11
12



AES Project #: 18-0105

Coordinate S'f)tem:
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DataSour[es:

3.4 Hydric Soils, Soil Erodibility, & Hydrologic Soil Groups

Soils

Deposits left by the Wisconsin glaciation 14,000 years ago are the raw materials of present soil types in the watershed. These raw materials include till (debris) and outwash. A combination of physical, biological, and chemical variables such as topography, drainage patterns, climate, and vegetation, have interacted over centuries to form the complex variety of soils found in the watershed. Most soils formed under prairie, wetland, and woodland vegetation. The most up to date soils mapping provided by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) was used to summarize the extent of soil types, including hydric soils, soil erodibility, and hydrologic soil groups within Lower Little Rock Creek watershed (Tables 3-6; Figures 11-13).

Hydric Soils

Wetlands or "Hydric Soils" generally form over poorly drained clay material associated with wet prairies, marshes, and other wetlands and from accumulated organic matter from decomposing surface vegetation. Hydric soils are important because they indicate the presence of existing wetlands or drained wetlands where restoration may be possible. Most of the wetlands in Lower Little Rock Creek watershed were intact until the late 1830s when European settlers began to alter significant portions of the watershed's natural hydrology and wetland processes; and "by 1860 the majority of Illinois' acreage was farmland" (VandeCreek). Where it was feasible wet areas were drained, streams channelized, and prairie and woodland cleared to farm the rich soils.

Historically there were approximately 1,776 acres of wetlands (16.8% of the watershed; as hydric soils) in the watershed. Approximately 8,765 acres (83%) were not hydric. As mentioned earlier, the location of hydric soils is often a likely indicator of the location of existing or drained wetlands. According to inventories of existing wetlands, 309 acres or 17% of the pre-European settlement wetlands remain. The location of hydric soils in the watershed is depicted on Figure 11. Existing wetlands and wetland restoration opportunities are discussed in detail in Section 3.13.3.

Table 3. Hydric soil classification and percentage of watershed area.

Soil Type	Acreage	Percent
Hydric	1,775.9	16.8%
Non-Hydric	8,765.2	83.2%
Total	**10,541.1**	

Soil Erodibility

Soil erosion is the process whereby soil is removed from its original location by flowing water, wave action, wind, and other factors. Sedimentation is the process that deposits eroded soils on other ground surfaces or in bodies of water such as streams and lakes. Soil erosion and sedimentation reduces water quality by increasing total suspended solids (TSS) in the water column and by carrying attached pollutants such as phosphorus, nitrogen, and hydrocarbons. When soils settle in streams and lakes they often blanket rock, cobble, and sandy substrates needed by fish and aquatic macroinvertebrates for habitat, food, and reproduction. Sedimentation is a problem in several stream reaches in the watershed (see Section 3.13.1).

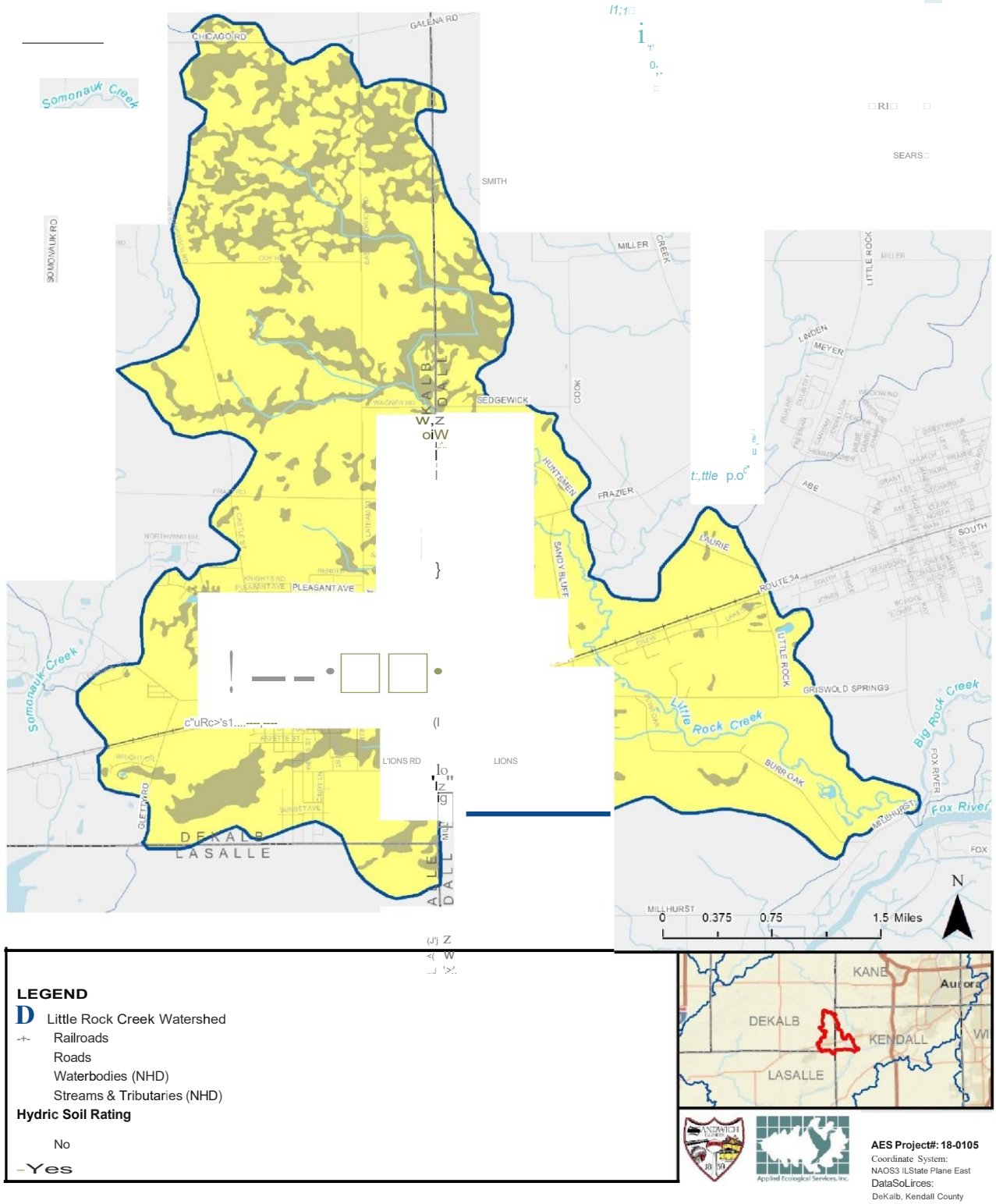
A highly erodible soils map was created by mapping the potential erosion hazard of the soils (Figure 12). It is important to know the location of highly erodible soils because these areas have the highest potential to degrade water quality during farm tillage and development. Based on mapping, 213 acres (2%) were rated as having a severe potential erosion hazard, 1,771 acres (17%) were rated as a moderate potential erosion hazard, and 8,528 acres (81%) were rated as a slight potential erosion hazard (30 acres were not rated). This is mostly due to the relatively flat landscape in the watershed; the lack of steep slopes reduces the potential erosion hazard of soils. The soils with a severe potential for erosion were primarily located along the slopes adjacent to Little Rock Creek and Little Rock Creek Tributary.

Table 4. Soil erodibility classification and percentage of watershed area.

Soil Erodibility Type	Acreage	Percent
Severe	213.2	2.0%
Moderate	1,770.8	16.8%
Slight	8,527.7	80.9%
Not rated	29.6	0.3%
Total	**10541.1**	

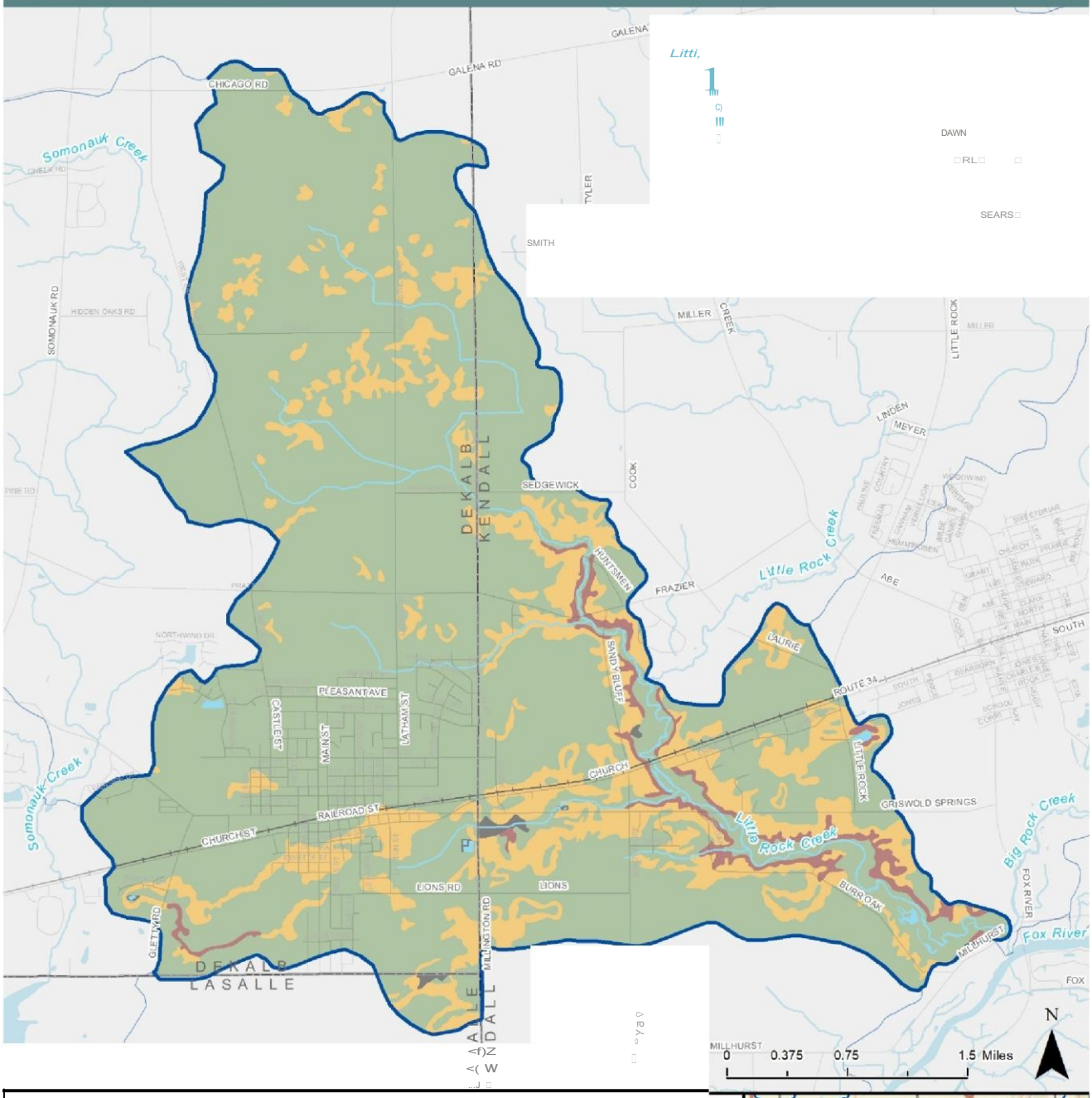
LITTLE ROCK CREEK WATERSHED

Figure 11. Hydric Soils



LITTLE ROCK CREEK WATERSHED

Figure 12: Potential Erosion Hazard

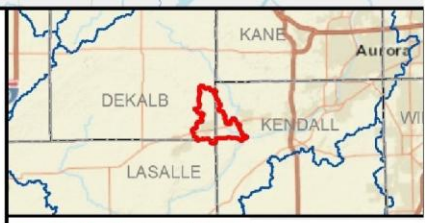


LEGEND

D little Rock Creek watershed
– Railroads
Roads
waterbodies (NHD)
Streams & Tributaries (NHD)

FOR - Potential Erosion Hazard (Road/Trail) - Dominant Component

- Severe
- Moderate
- Slight
- Not rated



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Coordinate System:
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DataSourct'ls:
DeKalb, Kendall County

Hydrologic Soil Groups

Soils also exhibit different infiltration capabilities and have been classified to fit what are known as "Hydrologic Soil Groups" (HSGs). HSGs are based on a soil's infiltration and transmission (permeability) rates and are used by engineers and planners to estimate stormwater runoff potential. Knowing how a soil will hold water ultimately affects the type and location of recommended infiltration Management Measures such as wetland restorations and detention basins. More important, however, is the link between hydrologic soil groups and groundwater recharge areas. Groundwater recharge is discussed in detail in Section 3.15.

HSG's are classified into four primary categories; A, B, C, and D, and three dual classes, A/D, B/D, and C/D. Dual classes represent soils that are in the D class naturally based on their characteristics, but when adequately drained are represented by the first of the two letters. Figure 13 depicts the location of each HSG in the watershed. The HSG categories and their corresponding soil texture, drainage description, runoff potential, infiltration rate, and transmission rate are shown in Table 4 while Table 5 summarizes the acreage and percent of each HSG. Group C soils are dominant throughout the entire watershed at about 44% coverage. Group C/D soils also make up a significant portion of the watershed at around 25% and are primarily limited to the northern and western portions of the watershed.

Table 4. Hydrologic Soil Groups and their corresponding attributes.

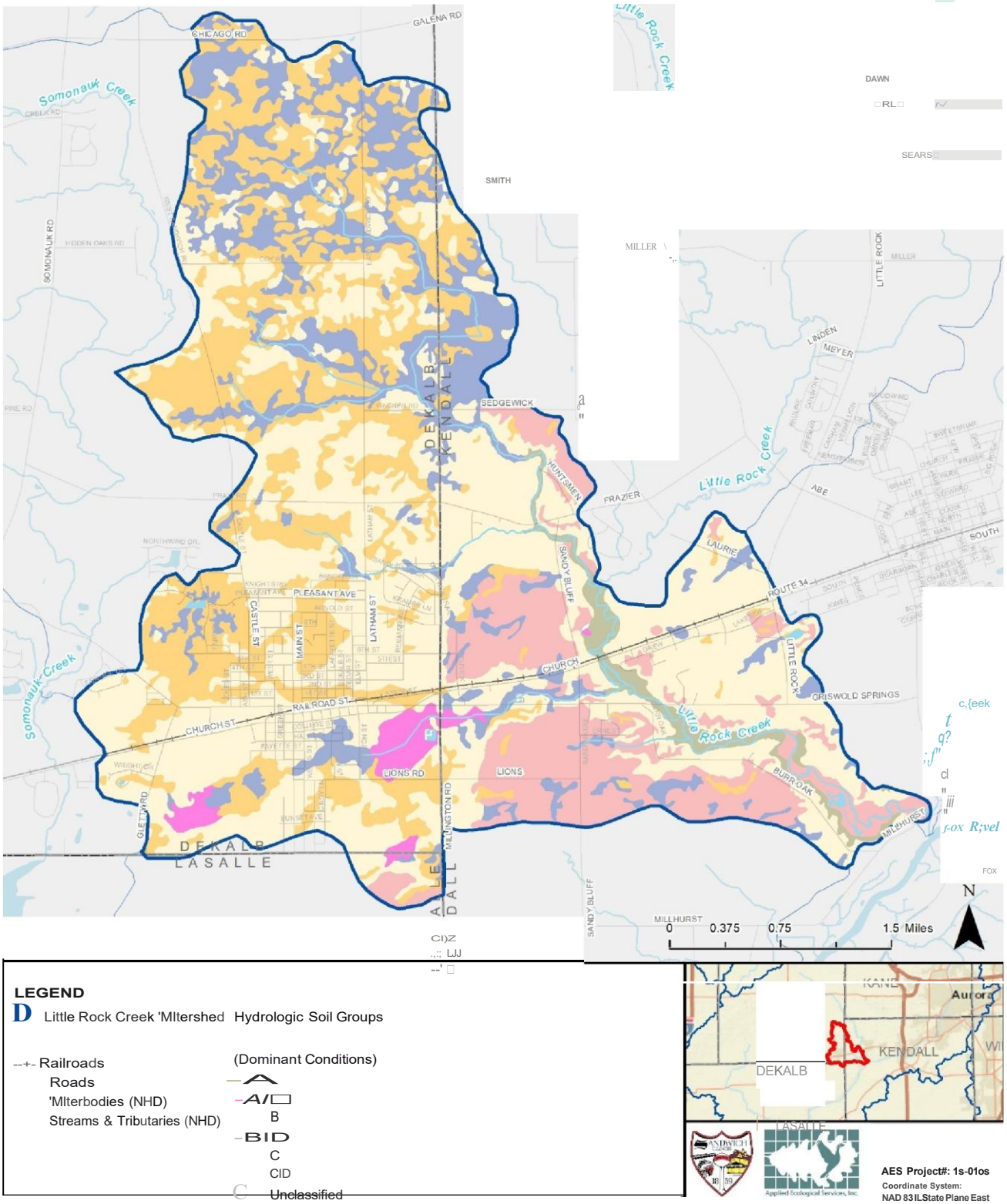
HSG	Soil Texture	Drainage Description	Runoff Potential	Infiltration Rate	Transmission Rate
A	Sand, Loamy Sand, or Sandy Loam	Well to Excessively Drained	Low	High	High
B	Silt Loam or Loam	Moderately Well to Well Drained	Moderate	Moderate	Moderate
C	Sandy Clay Loam	Somewhat Poorly Drained	High	Low	Low
D	Clay Loam, Silty Clay Loam, Sandy Clay Loam, Silty Clay, or Clay	Poorly Drained	High	Very Low	Very Low

Table 5. Hydrologic Soil Groups including acreage and percent of watershed.

Hydrologic Soil Group	Acreage	Percent
A	225.0	2.1%
A/D	167.5	1.6%
B	1,244.8	11.8%
B/D	1,622.0	15.4%
C	4,645.2	44.1%
C/D	2,629.6	24.9%
Unclassified	7.1	0.1%
Total	**10,541.1**	**100.0%**

LITTLE ROCK CREEK WATERSHED

Figure 13. Hydrolog1c Soil Groups



3.5 Jurisdictions, Roles, & Protections

Downtown Sandwich

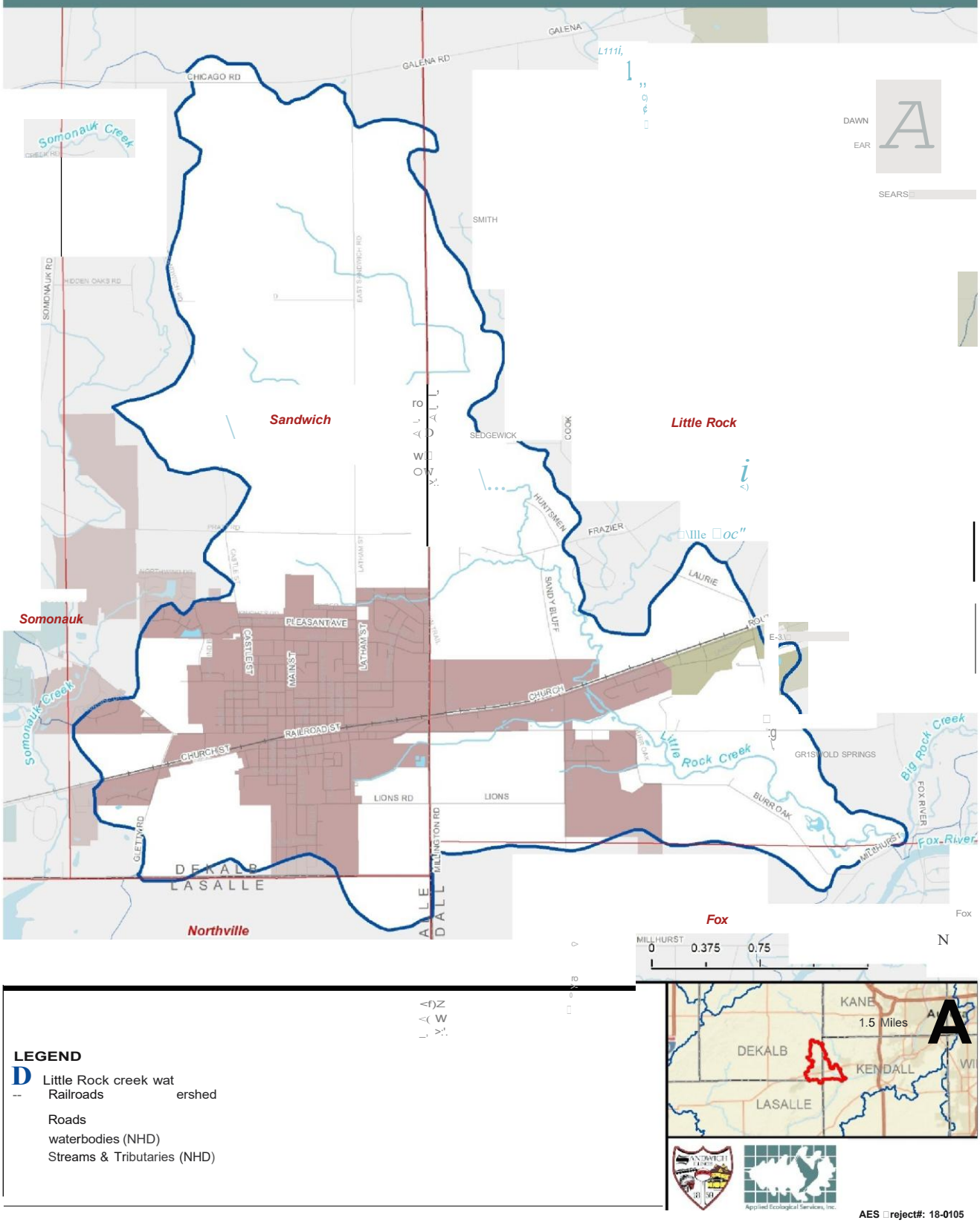
The Lower Little Rock Creek watershed is located across portions of three counties, and two municipalities (Table 7, Figure 14). The watershed falls primarily within DeKalb and Kendall Counties with small southern portions falling within LaSalle County. Of the municipalities in the watershed, the City of Sandwich has the largest share with 2,355.3 acres (22.3%), while the City of Plano (116.9 acres; 1.1%) extends into the eastern portion of the watershed along Route 34. The remaining areas fall on township land.

Table 7. County, township, and municipal jurisdictions.

Jurisdiction	Area (Acres)	% of Watershed
County		
DeKalb County	6,353.7	60.3%
Kendall County	4,058.6	38.5%
LaSalle County	128.8	1.2%
Total	**10,541.1**	**100.0%**
Unincorporated Township Areas		
Unincorporated Fox Township	126.8	1.2%
Unincorporated Little Rock Township	3,132.4	29.7%
Unincorporated Northville Township	125.4	1.2%
Unincorporated Sandwich Township	4,647.1	44.1%
Total	**8,031.7**	**76.2%**
Municipalities		
City of Sandwich	2,392.5	22.7%
City of Plano	116.9	1.1%
Total	**2,509.4**	**23.8%**

LITTLE ROCK CREEK WATERSHED

Figure 14: Watershed Jurisdictions



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DataSourct'ls:
DeKalb, Kendall County

Jurisdictional Roles and Protections

Natural resources throughout the United States are protected to some degree under federal, state, and/or local law, also referred to as regulations. A regulation is a rule or directive made and maintained by an authority, such as a law, act, or municipal ordinance. Jurisdiction authority is a hierarchy (Table 8), starting at the federal level, with subsequent levels (state, county, local, etc.) needing to follow the regulations of all the levels above it. For example, the City of Sandwich would need to follow all the Federal guidelines, all of the guidelines provided by the State of Illinois, all DeKalb County regulations, and then can also create and maintain regulations within the City limits. Lower levels of jurisdiction can be more restrictive, but not less restrictive. Watershed boundaries do not correlate with political boundaries and therefore, in order to properly protect water and other natural resources, cooperation and coordination among all these entities is essential.

Throughout the United States, natural resources of all sorts are protected to a varying degree under federal, state, and/or local law. Within the Lower Little Rock Creek watershed, the U.S. Army Corps of Engineers (USACE) regulate wetlands through Section 404 of the Clean Water Act. The U.S. Fish and Wildlife Service (USFWS), Illinois Department of Natural Resources (IDNR), Illinois Nature Preserves Commission (INPC), and Forest Preserve Districts protect natural areas and threatened and endangered species. Local municipalities also have ordinances that address other natural resource issues. The Illinois EPA Bureau of Water regulates wastewater and stormwater discharges to streams and lakes. Watershed protection in DeKalb, Kendall, and LaSalle Counties are primarily the responsibility of county and municipal level governments.

Other governments and private entities with watershed jurisdictional or technical advisory roles include the USFWS and IDNR, County Board Districts, and Soil and Water Conservation Districts (SWCDs). The USFWS and IDNR play a critical role in natural resource protection, particularly for rare or high-quality habitat and threatened and endangered species. They protect and manage land that often contains wetlands, lakes, ponds, and streams. County Boards oversee decisions made by respective county governments and therefore have the power to override or alter policies and regulations. The SWCDs provide technical assistance to the public and other regulatory agencies. Although the SWCDs have no regulatory authority, they influence watershed protection through soil and sediment control and pre and post-development site inspections.

Table 8. Levels of Jurisdiction.

Level of Jurisdiction	Entities
Federal	US Environmental Protection Agency (USEPA)
	- Office of Water
	US Army Corps of Engineers (USACE)
	US Department of Agriculture (USDA)
	- Natural Resources Conservation Service (NRCS)
	- Farm Service Agency (FSA)
	- Agricultural Research Service (ARS)
	- Forest Service (FS)
	- National Institute of Food and Agriculture (NIFA)
	- Rural Utilities Service (RUS)
	US Fish and Wildlife Service (USFWS)
	US Department of Transportation (USDOT)
	- Federal Aviation Administration (FAA)

Level of Jurisdiction	Entities
State	Illinois Environmental Protection Agency (IEPA)
	- Bureau of Land
	- Bureau of Water
	Illinois Department of Natural Resources (IDNR)
	- Office of Water Resources (OWR)
	- Illinois Nature Preserves Commission (INPC)
	Illinois Department of Agriculture (IDOA)
	Illinois Department of Transportation (IDOT)
County	DeKalb County Board
	DeKalb County Community Development Department
	DeKalb County Health Department
	DeKalb County Highway Department
	DeKalb County Soil and Water Conservation District
	DeKalb County Forest Preserve
	Kendall County Board
	Kendall County Planning, Building, and Zoning
	Kendall County Highway Department
	Kendall County Forest Preserve District
	Kendall County Soil and Water Conservation District
	LaSalle County Board
	LaSalle County Environmental Services and Land Use
	LaSalle County Highway Department
	LaSalle County Parks Department
Local	City of Sandwich
	City of Plano
	Unincorporated Fox Township
	Unincorporated Little Rock Township
	Unincorporated Northville Township
	Unincorporated Sandwich Township
Special	Drainage Districts
	DeKalb County Regional Office of Education
	Regional Office of Education #35
	Kendall County Regional Office of Education

Federal Government Roles and Protections

United States Army Corps of Engineers (USACE) - In the watershed area, the U.S. Army Corps of Engineers (USACE) regulate wetlands through Section 404 of the Clean Water Act. Land development affecting water resources (rivers, streams, lakes, wetlands, and floodplains) is regulated by the USACE when "Waters of the U.S." are involved. These types of waters include any wetland or stream/river that is hydrologically connected to navigable waters. The USACE primarily regulates filling activities and requires buffers or wetland mitigation for developments that impact jurisdictional wetlands. (USACE, 2020)

United States Department of Agriculture (USDA)- The United States Department of Agriculture, is the federal department responsible for developing and executing federal laws related to farming, forestry, rural economic development, and food. Agencies within the USDA include: Agricultural Marketing Service (AMS), Agricultural Research Service (ARS), Animal and Plant Health Inspection Service (APHIS), Center for Nutrition Policy and Promotion (CNPP), Economic

Research Service (ERS), Farm Service Agency (FSA), Food and Nutrition Service (FNS), Food Safety and Inspection Service (FSIS), Foreign Agricultural Service (FAS), Forest Service (FS), National Agricultural Library (NAL), National Institute of Food and Agriculture (NIFA), Natural Resources Conservation Service (NRCS), Risk Management Agency (RMA), Rural Development (RD), Rural Utilities Service (RUS), Rural Housing Service (RHS), and Rural Business-Cooperative Service (RBS). The programs most relevant to the management of the Little Rock Creek Watershed are discussed further in the following paragraphs. (USDA, 2020)

USDA Agricultural Research Service (ARS)- ARS is USDA's principal in-house research agency studying agricultural research and information. National Research Programs such as Nation Program 211: Water Availability and Watershed Management serve to effectively and safely manage water resources while protecting the environment and human and animal health. This goal is pursued by characterizing potential hazards, developing management practices, strategies and systems to alleviate problems, and providing practices, technologies, and decision support tools for the benefit of customers, stakeholders, partners, and product users. (USDA, 2020)

USDA Farm Service Agency (FSA)- The Farm Service Agency implements agricultural policy, administers credit and loan programs, and manages conservation, commodity, disaster and farm marketing programs through a national network of offices. The FSA's strives to support a market-oriented, economically and environmentally sound American agriculture that delivers an abundant, safe, and affordable food and fiber supply while sustaining quality agricultural communities. (USDA, 2020)

USDA Forest Service (FS)- The Forest Service works to sustain the health, diversity and productivity of America's forests and grasslands. The Forest Service seeks to support nature in sustaining life through their stewardship work. The Forest Service works in collaboration with communities and partners in providing access to resources and experiences that promote economic, ecological, and social vitality; and connecting people to the land and one another. (USDA, 2020)

USDA National Institute of Food and Agriculture (NIFA)- The National Institute of Food and Agriculture (NIFA) provides leadership and funding for programs that advance agriculture-related sciences. NIFA's mission is to invest in and advance agricultural research, education, and extension to solve societal challenges. NIFA invests in and supports initiatives that ensure the long-term viability of agriculture. NIFA applies an integrated approach to ensure that discoveries in agriculture-related sciences and technologies reach the people who can put them into practice. (USDA, 2020)

USDA Natural Resources Conservation Service (NRCS)- NRCS is the primary federal agency that works with private landowners to help them conserve, maintain and improve their natural resources to implement conservation practices that clean the air, conserve and clean the water, prevent soil erosion and create and protect wildlife habitat. They are also responsible for providing technical assistance to the USDA Farm Service Agency for sodbuster, wetland and highly erodible land determinations and compliance issues. (USDA, 2020)

USDA Rural Utilities Service (RUS)- RUS provides much-needed infrastructure and infrastructure improvements to rural communities. This includes water and wastewater treatment, electric power and telecommunications services. These services help to expand economic

opportunities and improve the quality of life for rural residents. The Water and Environmental Programs (WEP) provides loans, grants and loan guarantees for drinking water, sanitary sewer, solid waste and storm drainage facilities in rural areas and cities and towns of 10,000 or less. Public bodies, non-profit organizations and recognized Indian tribes may qualify for assistance. WEP also makes grants to non-profit organizations to provide technical assistance and training to help rural communities with their water, wastewater and solid waste problems. (USDA, 2020)

United States Department of Transportation (USDOT)- USDOT's mission is to serve the United States by ensuring a fast, safe, efficient, accessible and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people, today and into the future. (USDOT, 2020)

United States Environmental Protection Agency (USEPA)- The mission of the USEPA is to protect human health and the environment. The EPA works to ensure that Americans have clean air, land and water, and that National efforts to reduce environmental risks are based on the best available scientific information. They also work to ensure that Federal laws protecting human health and the environment are administered and enforced fairly and effectively.

As environmental stewardship is integral to U.S. policies concerning natural resources, human health, economic growth, energy, transportation, agriculture, industry, and international trade; these factors are similarly considered in establishing environmental policy. As well as ensuring that all parts of society have access to accurate information sufficient to effectively participate in managing human health and environmental risks. They also oversee that contaminated lands and toxic sites are cleaned up by potentially responsible parties and revitalized and chemicals in the marketplace are reviewed for safety. (USEPA, 2020)

United States EPA Office of Water (OW)- The Office of Water (OW) ensures drinking water is safe, and restores and maintains oceans, watersheds, and their aquatic ecosystems to protect human health, support economic and recreational activities, and provide healthy habitat for fish, plants and wildlife. OW is responsible for implementing the Clean Water Act and Safe Drinking Water Act, and portions of the Coastal Zone Act Reauthorization Amendments of 1990, Resource Conservation and Recovery Act, Ocean Dumping Ban Act, Marine Protection, Research and Sanctuaries Act, Shore Protection Act, Marine Plastics Pollution Research and Control Act, London Dumping Convention, the International Convention for the Prevention of Pollution from Ships and several other statutes. (USEPA, 2020)

United States Fish and Wildlife Service (USFWS)- USFWS and Illinois Department of Natural Resources (IDNR), along with Illinois Nature Preserves Commission (INPC) and Forest Preserve Districts, are responsible for protecting federal and state threatened and endangered species in the watershed--which are often found on land that contains wetlands, lakes, ponds, and streams. The USFWS and IDNR play a critical role in natural resource protection, particularly for rare or high-quality habitat and threatened and endangered species. They protect and manage land that often contains wetlands, lakes, ponds, and streams. Their programs function to: enforce federal wildlife laws, protect endangered species, manage migratory birds, restore nationally significant fisheries, conserve and restore wildlife habitat such as wetlands, help foreign governments with their international conservation efforts, and distribute hundreds of millions of dollars, through their Wildlife Sport Fish and Restoration program. (USFWS, 2020)

Federal Aviation Administration (FAA)- FAA's mission is to provide a safe, efficient aerospace system. The Federal Aviation Administration (FAA) plays a role in land use planning through advisory circulars such as AC 150/5200-33C "Hazardous Wildlife Attractants on or near Airports" which provides guidance on certain land uses that have the potential to attract hazardous wildlife on or near public-use airports. It also discusses airport development projects (including airport construction, expansion, and renovation) affecting aircraft movement near hazardous wildlife attractants. In which they recommend land uses such as wetlands, landfills, or detention basins should be outside of a 1-5-mile buffer zone, depending on the types of aircraft serviced by the airport. (FAA, 2020)

State Government Roles and Protections

Illinois Department of Agriculture (IDOA)- The Illinois Department of Agriculture advocates for Illinois' agricultural industry and provides necessary regulatory functions to benefit consumers, agricultural industry, and Illinois' natural resources. The Illinois Department of Agriculture's vision is to promote and regulate agriculture in a manner which encourages farming and agribusiness while protecting Illinois' consumers and our natural resources. The Illinois Department of Agriculture (IDOA) regulates pesticides and pesticide applicators, as well as the siting and construction of livestock production facilities, reduction of soil erosion on agricultural land, and oversees the groundwater monitoring network.

Two other noteworthy programs are the Conservation Practices Program and the Well Decommissioning Program. The Conservation Practices Program seeks protect and enhance natural resources and outdoor recreation in Illinois, with the Illinois Department of Agriculture overseeing the agriculture-related components. The Well Decommissioning Program seeks to seal abandoned wells to protect groundwater from direct contamination. (IDOA, 2020)

Illinois Department of Natural Resources (IDNR)- The Illinois Department of Natural Resources works to manage, conserve and protect Illinois' natural, recreational and cultural resources, further the public's understanding and appreciation of those resources, and promote the education, science and public safety of Illinois' natural resources for present and future generations. Offices within IDNR include: Architecture, Engineering and Grants; Compliance, Equal Employment Opportunity and Ethics; Grant Management & Assistance; Law Enforcement; Land Management (State Parks); Legal Affairs; Legislation; Mines & Minerals; Oil & Gas; Realty & Capital Planning; Resource Conservation; State Museums; Strategic Services; Water Resources; and World Shooting & Recreational Complex. (IDNR, 2020)

IDNR Office of Water Resources (OWR)- The Office of Water Resources is the lead state agency for water resources planning, navigation, floodplain management, the National Flood Insurance Program, water supply, drought, and interstate organizations on water resources. Interagency duties include the state water plan, drought response, flood emergency situation reports, and the comprehensive review of Illinois water use law. The Office of Water Resources consists of two Divisions: The Division of Capital Programs and The Division of Resource Management.

The Division of Capital Programs administers the Urban Flooding Mitigation program, water supply planning including water withdrawals from Federal reservoirs, stream gaging, and operation and maintenance of state facilities including Stratton Lock and Dam and Sinnissippi dam. The Division of Capital Programs is the Technical Liaison to the Illinois Emergency Management Agency and

provides daily briefings on flood conditions of monitored streams throughout the state and its boundary waters during and following a flood or other disasters.

The Division of Regulatory Programs administers regulatory programs over construction in the floodways of rivers, lakes, and streams; construction in the shore waters of Lake Michigan; construction and operation of dams; construction in public bodies of water; and diversion of water from Lake Michigan. Resource Management inspects dams, gives permits, coordinates the National Flood Insurance Program and regulates floodplains. (IDNR, 2020)

IDNR Illinois Nature Preserves Commission (INPC)- The mission of the Illinois Nature Preserves Commission (INPC) is to assist private and public landowners in protecting high quality natural areas and habitats of endangered and threatened species; in perpetuity, through voluntary dedication or registration of such lands into the Illinois Nature Preserves System. The Commission promotes the preservation of these significant lands and provides leadership in their stewardship, management and protection. (IDNR, 2020)

Illinois Environmental Protection Agency (IEPA)- Illinois EPA works to safeguard the state's natural resources from pollution to provide a healthy environment for its citizens. Through partnership with businesses, local governments and citizens, Illinois EPA works to continue protection of the air we breathe and our water and land resources. IEPA Bureau of Air, Bureau of Land, Bureau of Water, and Office of Energy operate within their respective fields. (IEPA, 2020)

IEPA Bureau of Land- The Bureau of Land protects human health and the environment by regulating the transfer, storage, and disposal of waste, and by overseeing the cleanup of contaminated properties. The Bureau's permitting programs regulate a wide range of waste related activities, including those involving municipal waste, landscape waste, composted material, construction and demolition debris, potentially infectious medical waste, and hazardous waste. (IEPA, 2020)

IEPA Bureau of Water- The Bureau of Water is committed to ensuring that Illinois' rivers, streams, and lakes will support all uses for which they are designated including protection of aquatic life, recreation, drinking water supply and fish consumption. The Bureau works to ensure that every Illinois public water system provides water that is superior quality, meets all regulatory requirements, and that Illinois' groundwater resources are protected for designated drinking water and other beneficial uses. To accomplish this mission, the Bureau monitors the quality of the state's surface and groundwater resources; runs a municipal, stormwater, and industrial effluent permitting program; administers a permit program for community water supplies; regularly inspects sources of water pollution and drinking water treatment facilities; responds to citizen complaints; ensures compliance with regulatory standards; and enforces applicable regulatory requirements. (IEPA, 2020)

To assist, the Bureau provides a number of loan and grant programs designed to upgrade or build new wastewater, stormwater treatment and public water supply infrastructure, reduce nonpoint source pollution, conduct green infrastructure projects, and protect and restore Illinois' inland lakes and streams.

The Illinois EPA is the designated state agency in Illinois to receive 319 federal funds from U.S. EPA. The purpose of Illinois EPA's 319 program is to work cooperatively with units of local

government and other organizations toward the mutual goal of protecting the water quality in Illinois through the control of nonpoint source (NPS) pollution. The program includes providing funding to these groups to implement projects that utilize cost-effective best management practices (BMPs) on a watershed scale. Projects may include structural BMPs such as detention basins and filter strips, non-structural BMPs such as construction erosion control ordinances and setback zones to protect community water supply wells. Technical assistance and information/education programs are also eligible.

NPDES Phase II Stormwater Permit Program
The Illinois EPA Bureau of Water regulates wastewater and stormwater discharges to streams and lakes by setting effluent limits, and monitoring/reporting on results. The Bureau oversees the National Pollutant Discharge Elimination System (NPDES) program. The NPDES program was initiated under the federal Clean Water Act to reduce pollutants to the nation's waters. This program requires permits for discharge of 1) treated municipal effluent; 2) treated industrial effluent; and 3) stormwater from municipal separate storm sewer systems (MS4's) and construction sites.

The Illinois EPA's NPDES Phase I Stormwater Program began in 1990 and applies only to large and medium-sized municipal separate storm sewer systems (MS4's), several industrial categories, and construction sites hydrologically disturbing 5 acres of land or more. The NPDES Phase II program began in 2003 and differs from Phase I by including additional MS4 categories, additional industrial coverage, and construction sites hydrologically disturbing greater than 1 acre of land. More detailed descriptions can be viewed on the Illinois EPA's web site.

Under NPDES Phase II, all municipalities with small, medium, and large MS4's are required to complete a series of Best Management Practices (BMPs) and measure goals for six minimum control measures:

1) Public education and outreach
2) Public participation and involvement
3) Illicit discharge detention and elimination
4) Construction site runoff control
5) Post-construction runoff control
6) Pollution prevention and good housekeeping

The Phase II Program also covers all construction sites over 1 acre in size. For these sites the developer or owner must comply with all requirements such as completing and submitting a Notice of Intent (NOI) before construction occurs, developing a Stormwater Pollution Prevention Plan (SWPPP) that shows how the site will be protected to control erosion and sedimentation, completing final stabilization of the site, and filing a Notice of Termination (NOT) after the construction site is stabilized.

The municipalities within the Little Rock Creek watershed, Sandwich and Plano, as well as the areas within DeKalb and Kendall Counties have been issued NPDES permits by Illinois EPA for stormwater discharges to MS4s. Sandwich and Plano were newly identified as urbanized areas following the 2010 census and thereby have permit conditions waived until 2021. LaSalle County is not identified as an urbanized area by IEPA and therefore does not have an MS4 permit. There is

one NPDES permitted wastewater treatment plant (WWTP) which discharges to Little Rock Creek. Sandwich WWTP discharges under NPDES Permit No. IL0030970.

Illinois Department of Transportation (IDOT)- Illinois Department of Transportation works to maintain a statewide transportation system with the mission of enhancing quality of life of Illinois residents through reduced congestion and increased mobility. They plan, administer, construct, and maintain rail, highway, airport, transit, waterways, and trail systems through five regions across the state.

As it relates to watershed planning, all transportation projects, involving the use of state and federal funds are required to follow formal procedures designed to protect the natural and social environment, this includes wetlands, plants, animals, air and water quality, archaeological and historic sites, agriculture, and communities. IDOT also has numerous wetland compensation sites and wetland mitigation bank sites for when impacts of wetland sites are unavoidable. (IDOT, 2020)

County and Local Government Roles and Protections

DeKalb County Board - DeKalb County operates under the township form of county government. The governing body is the County Board. As the legislative element, the County Board is responsible for developing all ordinances for the governance of DeKalb County and which laws are contained in the DeKalb County Code; establishing budget for several funds as well as levying taxes; circulating policies to the general public; and developing rules and regulations for the management of County operations. The County Board has eight (8) standing committees, which meet regularly once each month. Each member serves on two (2) committees. Standing Committees are as follows: Committee of the Whole; County Highway; Economic Development; Executive; Finance; Forest Preserve Operations; Health & Human Services; Law & Justice; and Planning & Zoning. Additionally, there is one current ad-hoc committee: Stormwater Management. (DeKalb County, 2020)

DeKalb County Community Development- The primary function of the Community Development Department, (formerly Planning, Zoning and Building Department) is to help direct and manage growth and land use changes in DeKalb County. The principal way in which the Department aids in such management is through the interpretation, application and enforcement of the County's Unified Comprehensive Plan, Zoning Ordinance, Subdivision Regulations, building codes and Stormwater Management Regulations by facilitating an efficient development process and influencing investment in the community.

The Department provides staff support and offers advice and assistance to the County Board, Planning and Zoning Committee, Zoning Hearing Officers, Economic Development Committee, DeKalb County Business Incubator and other County departments, as well as to local communities and residents. Stormwater Management, Environmental protection, and land development in DeKalb County are regulated by the DeKalb County Stormwater Management Ordinance. Land development located on unincorporated land within DeKalb County is ultimately regulated by the DeKalb County Zoning Ordinance. Unincorporated areas include 52,530.7 acres across ten townships. (DeKalb County, 2020)

DeKalb County Health Department- The mission of the DeKalb County Health Department is to promote optimal health for all county residents. Health promotion includes preventative health services, health protection services and health education. Working in partnership with other

organizations, programs help individuals, families, and the community prevent, as well as manage, health problems and risks.

DeKalb County Health Department has a strong commitment to delivering quality public health services with competence and skill, while respecting the dignity and rights of all individuals. The Health Department has three divisions: The Administration Division, The Health Protection Division, and The Community Health and Prevention Division. The Health Protection Division goal is to safeguard food and water from contamination. Services include regulation of private sewage systems and potable water. (DeKalb County, 2020)

DeKalb County Highway Department- Duties of the Highway Department include maintaining the shoulders, ditches, drainage structures and pavement surfaces on county roads. The DeKalb County Engineer, under the direction of the County Board, makes improvements to and maintains the highway system. The County Highway Department maintains 188 miles of bituminous-paved highways and 44 bridge structures on the county road system. These interconnect with over 801 miles of township roads and 142 township bridges of the nineteen townships. The Department also provides inspection of all county and township bridges every two years, reporting those findings to the Illinois Department of Transportation as required by Statute. The County Engineer and his staff also provide engineering expertise and advise to township highway commissioners (DeKalb County, 2020)

DeKalb County Soil and Water Conservation District- DeKalb County SWCD provides technical assistance to the public and other regulatory agencies. It is our mission to responsibly protect our healthy soil and clean water for all generations. The Soil and Water Conservation District is a local resource for natural resource concerns for the residents of DeKalb county. The Conservation District are actively involved with watershed planning in DeKalb County, they serve as a resource for natural resources education for youth and adults, and are advocates for preserving prime farmland in DeKalb County. Although the DCSWCD has no regulatory authority, it influences watershed protection through soil and sediment control and pre and post-development site inspections. (DeKalb County SWCD, 2020)

Kendall County Board- The Kendall County Board is an elected body which sets policy, ordinances, and budget appropriations for programs within the County. The Board consists of ten members elected from two districts, and eleven standing committees. (Kendall County, 2020)

Kendall County Planning, Building, and Zoning- The Planning, Building and Zoning (PBZ) Department is responsible for the administration and enforcement of the County's ordinances regulating the development of land in the unincorporated areas of the County. Overall responsibilities include issuing building permits, responding to complaints involving violations of the county's development regulations, as well as the development and maintenance of the County's Land Resource Management Plan (LRMP). PBZ staff also provides support to the County Board and related committees and commissions in reviewing and providing the County Board with recommendations on zoning and subdivision applications, updates to existing development regulations and revisions to the County's Land Resource Management Plan. (Kendall County PBZ, 2020)

Kendall County Highway Department- The Kendall County Highway Department is responsible for the construction and maintenance of the highways and bridges in the County and in townships.

The highway department is also responsible for the planning of this infrastructure and bidding of construction. (Kendall County Highway Department, 2020)

Kendall County Forest Preserve District- Kendall County Forest Preserve District (KCFPD) works to preserve and manage natural areas and open spaces, provide environmental education and offer recreational opportunities for the residents of Kendall County. KCFPD also works independently and in cooperation with other state and federal agencies to acquire and hold land for purposes of preservation and ecological restoration, and in the implementation of management practices which enhance biodiversity of natural areas. (KCFPD, 2020)

Kendall County Soil and Water Conservation District- Kendall County Soil and Water Conservation District's (KSWCD) mission is to promote the conservation and enhancement of soil, water and other natural areas within Kendall County. KSWCD provides cost-share assistance, financial incentives, and technical assistance for erosion and sediment control projects, water well decommissioning, nutrient management plan preparation and implementation, streambank stabilization restoration, and special projects such as urban retrofitting, stream crossings, shelterbelts, windbreaks, and protection of ecologically sensitive areas. (KSWCD, 2020)

LaSalle County Board- The LaSalle County Board is an elected body which sets policy, ordinances, and budget appropriations for programs within the County. The Board consists of twenty-nine (29) and thirty-two (32) standing committees and subcommittees. (LaSalle County Board, 2020)

LaSalle County Environmental Services and Land Use- LaSalle County Environmental Services and Land Use Department oversees environmental services, construction regulations and permits, floodplain ordinance, setback ordinance, solid and hazardous waste management, zoning and subdivision ordinances, natural hazard planning, and comprehensive planning. (LaSalle County Environmental Services and Land Use, 2020)

LaSalle County Highway Department- The LaSalle County Highway Department is responsible for the planning, design, construction, and maintenance of 371 miles of county highways, 79 major bridges and numerous drainage structures. In addition, the Highway Department provides technical assistance to all 37 Township Highway Commissioners and is the lead agency for township projects constructed or maintained with Motor Fuel Tax funding. (LaSalle County Highway Department, 2020)

LaSalle County Soil and Water Conservation District- The LaSalle County Soil and Water Conservation District in cooperation with NRCS work with landowners to implement effective conservation practices. Programs implemented by the district include: Streambank Stabilization and Restoration Program, Natural Resources Inventory, Land Evaluation and Site Assessment System (LESA) Report, and the Conservation Practices Program. Conservation practices such as terraces, filter strips, and grass waterways are all practices used to help reduce soil loss and decrease erosion on cropland; and through the Conservation Practices Program (CPP) local landowners have the opportunity to put these practices on the land at discounted cost. The District provides natural resources and conservation education programs for all ages and own and manage two education properties. (LaSalle County SWCD, 2020)

Townships and Municipalities- Municipalities in the watershed can provide additional watershed protection above and beyond existing watershed ordinances under local Village Codes. Municipal

codes present opportunities for outlining and requiring recommendations in this plan such as conservation development, Special Service Area (SSA) or watershed protection fees, and native landscaping.

Within DeKalb and Kendall counties, land development is regulated by zoning and stormwater management ordinances; while LaSalle county is regulated by a zoning ordinance, with plans to include a chapter on stormwater management (as of 2019, this chapter is not included.) Kendall County's stormwater ordinance (revised October 15, 2019) is enforced by county agencies, and delegated to "Certified Communities". Similarly, in DeKalb County, a Countywide Stormwater Management Ordinance is part of an ongoing stormwater management planning process which began in 2005. "Exempt Municipalities" are those within DeKalb County whose stormwater management ordinance is at least as stringent as that of DeKalb County.

Land development located on unincorporated land within DeKalb, Kendall, and LaSalle Counties is ultimately regulated by their respective zoning and land use departments. Respectively, these are: DeKalb Community Development Department, Planning, Building, and Zoning of Kendall County, and LaSalle County Environmental Services and Land Use. Unincorporated areas include 127 acres in Fox Township, 3,132 acres in Little Rock Township, 125 acres in Northville township, and 4,647 acres in Sandwich Township. Development in these townships must be reviewed by the respective agencies listed above.

Municipalities in the watershed may or may not provide additional watershed protection above and beyond existing watershed ordinances under local Municipal Codes. Municipal codes present opportunities for outlining and requiring recommendations in this plan such as conservation development, Special Service Area (SSA) or watershed protection fees, and native landscaping. The ordinances of City of Sandwich and City of Plano will be discussed further in Section 3.6.

Special Jurisdiction Roles and Protections

Drainage Districts- According to Article III of Illinois Compiled Statute 70 ILCS 605, 3-1- "Drainage districts may be formed to construct, maintain, or repair drains or levees or to engage in other drainage or levee work for agricultural, sanitary or mining purposes." Drainage districts (discussed further in section 3.7) are local bodies formed for the purpose of draining, ditching, and improving land for agricultural and sanitary purposes. (CyberDriveIllinois, 2020)

School Districts- The DeKalb County Regional Office of Education (ROE), Regional Office of Education #35, and Kendall County Regional Office of Education serve the watershed in preK-12 education.

3.6 Existing Policies and Ordinance Review

Protection of natural resources and green infrastructure during future urban growth will be important for the future health of Lower Little Rock Creek watershed. To assess how future growth might further impact the watershed, an assessment of local ordinances was performed to determine how development currently occurs in each local government. In this way, potential improvements to local ordinances can be identified. As part of the assessment, municipal governments were asked to compare their local ordinances against model policies outlined by the Center for Watershed Protection (CWP) in a publication entitled "*Better Site Design: A Handbook for Changing Development Rules in Your Community"* (CWP, 1998) and complete *The Code & Ordinance Worksheet: A Tool for Evaluating Development Rules in Your Community* (CWP, 2017).

CWP's recommended ordinance review process involves assessments of four general categories including Residential Streets & Parking Lots, Lot Development, Conservation of Natural Areas, and Runoff Reduction. Various questions with point totals are examined under each category. The maximum score ranges from 111 to 126 points, based on which form is used (rural or suburban, respectively) and final scores are depicted as a percentage of the total. CWP also provides general guidance based on scores. Scores between 60 and 80 suggest that it may be advisable to reform local development ordinances. Scores less than 60 generally mean that local ordinances are not environmentally friendly and serious reform may be needed. Kendall County scored the highest with 63.5 points followed by DeKalb County with 60 points and both used the rural form (111 points possible). The City of Sandwich scored 39.5 points using the suburban form (126 points possible). Although these scores are relatively low, it should be noted that this assessment is meant to be a tool to local communities to help guide development of future ordinances. Various policy recommendations are included in the Action Plan section of the report to address general ordinance deficiencies. The results of the review for each local government can be found in Appendix B.

3.7 Demographics

There is no regional planning body that covers the entire watershed area and therefore finding future demographic projections for the watershed is difficult. The Chicago Metropolitan Agency for Planning (CMAP), through their *On to 2050 Comprehensive Regional Plan*, provides a regional framework plan for the greater Chicagoland area to plan more effectively with growth forecasts. CMAP's 2015 to 2050 forecasts of population, households, and employment was used to project how these attributes will impact the Lower Little Rock Creek watershed. CMAP develops these forecasts by first generating region wide estimates for population, households, and employment then meets with local governments to determine future land development patterns within each jurisdiction. However, this CMAP data does not cover the entirety of the Lower Little Rock Creek watershed and terminates at the Kendall County border. To rectify this, data was supplemented with American Community Survey (ACS) 2015 data for DeKalb County. Within the CMAP data set, the data is generated by Township, Range, and quarter Section; the ACS is groups into larger blocks as is depicted on Figures 15-17. Applied Ecological Services, Inc. (AES) used GIS to overlay the Lower Little Rock Creek watershed boundary onto CMAP's quarter Section data. If any part of a quarter Section or census block fell inside the watershed boundary, the statistics for the entire quarter Section were included; therefore, these estimates all represent a slight overestimate for the watershed.

There is no regional planning body that covers the DeKalb/LaSalle portions of the watershed. AES was able to locate population projections by county created by the Illinois Department of Public Health. These projections are based on 2010 census data and on a specific set of assumptions, laid out in full in IDPH's *Population Projections: Illinois, Chicago and Illinois Counties by Age and Sex: July 1, 2010 to July 1, 2025 (2014 Edition)*. In consultation with the watershed committee, AES assumed that the population of the DeKalb portion of Lower Little Rock Creek watershed will grow at the same rate as the estimate for DeKalb County, as calculated by IDPH. According to IDPH, the population of DeKalb County is expected to increase from 105,160 in 2010 to 126,927 by 2025, a 20.7% increase. Therefore, AES assumes that the population of the DeKalb/LaSalle portion of Lower Little Rock Creek watershed is expected to increase from 12,335 (Census data) in 2010 to 14,888 by 2025, or a 20.7% increase. Aggregating these projections with the CMAP 2025 projections amounts to a projected watershed population of 16,546 in 2025. Watershed population, household, and employed population, both current and projected, are summarized in Table 9.

Table 9. Watershed population, household, and employed population, current and projected.

Data Category	2015	2025	Change (2015-2025)	Percent Change (2015-2025)	2050	Change (2015-2050)	Percent Change (2015-2050)
Kendall County (CMAP)							
Population	1,200	1,658	458	38.2%	5,013	3,813	317.8%
Household	429	635	206	48.0%	2,049	1,620	377.6%
Employed Population	1,059	1,135	76	7.2%	1,898	839	79.2%
DeKalb + LaSalle Counties (ACS)							
Population	12,022	14,888*	N/A	N/A	N/A	N/A	N/A
Household	4,438	N/A	N/A	N/A	N/A	N/A	N/A
Employed Population	6,084	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated based on IDPH estimates for DeKalb County and 2010 Census data.

Figures 15, 16, and 17 respectively display the current (2015) Total Population, Households, and Employee Population for the watershed based on the combined CMAP and ACS data. Estimated increases across all three categories is centered on Sandwich and the outskirts of Plano and spreads outward from both. Increases in Total Population and Households are projected in areas that are currently open space and agricultural land uses.

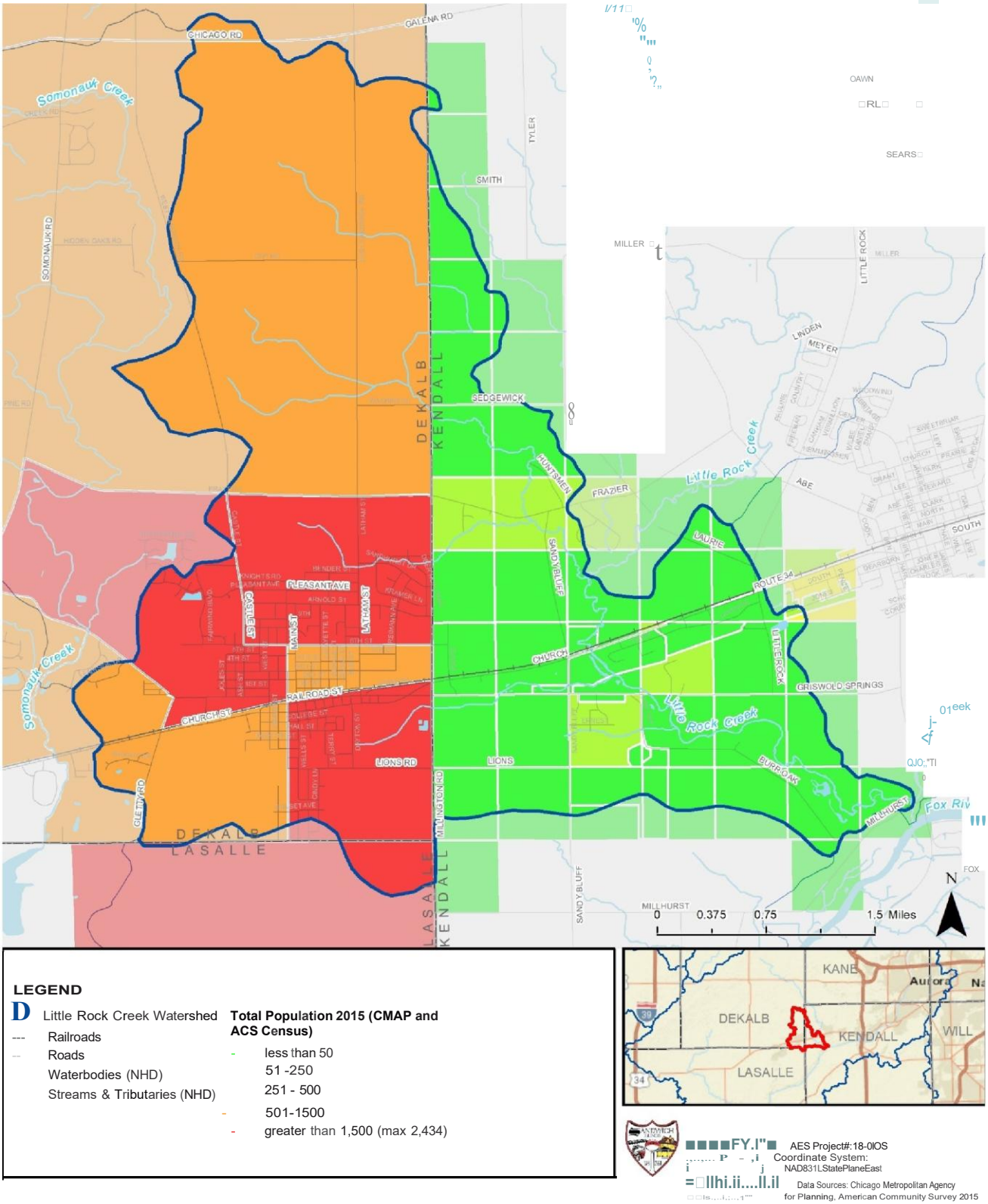
Socioeconomic Status

The City of Sandwich represents nearly a quarter of the watershed and serves as a good approximation for watershed-wide socioeconomic indicators. Sandwich can be described as predominately working class, composed primarily of a white population (90.8%). According to 2017 American Community Survey data, it has a median household income of about $62,000 a year with around 71% of the population living in owned-occupied housing. Around 42% of Sandwich's residents have a high school diploma and around 11% hold a bachelor's degree or higher.

Turf in woodland neighborhood

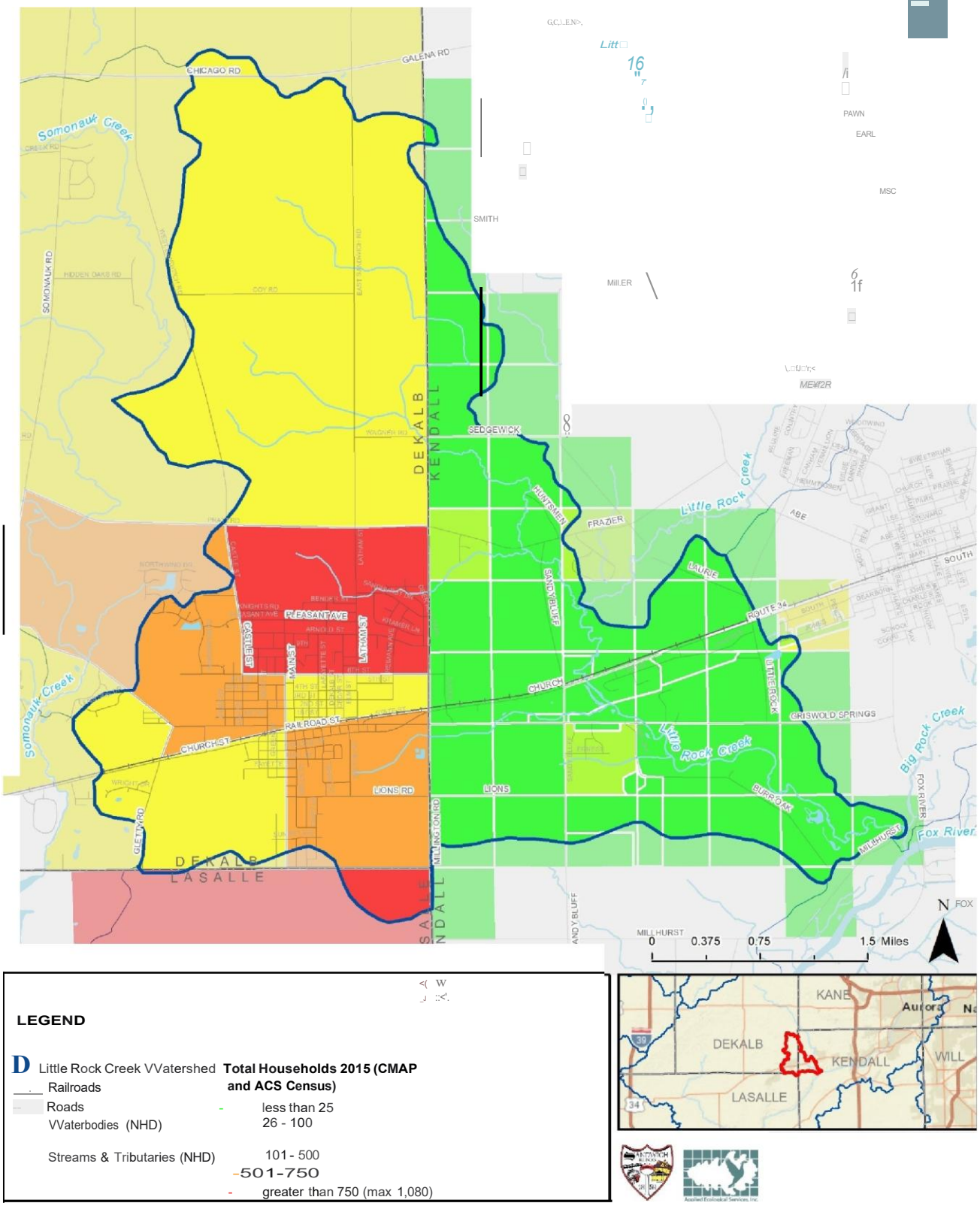
LITTLE ROCK CREEK WATERSHED

Figure 15. 2015 Total Population



LITTLE ROCK CREEK WATERSHED

Figure 16 2015 Total Households



LEGEND

D Little Rock Creek VVatershed
Railroads
Roads
VVaterbodies (NHD)
Streams & Tributaries (NHD)

Total Households 2015 (CMAP and ACS Census)

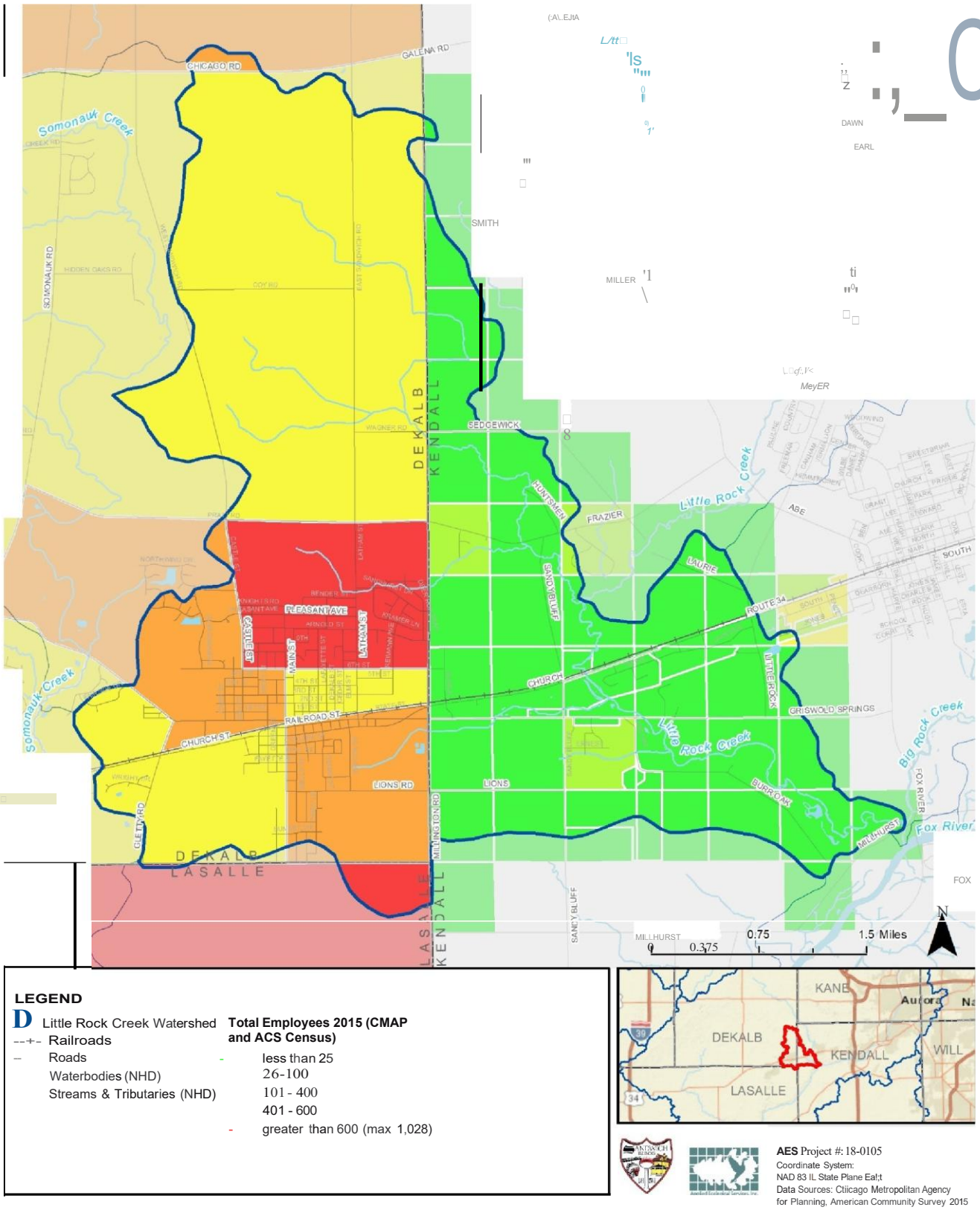
- less than 25
- 26 - 100
- 101 - 500
- 501-750
- greater than 750 (max 1,080)

AES Project-#: 18-0105
Coordinate System;
NAO 83 IL Stale Plane East

Data Sources: Chimgo Metropolitan Agency
Tx: Planning Area; CJ: Community Survey 2015

LITTLE ROCK CREEK WATERSHED

Figure 17: 2015 Total Employees



LEGEND

D Little Rock Creek Watershed
--+- Railroads
– Roads
Waterbodies (NHD)
Streams & Tributaries (NHD)

Total Employees 2015 (CMAP and ACS Census)

- less than 25
- 26-100
- 101 - 400
- 401 - 600
- greater than 600 (max 1,028)

AES Project #: 18-0105
Coordinate System:
NAD 83 IL State Plane Eal;t
Data Sources: Ctiicago Metropolitan Agency for Planning, American Community Survey 2015

3.8 Existing & Future Land Use/Land Cover

2018 Land Use/Land Cover

Highly accurate land use/land cover data was produced for Lower Little Rock Creek watershed using several sources of data. The most recent land use/land cover data from DeKalb and Kendall Counties along with the City of Sandwich was obtained from comprehensive plans. Aerial photography of the watershed was also overlaid on existing land use data in GIS so that additional discrepancies could be corrected. Finally, several corrections were made to land use based on field notes taken by Applied Ecological Services, Inc (AES) during the fall of 2019 watershed resource inventory. The 2018 land use/land cover data and map for Lower Little Rock Creek watershed is included in Table 10 and depicted on Figure 18. Land cover classifications are defined in the "Noteworthy- Land Use/Land Cover Definitions" side bar below.

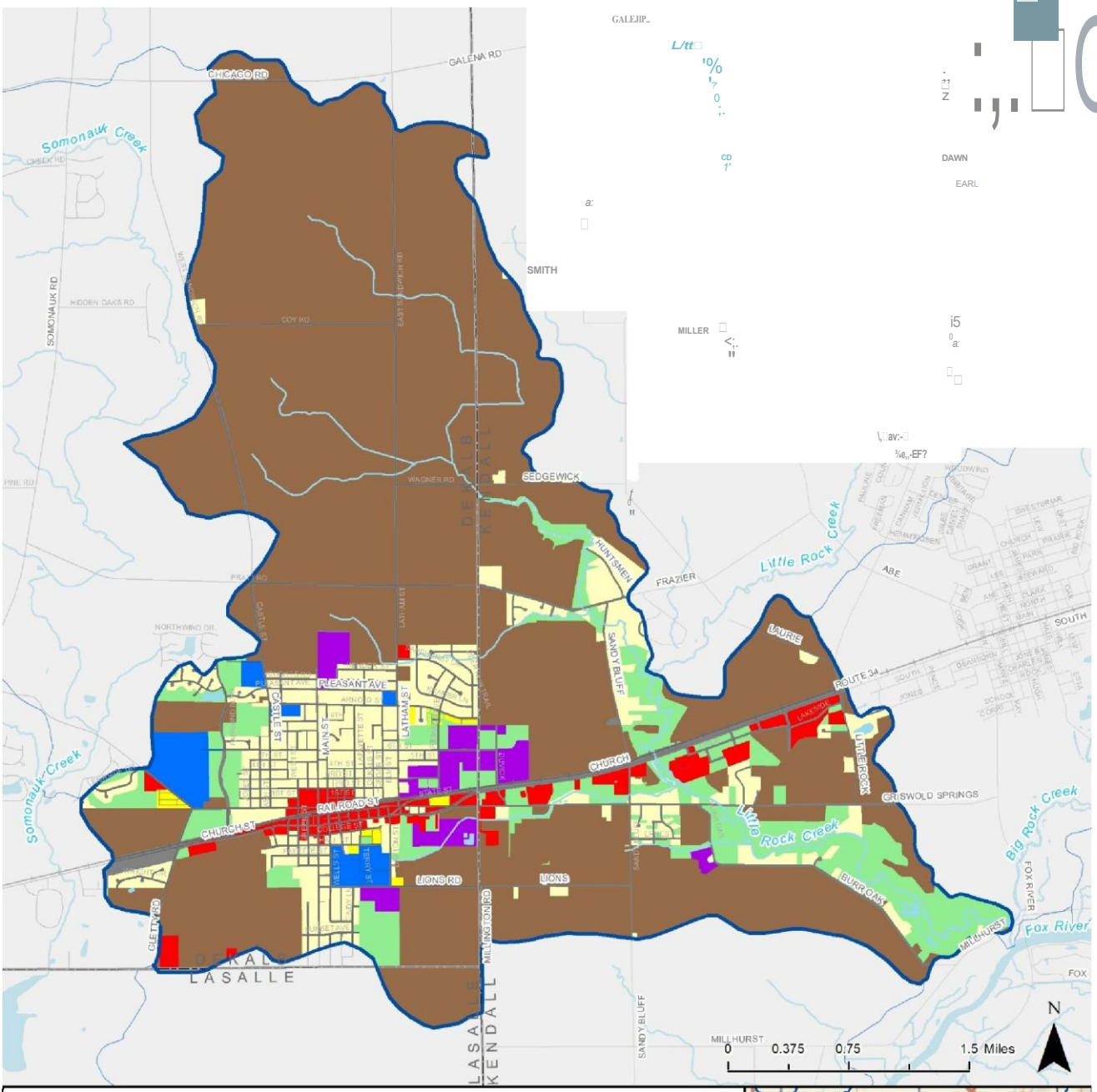
Agricultural areas are the most abundant land use in the watershed at 7,140 acres or 67.7%. Other common land uses include single-family residential (1,078.0; 10.2%), Open Space (981.7 acres; 9.4%), transportation (643.8 acres; 6.1%), commercial/retail (251.7 acres; 2.4%), industrial (208.5 acres; 2.0%), and municipal/institutional (170.7 acres; 1.6%).

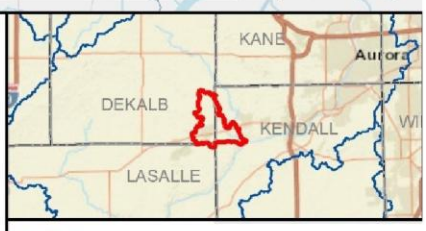
Table 10. Existing 2018 land use/land cover classifications and acreage.

Land Use	Current (2018) Areas (acres)	Current % of Watershed
Agriculture	7,140.4	67.7%
Single Family Residential	1,078.0	10.2%
Open Space	981.7	9.4%
Transportation	643.8	6.1%
Commercial/Retail	251.7	2.4%
Industrial	208.5	2.0%
Municipal/Institutional	170.7	1.6%
Multi-Family Residential	35.6	0.3%
Water	28.9	0.3%
Utility	2.1	0.0%
Total	**10,541.2**	**100.0%**

LITTLE ROCK CREEK WATERSHED

Figure 18: Current Land Use 2018





LEGEND

D Little Rock Creek Watershed

---<--- Railroads

Roads

Waterbodies (NHD)

Streams & Tributaries (NHDJ

Current Land Use

- Agriculture
- Single Family Residential
- Multi-Family Residential
- Res/Commercial Mixed
- Commercial/Retail
- Industrial/Business Pk
- Industrial
- Municipal/Institutional
- Open Space
- Wetlands
- Transportation/Utility

AES Project#: 18-0105
Coordinate System:

NAD 83 II State Plane East
Data
Sources:
OeK.31b
County,
Kendall
County, City
of Sandwich

Agricultural land has dominated the watershed since the time it was settled in the 1800s to present. Agricultural operations comprise 7,140.4 acres or 67.7% of the watershed in 2018. Agricultural land use is spread throughout the watershed except for areas directly adjacent to Sandwich and the corridors abutting Little Rock Creek. As Sandwich expands going forward, existing agricultural lands are slated for future residential, industrial, and commercial development.

Single family residential comprises the second most acreage at 1,078.0 acres or 10.2%; most of this is directly adjacent to the city of Sandwich. Current aerial imagery shows roads set up to support residential development on the outer edges of existing residential areas.

Most natural areas can be found in the forested areas directly adjacent to Little Rock Creek. For the most part, these areas are privately owned and subdivided, though the Little Rock Creek Forest Preserve covers a large portion of the southeastern corner of the watershed. Open water land cover is represented by Little Rock Creek.

Total undeveloped or open space land uses such as agricultural lands, conservation, golf courses, open water/wetlands, parks, utility easements, and forest/shrubland/grassland make up 8,153.0 acres or 77.3% of the watershed. Developed land uses account for the remaining 2,388.2 acres or 22.7% of the watershed.

Noteworthy-Land Use/Land Cover Definitions:

Agricultural: Land use that includes out-buildings and barns, row & field crops and fallow field farms and pasture, includes dairy and other livestock grazing. Also includes nurseries, greenhouses, orchards, tree farms, and sod farms.

Commercial/Retail: Land use that includes shopping malls and their associated parking, single structure office/hotels and urban mix (retail trade like lumber yards, department stores, grocery stores, gas stations, restaurants, etc.).

Industrial: Land use that includes industrial, warehousing and wholesale trade, such as mineral extraction, manufacturing and processing, associated parking areas, truck docks, etc.

Residential-Multifamily: Land use that includes multifamily residences. These include duplex and townhouse units, apartment complexes, retirement complexes, mobile home parks, trailer courts, condominiums, and associated parking on lots less than 1/8 acre with impervious cover around 65%.

Municipal/Institutional: Land use that includes medical facilities, educational facilities, government buildings, religious facilities, and others.

Open Space: Open space is land within a municipal planning jurisdiction that is either used or is designated for future use as public or private parks, golf courses, natural areas, and low-intensity land uses such as stormwater management facilities.

Single Family Residential (≥2 acre lots): Land use that includes single family homes and farmhouses and immediate residential area around them with lot sizes greater than or equal to 2 acres and impervious cover less than 5%.

Transportation: Land use that includes railroads, rail rapid transit and associated stations, rail yards, linear transportation such as streets and highways, and airport transportation.

Utility Facility: Land use that includes telephone, radio and television towers, dishes, gas, sewage pipeline, right-of-ways, wastewater facilities, etc.

Water & Wetland: Open water and wetland areas including rivers, streams, canals, lakes, ponds, detention basins, reservoirs, lagoons/sloughs, marshes, wet prairie, meadows, bogs, etc.

Future Land Use/Land Cover Predictions

Information on predicted future land use/land cover for the watershed was obtained primarily from municipal comprehensive plans where available. Available data was analyzed, and GIS used to map predicted land use/land cover changes. The results are summarized in Table 11 and Figure 19. On the future land use map (Figure 19), areas in white depict where predicted future land use remains unchanged from 2018, while the colors represent the predicted future land use.

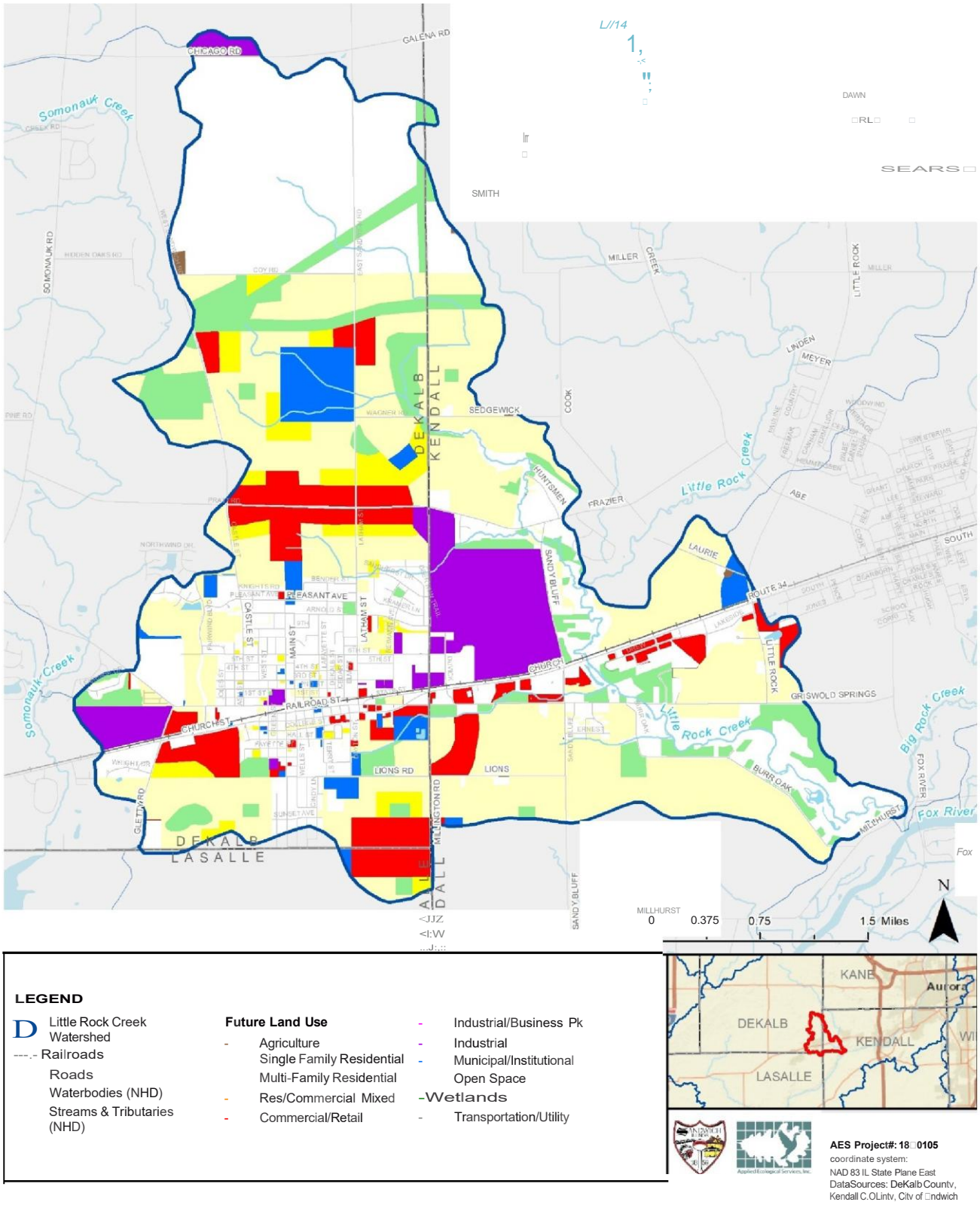
Table 11 compares existing land use/land cover acreage to predicted future land use/land cover acreage. The largest loss of a current land use/land cover is expected to occur on agricultural land where approximately 5,664.5 acres of the existing 7,140.4 acres (53.7% decrease relative to total watershed) is expected to be converted to mostly residential and commercial/retail/industrial land uses. These changes are expected to expand outward from the existing developed land in Sandwich with industrial and commercial/retail land use expanding to areas easily accessed by existing transportation corridors. The largest growth area is Single Family Residential where there is expected to be an expansion of 3,254.5 acres (30.9%), Commercial/Retail (700.9 acres, 6.6%), Industrial (546.7 acres, 5.2%), Multi-family Residential (318.1 acres, 3.0%), and Municipal/Institutional (283.6, 2.7%). In addition, it is interesting to note that existing open space is expected to increase from to 527.5 acres (5.0%) in the future.

Table 11. Comparison between 2018 and predicted future (2030) land use/land cover statistics.

Land Use	Current Areas (acres)	Current % of Watershed	Future Areas (acres)	Future % of Watershed	Change (acres)	Change (%)
Agriculture	7,140.4	67.7%	1,475.9	14.0%	-5,664.5	-53.7%
Single Family Residential	1,078.0	10.2%	4,332.4	41.1%	3,254.5	30.9%
Open Space	981.7	9.4%	1,461.7	13.8%	527.5	5.0%
Transportation	643.8	6.1%	678.9	6.4%	35.0	0.3%
Commercial/Retail	251.7	2.4%	952.6	9.0%	700.9	6.6%
Industrial	208.5	2.0%	755.1	7.2%	546.7	5.2%
Municipal/Institutional	170.7	1.6%	454.2	4.3%	283.6	2.7%
Multi-Family Residential	35.6	0.3%	353.7	3.4%	318.1	3.0%
Water	28.9	0.3%	29.1	0.3%	0.2	0.0%
Utility	2.1	0.0%	0.0	0.0%	-2.1	0.0%
Total	**10,541.2**	**100.0%**	**10,541.2**	**100.0%**	**0.0**	**0.0%**

LITTLE ROCK CREEK WATERSHED

Figure 19: Future (2030) Land Use/Land Caver Changes



LEGEND

- Little Rock Creek Watershed
- Railroads
- Roads
- Waterbodies (NHD)
- Streams & Tributaries (NHD)

Future Land Use

- Agriculture
- Single Family Residential
- Multi-Family Residential
- Res/Commercial Mixed
- Commercial/Retail
- Industrial/Business Pk
- Industrial
- Municipal/Institutional
- Open Space
- Wetlands
- Transportation/Utility

AES Project#: 18□0105
coordinate system:
NAD 83 IL State Plane East
DataSources: DeKalb Countv, Kendall C.OLintv, Citv of □ndwich

3.9 Transportation Network

Roads

As the majority of the watershed is dominated by open space and agricultural land uses, major thoroughfares through the watershed are limited, and the majority of the existing roads are through neighborhoods. The major east-west thoroughfare is US Route 34 (Church Street); E Sandwich Road runs north from Sandwich to Hinckley. There are around 69 miles of roads within the watershed and 2.6 miles of proposed trail (Figure 20).

Airport

Woodlake Landing Airport-IS65 is a private airport located two miles southwest of downtown Sandwich. It has two runways, a 500-foot and a 250-foot, and has been in operation since 1947. It is owned by Lincoln Development Corp, located at 1560 W. Church St., and is home to approximately 40 aircraft.

Woodlake Landing Airport-IS65

Railroads

The railway which runs east-west through the watershed along US Route 34 is operated by BNSF Railway Company. The railway is primarily used to transport freight (such as coal) and agricultural products.

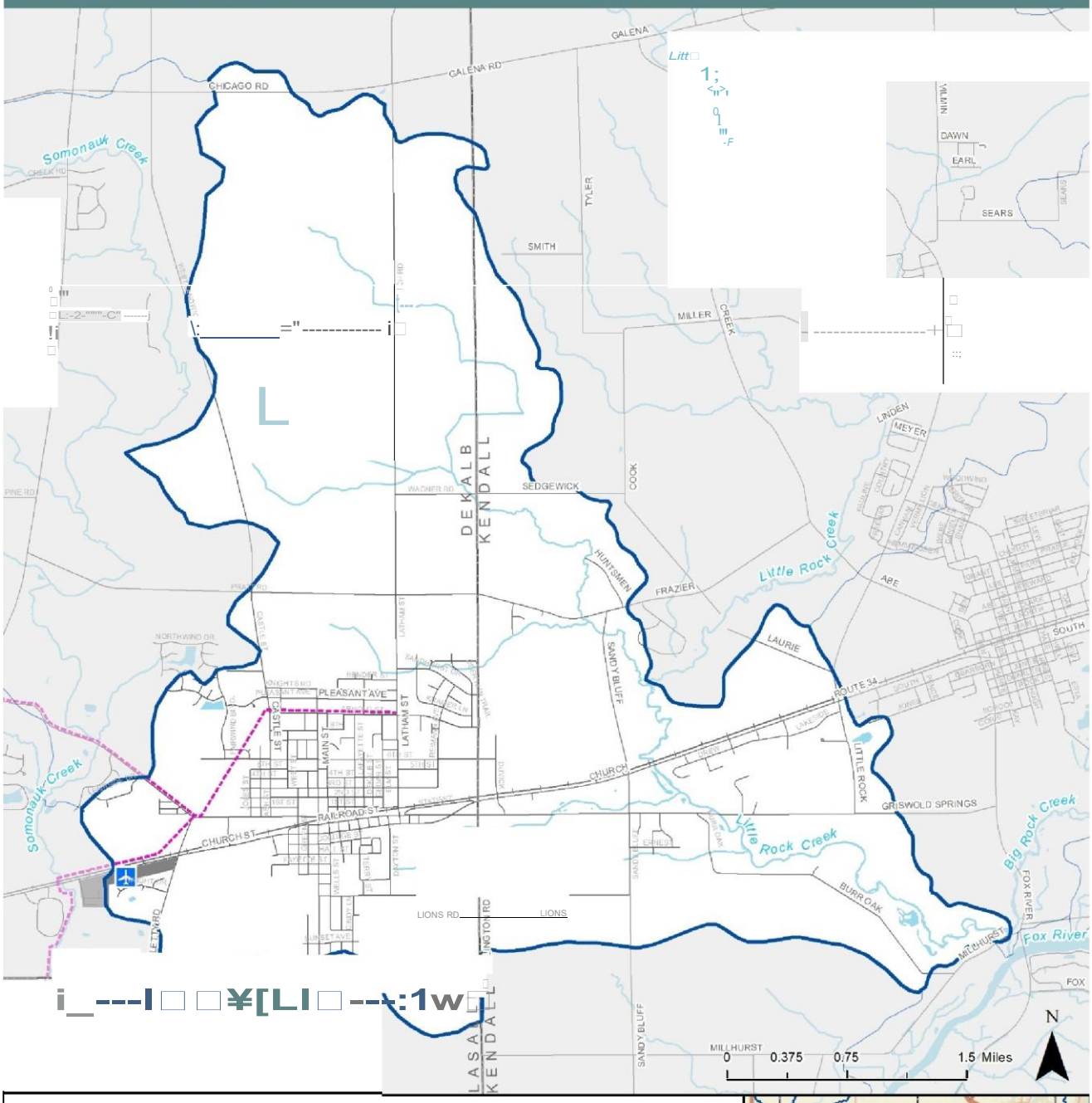
BNSF Railroad

Trails/Bike Paths

There is not an extensive trail network within the watershed boundaries. There is a proposed trail of 2.6 miles extending westward from the city of Sandwich, exiting the watershed.

LITTLE ROCK CREEK WATERSHED

Figure 20: Transportation Network



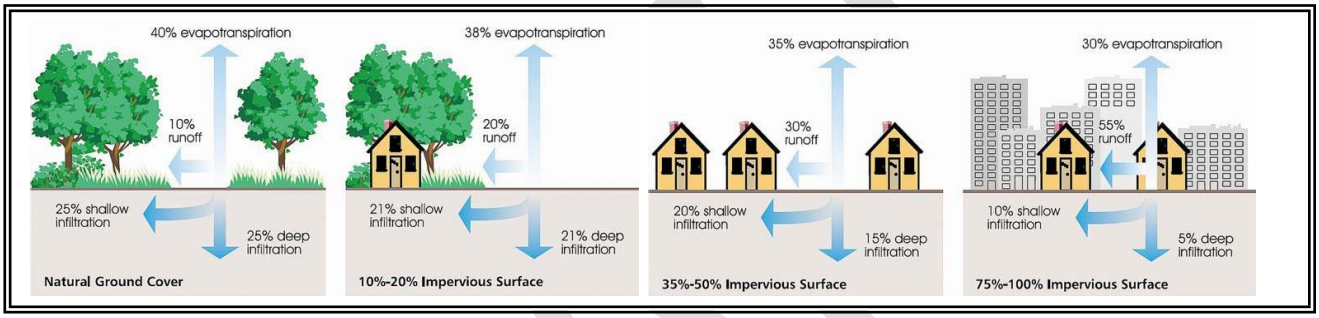
LEGEND

- Little Rock Creek 1/<kitershed
- Railroads
- -Roads
- 1/<kiterbodies (NHD)
- Streams & Tributaries (NHD)
- Bike Trails (Proposed)
- 1/\bodlake Landing Airport - IS65

AES Project #: 18-0105
coordinate System:
NAD83 IL State Plane East
Data Sources: DeKalb County, Kendall County, City of Sandwich

3.10 Impervious Cover Impacts

Impervious cover is defined as surfaces of an urban landscape that prevent infiltration of precipitation (Scheuler, 1994). Imperviousness is an indicator used to measure the impacts of urban land uses on water quality, hydrology and flows, flooding/depressional storage, and habitat related to streams (Figure 20). Based on studies and other background data, Scheuler (1994) and the Center for Watershed Protection (CWP) developed an Impervious Cover Model used to classify streams within subwatersheds into three quality categories: Sensitive, Impacted, and Non-Supporting (Table 12). In general, Sensitive subwatersheds have less than 10% impervious cover, stable channels, good habitat, good water quality, and diverse biological communities whereas streams in Non-Supporting subwatersheds generally have greater than 25% impervious cover, highly degraded channels, degraded habitat, poor water quality, and poor-quality biological communities. In addition, runoff over impervious surfaces collects pollutants and warms the water before it enters a stream resulting in a shift from sensitive species to ones that are more tolerant of pollution and hydrologic stress.



Source: The Federal Interagency Stream Restoration Working Group, 1998 (Rev. 2001).

Figure 20. Relationship between impervious surfaces, evapotransporation, & infiltration.

Table 12. Impervious category & corresponding stream condition via the Impervious Cover Model.

Category	% Impervious	Stream Condition within Subwatershed
Sensitive	<10%	Stable stream channels, excellent habitat, good water quality, and diverse biological communities
Impacted	>10% but <25%	Somewhat degraded stream channels, altered habitat, decreasing water quality, and fair-quality biological communities.
Non-Supporting	>25%	Highly degraded stream channels, degraded habitat, poor water quality, and poor-quality biological communities.

Source: (Zielinski, 2002)

Sensitive Stream

Impacted Stream

Non-Supporting Stream

The following paragraphs describe the implications of increasing impervious cover:

Water Quality Impacts
Imperviousness affects water quality in streams and lakes by increasing pollutant loads and water temperature. Impervious surfaces accumulate pollutants from the atmosphere, vehicles, roof surfaces, lawns and other diverse sources. During a storm event, pollutants such as nutrients (nitrogen and phosphorus), metals, oil/grease, and bacteria are delivered to streams and lakes. According to monitoring and modeling studies, increased imperviousness is directly related to increased urban pollutant loads (Schueler, 1994). Furthermore, impervious surfaces can increase stormwater runoff temperature as much as 12 degrees compared to vegetated areas (Galli, 1990). According to the Illinois Pollution Control Board (IPCB), water temperatures exceeding 90°F (32.2°C) can be lethal to aquatic fauna and can generally occur during hot summer months.

Hydrology and Flow Impacts
Higher impervious cover translates to greater runoff volumes thereby changing hydrology and flows in streams. If unmitigated, high runoff volumes can result in higher floodplain elevations (Schueler, 1994). In fact, studies have shown that even relatively low percentages of imperviousness (5% to 10%) can cause peak discharge rates to increase by a factor of 5 to 10, even for small storm events. Impervious areas come in two forms: 1) disconnected and 2) directly connected. Disconnected impervious areas are represented primarily by rooftops, so long as the rooftop runoff does not get funneled to impervious driveways or a stormsewer system. Significant portions of runoff from disconnected surfaces usually infiltrate into soils more readily than directly connected impervious areas such as parking lots that typically end up as stormwater runoff directed to a stormsewer system that discharges directly to a waterbody.

Flooding and Depressional Storage Impacts
Flooding is an obvious consequence of increased flows resulting from increased impervious cover. As stated above, increased impervious cover leads to higher water levels, greater runoff volumes, and high floodplain elevations. Higher floodplain elevations usually result in more flood problem areas. Furthermore, as development increases, wetlands and other open space decrease. A loss of these areas results in increased flows because wetlands and open space typically soak up rainfall and release it slowly via groundwater discharge to streams and lakes. Detention basins can and do minimize flooding in highly impervious areas by regulating the discharge rate of stormwater runoff, but detention basins do not reduce the overall increase in runoff volume.

Habitat Impacts
A threshold in habitat quality exists at approximately 10% to 15% imperviousness (Booth and Reinelt, 1993). When a stream receives more severe and frequent runoff volumes compared to historical conditions, channel dimensions often respond through the process of erosion by widening, downcutting, or both, thereby enlarging the channel to handle the increased flow. Channel instability leads to a cycle of streambank erosion and sedimentation resulting in physical habitat degradation (Schueler, 1994). Streambank erosion is one of the leading causes of sediment suspension and deposition in streams leading to turbid conditions that may result in undesirable changes to aquatic life (Waters, 1995). Sediment deposition alters habitat for aquatic plants and animals by filling interstitial spaces in substrates important to benthic macroinvertebrates and some

fish species. Physical habitat degradation also occurs when high and frequent flows result in loss of riffle-pool complexes.

2018 Impervious Cover Estimate & Future Vulnerability

In 1998, the Center for Watershed Protection (CWP) published the Rapid Watershed Planning Handbook. This document introduced rapid assessment methodologies for watershed planning. The CWP released the Watershed Vulnerability Analysis as a refinement of the techniques used in the Rapid Watershed Planning Handbook (Zielinski, 2002). The vulnerability analysis focuses on existing and predicted impervious cover as the driving forces impacting potential stream quality within a watershed. It incorporates the Impervious Cover Model described at the beginning of this subsection to classify Subwatershed Management Units (SMUs). SMUs are defined and examined in more detail in Section 3.3.

Applied Ecological Services, Inc. (AES) used a modified Vulnerability Analysis to compare each SMU's vulnerability to predicted land use changes across Lower Little Rock Creek watershed. Three steps were used to generate a vulnerability ranking of each SMU. The results were used to make and rank recommendations in the Action Plan related to curbing the negative effects of predicted land use changes on the watershed. The three steps are listed below and described in detail on the following pages:

Step 1: Existing impervious cover classification of SMUs based on 2018 land use/land cover

Step 2: Predicted future impervious cover classification of SMUs based on predicted land use/land cover changes

Step 3: Vulnerability Ranking of SMUs based on changes in impervious cover and classification

Step 1: Existing Impervious Cover Classification

Step 1 in the Vulnerability Analysis is an existing classification of each SMU based on 2018 land use/land cover and measured impervious cover. 2018 impervious cover was calculated by assigning an impervious cover percentage for each land use/land cover category based upon the United States Department of Agriculture's (USDA) Technical Release 55 (TR55) (USDA 1986). Highly developed land such as commercial/retail for example is estimated to have over 70% impervious cover while a typical medium density residential development exhibits around 25% impervious cover. Open space areas such as forest preserves generally have less than 5% impervious cover. GIS analysis was used to estimate the percent impervious cover for each SMU in the watershed using 2018 land use/land cover data. Each SMU then received an initial classification (Sensitive, Impacted, or Non-Supporting) based on percent of existing impervious cover (Table 13; Figure 22).

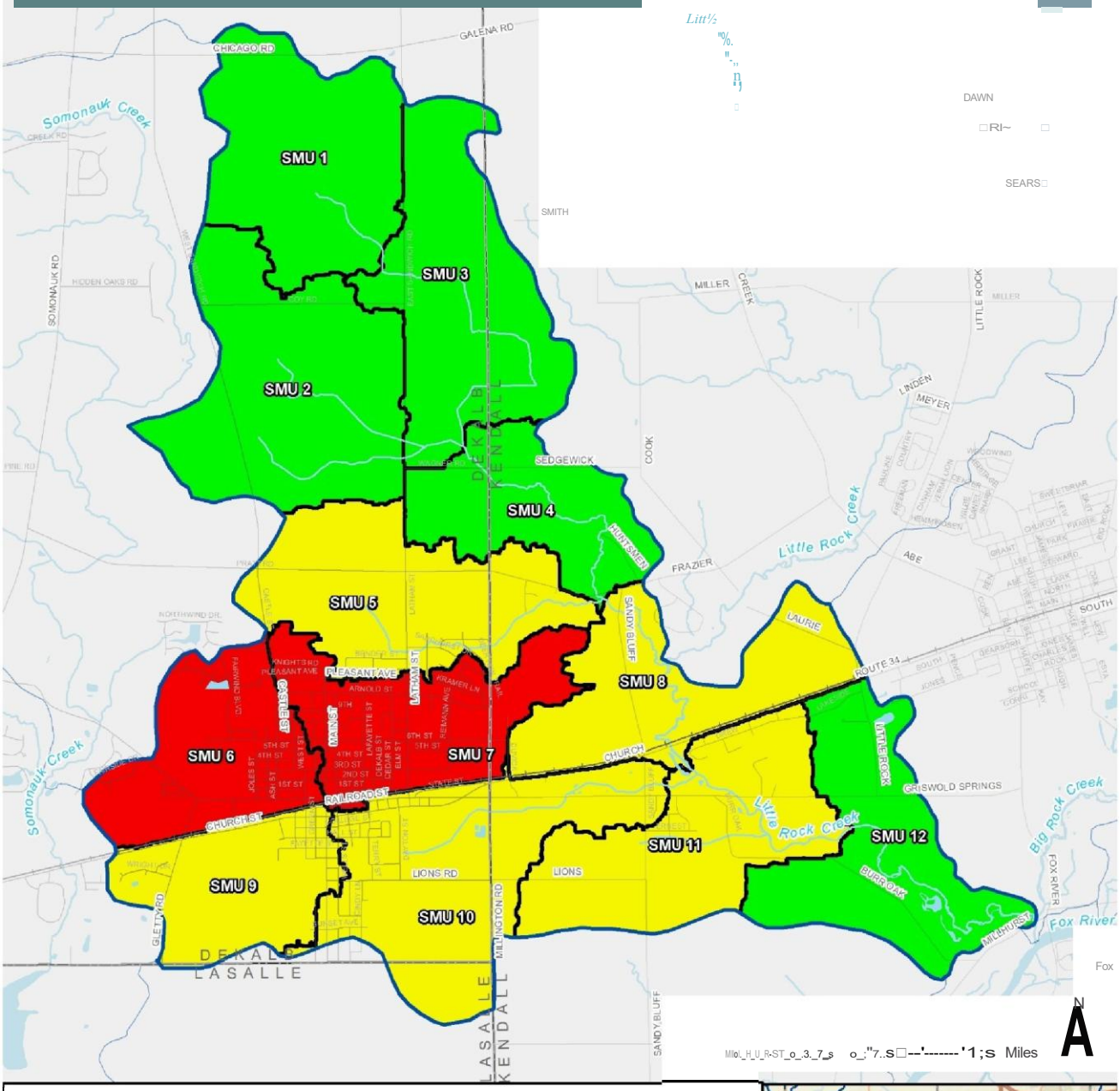
To summarize, five SMUs (SMUs 1-4, and 12) were classified as Sensitive, five as Impacted (SMUs 5 & 8-11), and two as Non-Supporting (SMUs 6 & 7) based on 2018 impervious cover estimates. Sensitive SMUs 1-4 are located on open space, low density residential, and agricultural lands north of the City of Sandwich, while Sensitive SMU 12 consists of open space and low-density residential south of Plano and near the outlet of Little Rock Creek. The Impacted SMUs center around the City of Sandwich where urban and low-density residential development are common. The Non-Supporting SMUs are associated with the most heavily urbanized portions of Sandwich.

Table 13. Existing (2018) and predicted future (2030) impervious cover and vulnerability by Subwatershed Management Unit.

SMU #	Acres	Step 1: Existing Impervious %	Existing (2018) Impervious Classification	Step 2: Predicted Impervious %	Predicted (2030) Impervious Classification	Percent Change	Step 3: Vulnerability
1	942.7	0.6%	Sensitive	3.8%	Sensitive	3.2%	Low
2	1,188.3	1.6%	Sensitive	30.6%	Non-Supporting	29.0%	High
3	1,041.8	1.3%	Sensitive	14.2%	Impacted	12.9%	Low
4	631.7	5.2%	Sensitive	30.7%	Non-Supporting	25.5%	High
5	962.2	10.5%	Impacted	54.3%	Non-Supporting	43.8%	High
6	706.5	29.7%	Non-Supporting	48.5%	Non-Supporting	18.8%	Medium
7	749.9	34.8%	Non-Supporting	52.8%	Non-Supporting	18.0%	Medium
8	801.8	12.2%	Impacted	44.9%	Non-Supporting	32.7%	High
9	606.8	22.0%	Impacted	48.1%	Non-Supporting	26.2%	High
10	1,094.7	24.4%	Impacted	54.2%	Non-Supporting	29.7%	High
11	950.2	11.3%	Impacted	28.5%	Non-Supporting	17.1%	Medium
12	864.5	8.0%	Sensitive	23.1%	Impacted	15.1%	Low

LITTLE ROCK CREEK WATERSHED

Figure 22: Current Impervious Cover Cfassificat,on based on Land Use/Land Cover

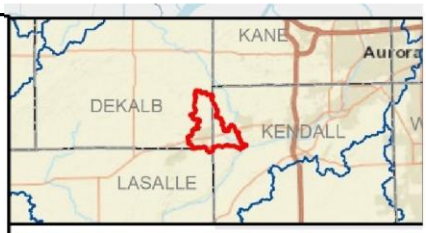


LEGEND

D Little Rock Creek Watershed
---<-- Railroads
– Roads
Waterbodies (NHD)
Streams & Tributaries (NHD)

2018 Impervious Cover by SMU

a Sensitive (<10%)
Impacted (>10% but <25%)
- Non-Supporting (>25%)



AES Project#: 1s-01os
Coordinate System:
NAD83 IL State Plane East
Data Sources: DeK,;1ib County, Kendall County, City of Sandwich

Step 2: Predicted Future Impervious Cover Classification
Predicted future impervious cover was evaluated in Step 2 of the vulnerability analysis by classifying each SMU as Sensitive, Impacted, or Non-Supporting based on predicted land use changes. Table 13 and Figure 23 summarize and depict predicted future impervious cover classifications for each SMU. This step identifies Sensitive and Impacted SMUs that are most vulnerable to future development pressure. SMUs 2-5 and 8-12 all changed classification, and of these two (SMUs 2 and 4) changed classification from Sensitive to Non-Supporting. These changes are attributed to predicted increase in predominantly residential, commercial/retail, and industrial development planned for the areas surrounding the City of Sandwich. The resulting land use changes will cause a significant increase in impervious cover.

Step 3: Vulnerability Ranking
The vulnerability of each SMU to predicted future land use changes was determined by considering the following questions:

1. Will the SMU classification change?
2. Does the SMU classification come close to changing (within 2%)?
3. What is the absolute change in impervious cover from existing to predicted conditions?

Vulnerability to future development for each SMU was categorized as Low, Medium, or High:
Low = no change in classification or ≤15% change in impervious cover
Medium = classification change and/or 15-25% change in impervious cover
High = classification change and >25% change in impervious cover

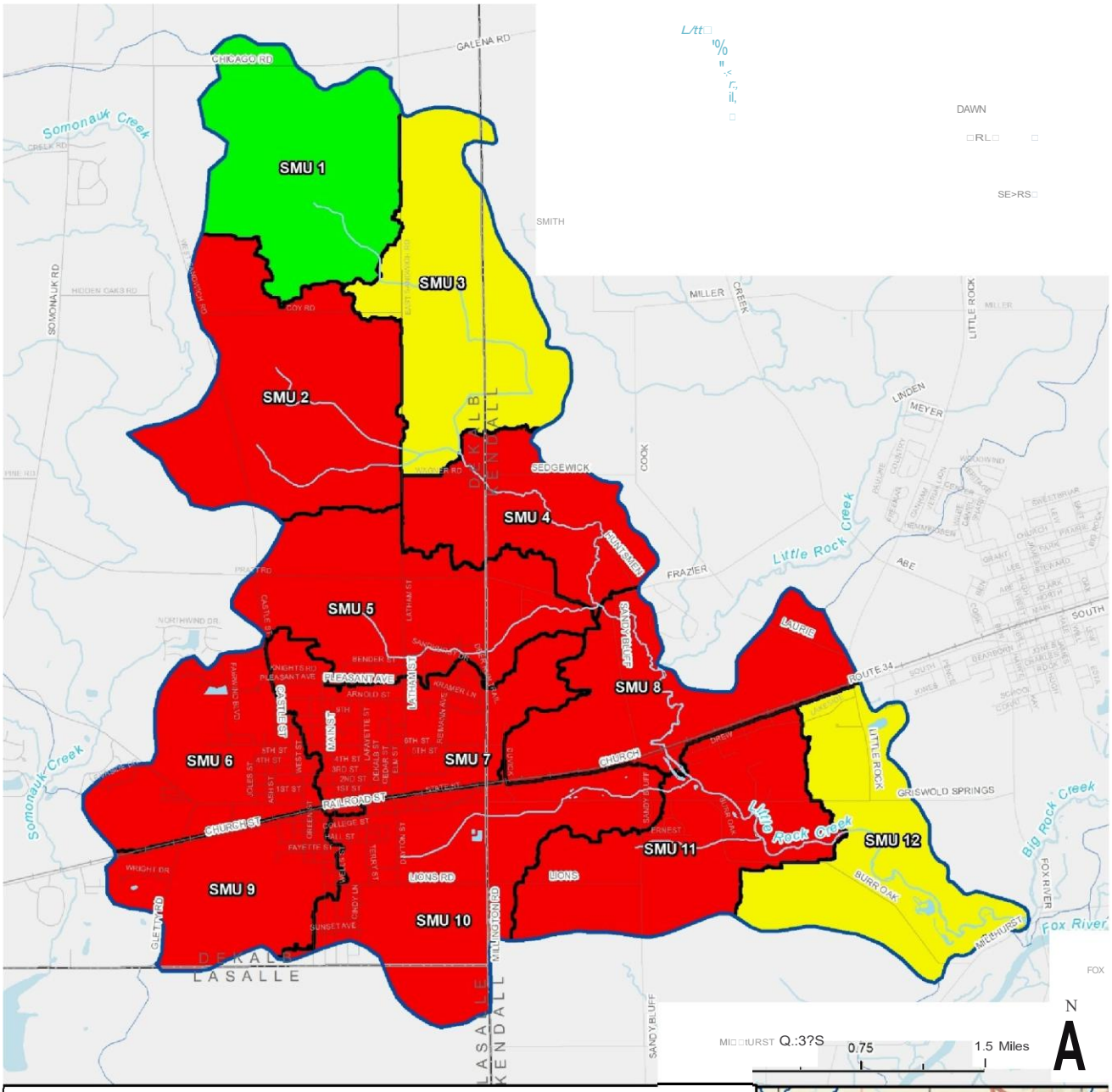
The vulnerability analysis resulted in 6 High, 3 Medium, and 3 Low ranked SMUs (Table 13; Figure 24). SMUs 2, 4, 5, and 8-10 are ranked as highly vulnerable to future problems associated with impervious cover because each is expected to change classification and experience more than a 25% increase in impervious cover. Predicted urban and residential development immediately surrounding Sandwich as the City continues to grow is the potential causes of increased impervious cover. Protecting natural resources as this urbanization moves forward will be an important part of protecting water quality for the future health of the watershed.

SMUs 6, 7, and 11 are ranked as moderately vulnerable to predicted land use changes. All three SMUs are expected to have a 15-25 % increase in impervious cover based on future land use predictions. SMUs 4 and 5 did not change classification (both were and will be Non-Supporting) while SMUs 11 is expected to change from Impacted to Non-Supporting. Predicted residential and commercial/retail development are expected to drive the increases in impervious cover in these SMUs. The remaining SMUs are less vulnerable to predicted future land use changes.

The results of this analysis clearly highlight the need to protect existing natural resources ahead of planned residential and commercial/retail development changes. It will be important to consider developing these areas using Conservation Design or Low Impact Development standards that incorporate the most effective and reliable Stormwater Treatment Train practices whereby stormwater is routed through various Management Measures prior to being released from the development site.

LITTLE ROCK CREEK WATERSHED

Figure 23: Future Impervious Cover Classificatwn based on Land Use/Land Cover



LEGEND

D Little Rock Creek Watershed
-- Railroads
– Roads
Waterbodies (NHD)
Streams & Tributaries (NHD)

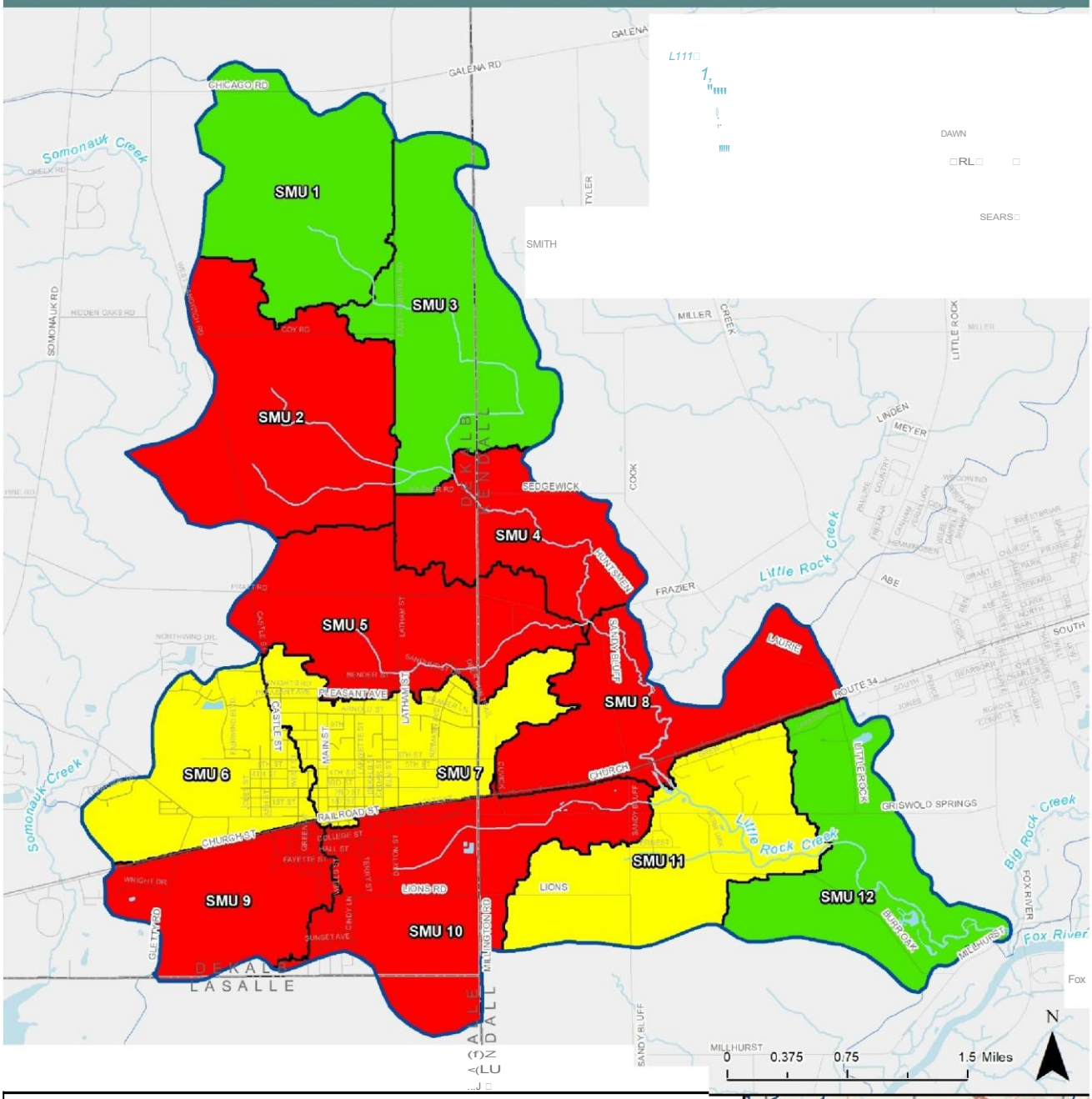
2030 Impervious Cover by SMU

Sensitive (<10%)
Impacted (>10% but <25%)
Non-Supporting (>25%)

AES Project#: 18-0105
Coordinate System:
NAO 83 ILState Plane East
Da'4 Sources: DeKalb County, Kendall County, City of Sandwich

LITTLE ROCK CREEK WATERSHED

Figure 24: Vulnerability Ranking of SMUs based on Predicted Future Land Use Changes



LEGEND

- Little Rock Creek \Natershed
- Railroads
- Roads
- \Naterbodies (NHD)
- Streams & Tributaries (NHD)

Vulnerability Ranking

- -High
- c:]Medium
- c:]Low

AES Project#: 18-0105
Coordinate System:
NAD 83 ILState Plane East
Oata Sources: OeK;;ilb County, Kendall County, City of Sandwich

3.11 Open Space Inventory, Prioritization, & Green Infrastructure Network

A major component of watershed planning includes an examination of open space to determine how it best fits into a "Green Infrastructure Network". Green infrastructure is best defined as an interconnected network of natural areas and other open space that conserves natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife (Benedict 2006). Natural features such as stream corridors, wetlands, floodplain, woodlands, and grassland are the primary components of green infrastructure. Working lands such as farms and partially developed areas including parks, ball fields, golf courses, school grounds, detention basins, large residential parcels, and any residential lot that includes a stream corridor are also considered components of a Green Infrastructure Network. A three-step process was used to create a parcel-based Green Infrastructure Network for the Lower Little Rock Creek watershed:

Step 1: All parcels of land in the watershed were categorized as open space, partially open space, or developed.
Step 2: All open and partially open parcels were prioritized based on a set of criteria important to green infrastructure.
Step 3: Prioritized open and partially open parcels were configured to form a Green Infrastructure Network.

For this watershed plan, an "open space" parcel is generally defined as any parcel that is not developed such as a nature preserve or agricultural field. "Partially open" parcels have been developed to some extent, but the parcels still offer potential green infrastructure opportunities. Examples of partially open parcels include school grounds and residential lots generally greater than two to three acres with minimal development. Parcels that are mostly built out such as commercial/retail areas and roads are considered "developed." Public versus private and protected versus unprotected status of open and partially open space parcels are other important green infrastructure attributes that are discussed in more detail below. Parcels range in size from less than 1 acre to 197 acres with a 3-acre average.

Open, Partially Open, & Developed Parcels

Step 1 in creating a Green Infrastructure Network was completed by categorizing all parcels in the watershed as "open," "partially open," or "developed." Figures 25 and 26 summarize and depict Step 1 results used to develop the Green Infrastructure Network. Open space parcels comprise approximately 8,032 acres or 76% of the watershed. Partially open parcels make up another 955 acres or 9% of the watershed. Developed parcels account for the remaining 1,555 acres or 15% of the watershed. Most open and partially open parcels are located on agricultural land and open space along stream corridors.

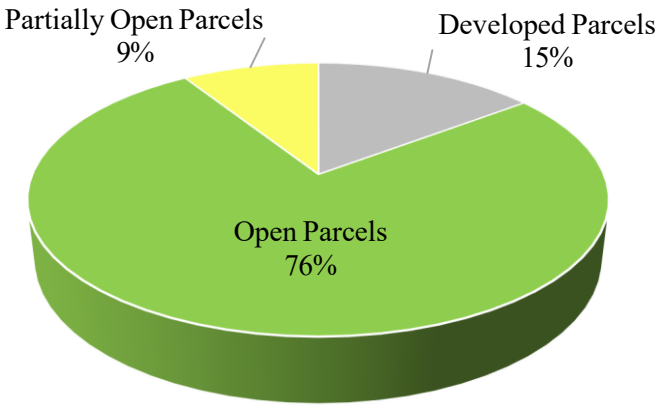
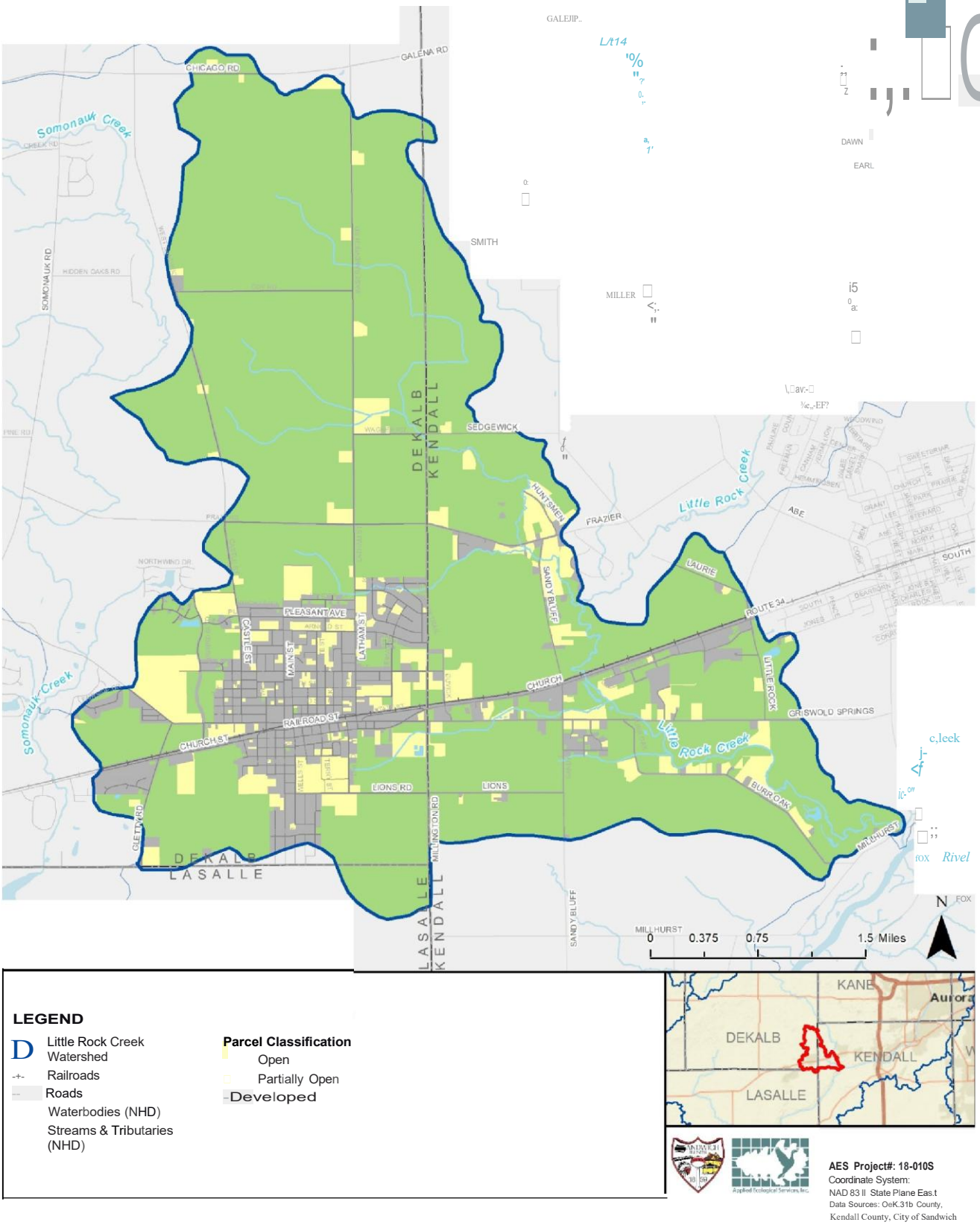


Figure 25. Distribution of open, partially open, and developed parcels.

LITTLE ROCK CREEK WATERSHED

Figure 26: Open, Partially Open and Developed Parcels



LEGEND

- D Little Rock Creek Watershed
- -+- Railroads
- Roads
- Waterbodies (NHD)
- Streams & Tributaries (NHD)

Parcel Classification

- Open
- Partially Open
- Developed

AES Project#: 18-010S
Coordinate System:
NAD 83 Il State Plane Eas.t
Data Sources: OeK.31b County, Kendall County, City of Sandwich

Public/Private Ownership of Open and Partially Open Parcels

The public or private ownership of each open and partially open parcel was determined from available parcel data. Developed parcels are not included in this summary. Publicly owned parcels include those owned by state, county, township, or municipal government or school districts. Public open and partially open parcels account for 2% and 3% of the open and partially open acreage respectively (Figures 27 & 29). Private ownership types include homeowners/business associations, commercial, residential, agricultural, etc. Private open parcels comprise 87% of the open and partially open acreage whereas private partially open parcels comprise 8% (Figures 27 & 29). Public open and partially open parcels are owned by county forest preserves, park districts, and municipalities.

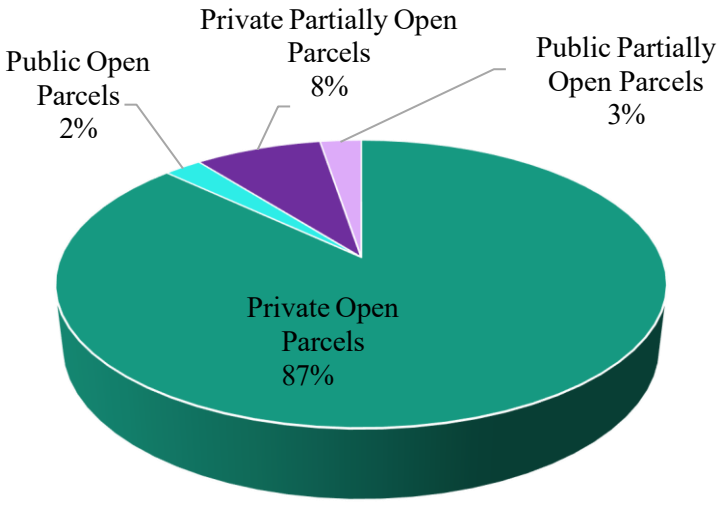


Figure 27. Distribution of private and public open and partially open parcels.

Protected Status of Open and Partially Open Parcels

Preservation of open space is critical to maintaining and expanding green infrastructure and is an important component of sustaining water quality, hydrological processes, ecological function, and the general quality of life for both wildlife and people. Without preservation, open space can be converted to other less desirable land uses in the future. Protected open and partially open parcels account for about 6% of the open and partially open parcel acreage in the watershed while unprotected open and partially open parcels account for the remaining 94% (Figures 28 & 30). Most protected open or partially open parcels are owned by county forest preserves, park districts, and municipalities.

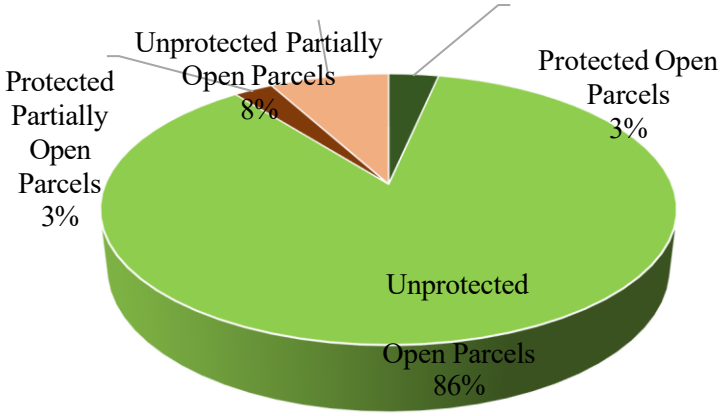


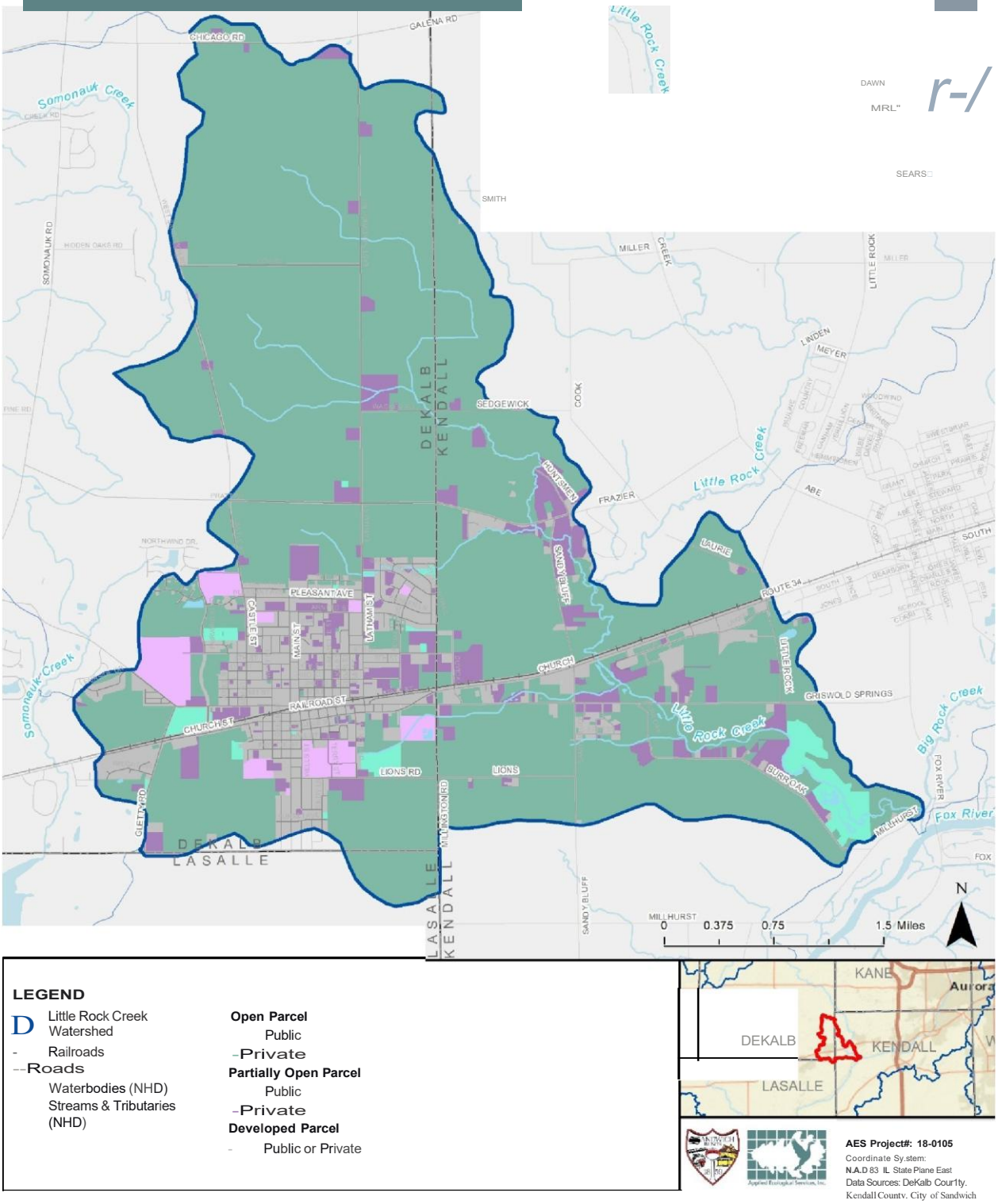
Figure 28. Distribution of protected and unprotected open and partially open parcels.

The most critical unprotected open and partially open parcels include undeveloped agricultural land and the open space areas along Little Rock Creek and its tributaries. Many of these areas are currently open space connected or adjacent to other green infrastructure. Future development that incorporates conservation design and/or Stormwater Treatment Train systems will be extremely

important in these areas to improve water quality and reduce stormwater runoff volume to an already stressed Little Rock Creek.

LITTLE ROCK CREEK WATERSHED

Figure 29· Public vs, Private Ownership of Open or Partially Open Parcels



LEGEND

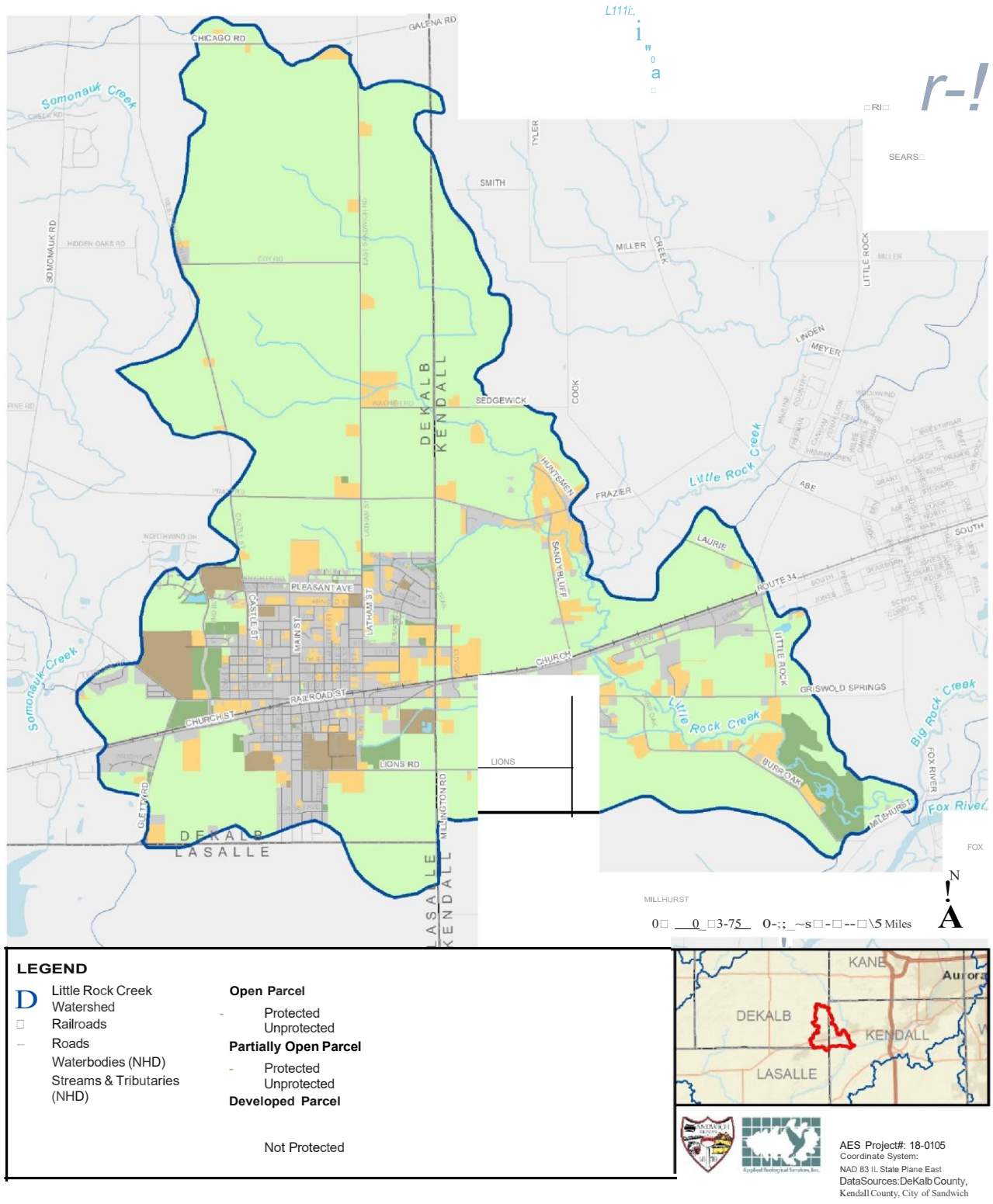
D Little Rock Creek Watershed
- Railroads
--Roads
Waterbodies (NHD)
Streams & Tributaries (NHD)

Open Parcel
Public
-Private
Partially Open Parcel
Public
-Private
Developed Parcel
- Public or Private

AES Project#: 18-0105
Coordinate Sy.stem:
N.A.D 83 IL State Plane East
Data Sources: DeKalb Cour1ty.
Kendall Countv. City of Sandwich

LITTLE ROCK CREEK WATERSHED

Figure 30: Protection Status of Open and Partially Open Parcels



LEGEND

- D Little Rock Creek Watershed
- Railroads
- Roads
- Waterbodies (NHD)
- Streams & Tributaries (NHD)

Open Parcel

- Protected
- Unprotected

Partially Open Parcel

- Protected
- Unprotected

Developed Parcel

- Not Protected

AES Project#: 18-0105
Coordinate System:
NAD 83 IL State Plane East
DataSources:DeKalb County, Kendall County, City of Sandwich

Open Space Parcel Prioritization

Step 2 in creating a Green Infrastructure Network for Lower Little Rock Creek watershed was completed by prioritizing open and partially open parcels. For this step, 11 prioritization criteria important to green infrastructure were examined via a GIS analysis (Table 14). If an open or partially open parcel met a criterion it received one point. If the parcel did not meet that criterion, it did not receive a point. This process was repeated for each open and partially open parcel and for all criteria. The prioritization process was not completed for developed parcels. The total points received for each parcel were summed to determine parcel prioritization within the Green Infrastructure Network - parcels with the highest number of points being more important to green infrastructure than parcels that met fewer criteria.

The combined highest possible total of points any one parcel could accumulate was 11 (11 of 11 total criteria met). The highest actual total value received by a parcel in the weighting process was 8 (having met 8 of the 11 criteria). After completion of the prioritization, parcels were categorized as "High Priority," "Medium Priority," or "Low Priority" based on point totals. Parcels meeting 6-8 of the criteria were designated High Priority for inclusion into the Green Infrastructure Network while parcels meeting 4-5 criteria were designated Medium Priority. Parcels with a combined value of 0-3 were categorized as Low Priority but were not necessarily excluded from the Green Infrastructure Network based on their location or position as linking parcels.

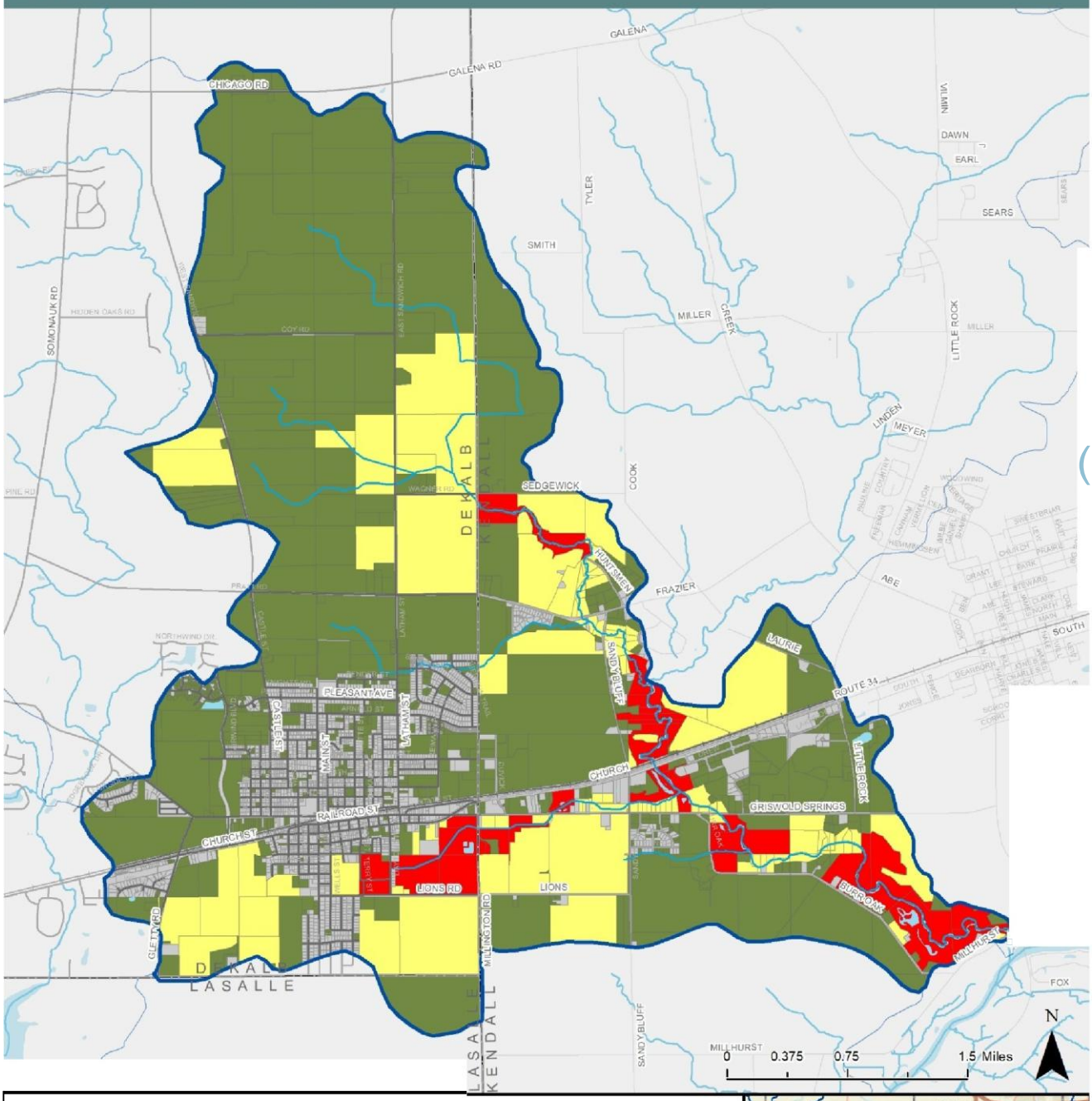
Figure 31 depicts the results of the parcel prioritization. The Green Infrastructure Network for the Lower Little Rock Creek watershed follows the existing streams and tributaries and upstream or headwater wetland areas. The High Priority parcels typically include parks, natural areas, and riparian areas along the lowest reaches of Little Rock Creek. Many of the Medium Priority parcels intersect tributary streams or wetlands. Low Priority parcels are generally isolated from other natural features and include many privately-owned agricultural parcels in upland areas.

Table 14. Criteria used to prioritize parcels for a Green Infrastructure Network.

Green Infrastructure Criteria
1. Open or partially open parcels that intersect FEMA 100-year floodplain
2. Open or partially open parcels within 0.5-miles of any headwater stream
3. Open or partially open parcels that intersect a wetland
4. Open or partially open parcels that include a potentially restorable wetland
5. Open or partially open parcels equal to or greater than 10 acres
6. Open or partially open parcels that are within 100 feet of a stream or significant open water
7. Open or partially open parcels in a "Highly Vulnerable" Land Use/Land Cover SMU
8. Open or partially open parcels adjacent to or including private or public protected open space
9. Open or partially open parcels managed by the DeKalb or Kendall County Forest Preserve District or a local park district.
10. Open or partially open parcels that intersect existing trails
11. Open or partially open parcels that include or intersect an "Important Natural Area"

LITTLE ROCK CREEK WATERSHED

Figure 31: Open Space Parcel Prioritization

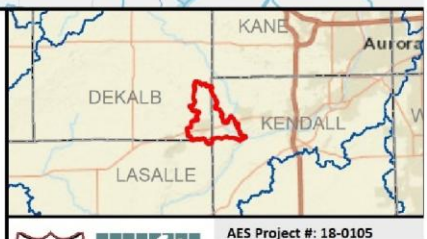


LEGEND

- D Little Rock Creek Watershed
- ------- Railroads
- --Roads
- Waterbodies (NHD)
- --Streams
- D Adjacent Watersheds

Parcel Prioritization Points

- o - 3 Low Priority
- 4 - 5 Medium Priority
- 6 - 8 High Priority
- Developed Parcel



AES Project #: 18-0105

Coordinate System:
NAD 83 IL State Plane East
Data Sources: DeKalb County, Kendall County, City of Sandwich

Green Infrastructure Network

The final step (Step 3) in creating a Green Infrastructure Network for Lower Little Rock Creek watershed involves laying out the network by incorporating: 1) prioritized open space results from Steps 1 & 2, 2) information gathered during the watershed resource field inventory conducted by AES, and 3) stakeholder recommendations. County and region-wide green infrastructure plans generally focus on natural features such as stream corridors, wetlands, floodplain, buffers, and other natural components. The Green Infrastructure Network created for Lower Little Rock watershed captures all the natural components and other green infrastructure such as recreational parks, large residential lots, municipal land, and some riparian areas at the parcel level. Parcel level green infrastructure planning is important because land purchases, acquisitions, and land use changes almost always occur at the parcel level. A Green Infrastructure Network for Lower Little Rock Creek watershed is illustrated on Figure 33.

Perhaps the most important aspect of green infrastructure planning is that it helps communities identify and prioritize conservation opportunities and plan development in ways that optimize the use of land to meet the needs of people and nature (Benedict, 2006). Green infrastructure planning provides a framework for future growth that identifies areas not suitable for development, areas suitable for development but which should incorporate conservation design or low impact development standards, and areas that do not affect green infrastructure.

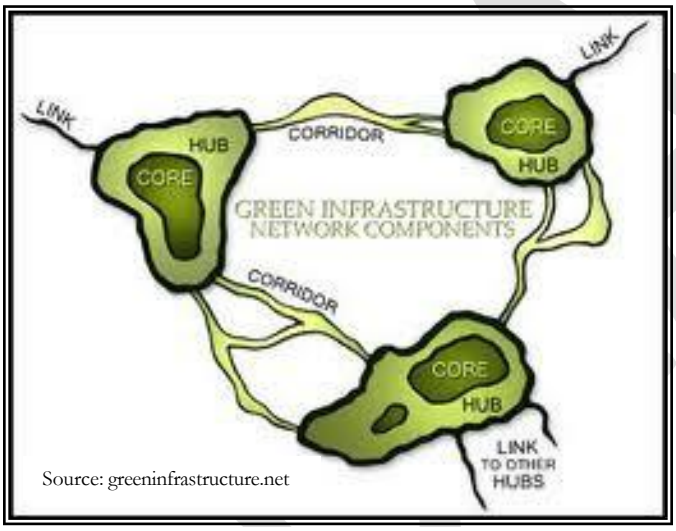


Figure 32. Green Infrastructure components

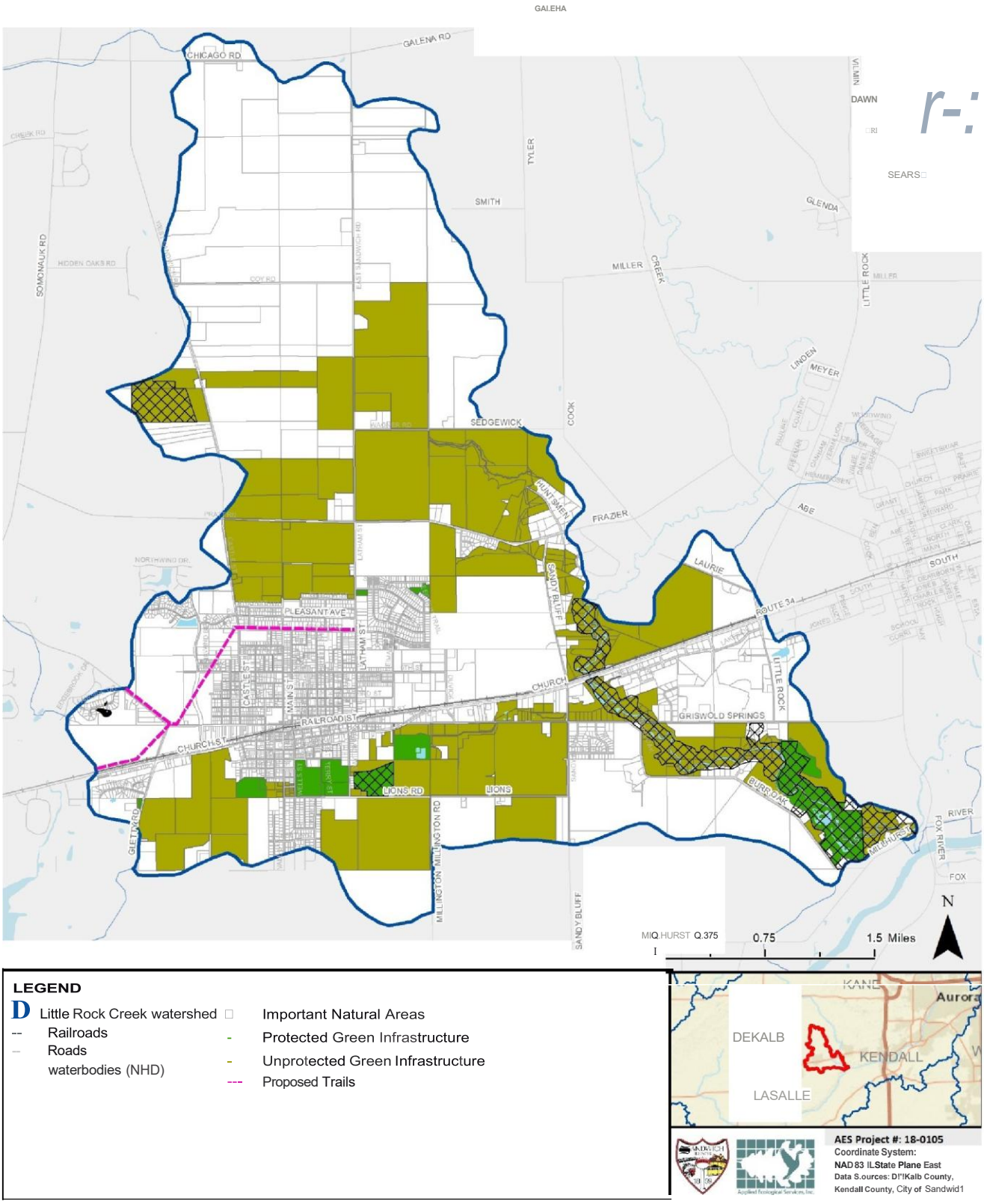
A Green Infrastructure Network is a connected system of *Hubs* and linking *Corridors* (Figure 32). Hubs generally consist of the largest and least fragmented areas such as Little Rock Creek Forest Preserve, Harvey Creek Conservation Area, the intact riparian areas along the lower reaches of Little Rock Creek, and several agricultural areas. Corridors are generally formed by smaller private/ unprotected parcels along developed reaches of Little Rock Creek and tributaries. Corridors are extremely important because they provide biological conduits between hubs. However, most parcels forming corridors are not ideal green infrastructure until landowners, businesses, and farmers embrace the idea of managing stream corridors. In total, the Green Infrastructure Network for Lower Little Rock Creek watershed encompasses 3,501 acres (239 parcels), of which 291 acres (8%) are protected.

While not part of the Green Infrastructure Network identified for Lower Little Rock Creek watershed, a small portion of the Edgebrook Country Club (an 18-hole regulation course) falls within the southwestern portion of the watershed.

The Action Plan section of this report contains recommendations for implementing the Green Infrastructure Network.

LITTLE ROCK CREEK WATERSHED

Figure 33: Green Infrastructure Network



3.12 Important Natural Areas

For this watershed plan, "Important Natural Areas" include protected woodlands within Kendall County Forest Preserve District and Sandwich Park District (Table 15; Figure 34). Important Natural Areas provide greenway corridors that interconnect land and waterways, support native species, maintain natural ecological processes, and contribute to the health and quality of life for communities and people. Several Important Natural Areas are located in the watershed including a forest preserves and city owned park.

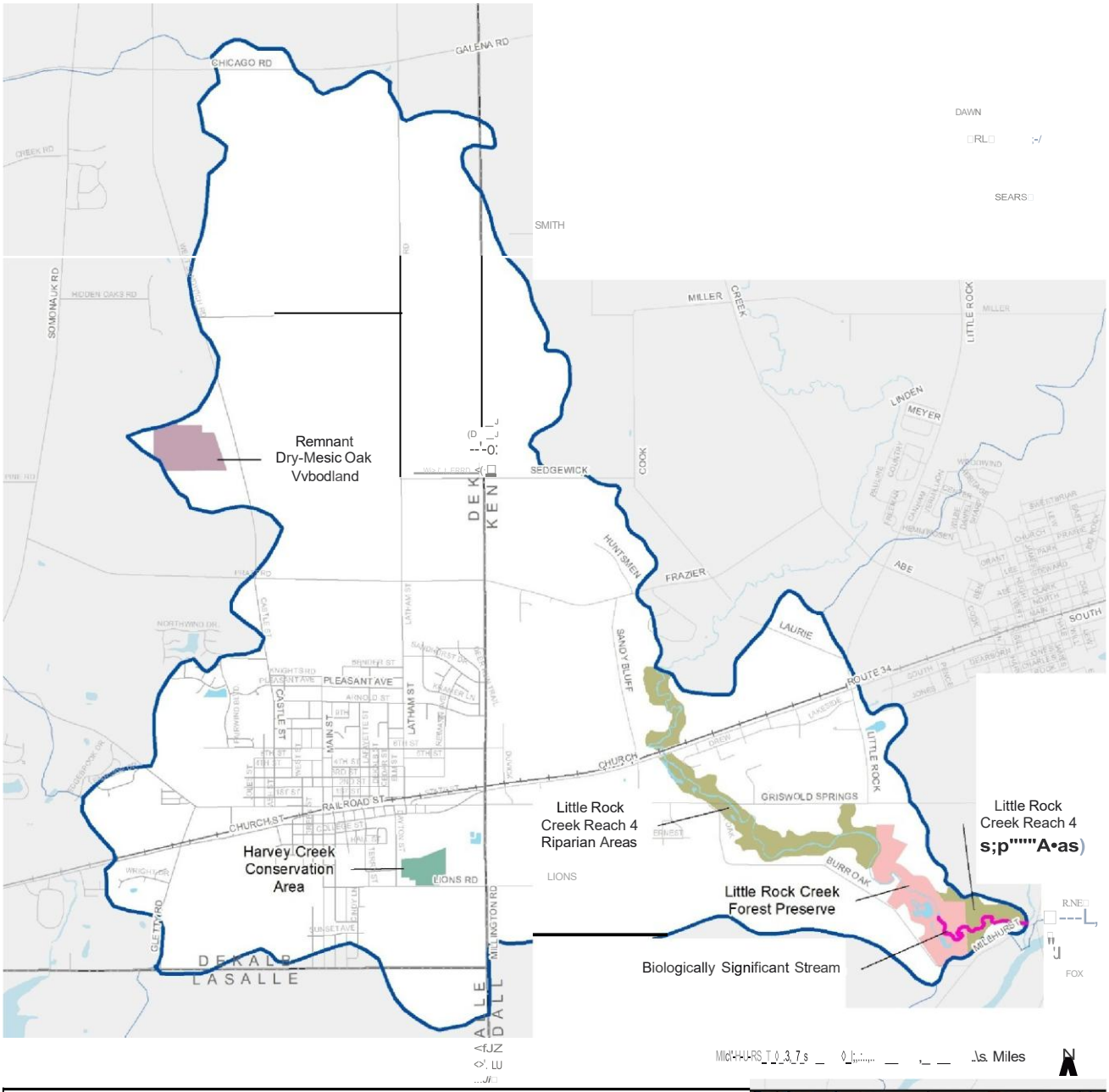
Table 15. Important Natural Areas summary data.

Natural Area	Size (ac/lf)	Description
Kendall County Forest Preserve District		
Little Rock Creek Forest Preserve	133 ac	Mesic and floodplain oak woodland along 1.3 miles of a high-quality section of Little Rock Creek
Portion of Little Rock Creek Reach 2	4,600 lf	Downstream-most 4,600 linear feet classified as a Biologically Significant Stream by IDNR
Sandwich Park District		
Harvey Creek Conservation Area	30 ac	Restored wetland and prairie park with a walking path.
Other Open Spaces		
Little Rock Creek Reach 1 and 2 Riparian Areas	237 ac	High quality sections of Little Rock Creek and oak woodland riparian area
Dry-Mesic Oak Woodland	68 ac	Dry-mesic oak woodland

Signage at Little Rock Creek Forest Preserve

LITTLE ROCK CREEK WATERSHED

Figure 34: Important Natural Areas

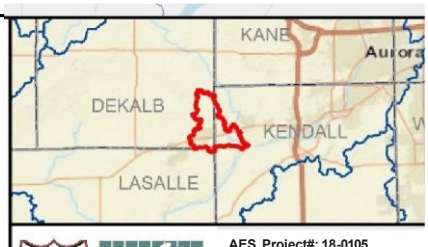


LEGEND

D Little Rock Creek Watershed **Important Natural Areas**

-+- Railroads
-- Roads
Waterbodies (NHD)

- Harvey Creek Conservation Area
Little Rock Creek Forest Preserve
- Little Rock Creek Reach 4 Riparian Areas
- Remnant Dry-Mesic Oak Woodland
-- Biologically Significant Streams



AES Project#: 18-0105
Coordinate System:
NAD 83 ILState Plane East
Oata Sources: DeK;:ilb County,
Kendall County, City of Sandwich

Forest Preserves

The Kendall County Forest Preserve District purchased the 133-acre Little Rock Forest Preserve in 2018 and was opened to the public in June of 2019. Prior to the purchase, the property was used as a boy scout camp. The preserve sits within a steep valley along 1.3 miles of Little Rock Creek (Reach 2) and is adjacent to Maramech Forest Preserve. The floodplain shelf is comprised of oak, sycamores and hackberry. The steep slopes consist of a mesic-oak woodland with red, white, and chinkapin oak trees, sugar maple, and basswood.

Little Rock Creek Forest Preserve

The downstream-most 4,600 linear feet of Little Rock Creek Reach 2 through the forest preserve is graded as a "Class B" stream by the Illinois Department of Natural Resources for Integrity Ratings and Diversity (IDNR 2008). The Integrity Rating measures the system's biological wholeness and the ability of a system to support organisms and processes comparable to natural habitat of the region (IDNR 2008). Little Rock Creek Forest Preserve scored 42/50 with 26 species of fish identified in the creek (Forest Foundation of Kendall County, 2020). Only 2.7% of total valley segments within the state receive a rating (IDNR 2008). Little Rock Creek is also classed as a Biologically Significant Stream. Biologically Significant Streams have a high diversity or integrity rating for at least two taxonomic group (fish, aquatic macroinvertebrates, and/or mussels) (IDNR 2008).

Sandwich Park District

Harvey Creek Conservation area is a 30-acre park with restored wetlands and prairies. A paved circular walking path with interpretive signs and picnic area provides recreational opportunities for visitors.

Harvey Creek Conservation Area

Other Open Space

Little Rock Creek Reaches 1 and 2 are located upstream and downstream of Little Rock Creek Forest Preserve. Like Little Rock Creek Forest Preserve, Reach 1 sits in a steep valley with a wide floodplain. High quality tree species such as sycamore, oak, and hackberry comprise the vegetation on the floodplain shelf, however, woody, weedy species such as American elm, sugar maple, buckthorn, and honeysuckle are beginning to dominate. The slopes are dominated by high quality mesic woodland species including bur oak, red oak, and chinkapin oak,

sugar maple, and basswood.

A large plot of remnant dry-mesic oak woodland is located west of West Sandwich Road and north of Pratt Road. The woodland is located on private land and consists of old growth oaks. Historically, this woodland exhibited a relatively open canopy with lush ground layer vegetation that was maintained by frequent fires prior to European settlement in the 1840s. In the last 150+ years, many second growth woody species such as maple, basswood, elm and invasive honeysuckle and buckthorn has become dominant leading to heavily shaded conditions that limits ground layer vegetation growth and more importantly, regeneration of oak trees. Significant canopy tree thinning, removal of invasive shrubs, seeding of ground layer, and reintroduction of fire is essential to improve the long-term health of this woodland.

Dry-mesic Oak Woodland west of West Sandwich Rd

About two thirds of the riparian areas of Little Rock Creek Reach 2 fall within Little Rock Creek Forest Preserve. Throughout this reach the riparian area is comprised of oak, sycamores, and hackberry. The steep slopes consist of a mesic-oak woodland with red, white, and chinkapin oak trees, sugar maple, and basswood.

3.13 Watershed Drainage System

3.13.1 Little Rock Creek & Tributaries

Little Rock Creek and Little Rock Creek tributary are the two primary streams in Lower Little Rock Creek watershed with 3 tributary streams accounting for approximately 10.6 stream and tributary miles. (Table 16; Figure 35) Little Rock Creek tributary begin as an channelized ditch in agriculture fields north of Wagner Road and flows southeast for 3.4 miles where it meets Little Rock Creek south of Woodland Drive. The studied portion of Little Rock Creek begins at the convergence of Little Rock Creek and Little Rock Creek Tributary; however, the creek begins as an agriculture ditch near Afton Center and flow south approximately 38 miles before converging with Little Rock Creek Tributary. Little Rock Creek flows from the convergence southeast in a steep valley for 4.5 miles of privately owned and Little Rock Creek Forest Preserve property that contains a wide floodplain shelf of oaks (*Quercus* species), sycamore (*Celtis occidentalis*), and hackberries (*Celtis occidentalis)* with mesic oak woodland side slopes. From there it exits the watershed and enters Big Rock Creek and the Fox River. There are no lakes in the watershed.

Grass swale headwaters of Little Rock Creek Tributary

Table 16. Summary of Little Rock Creek and tributary reaches and length.

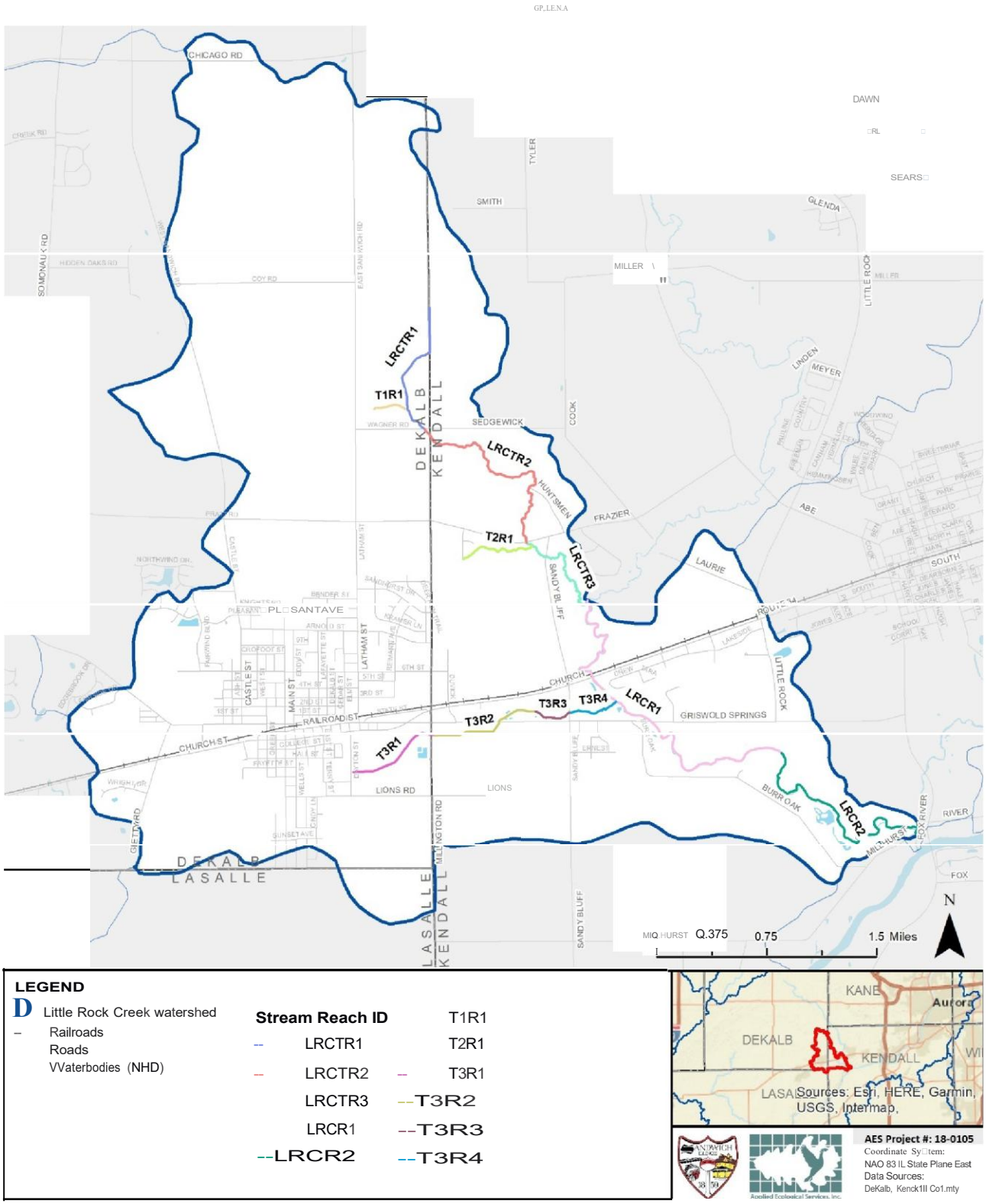
Stream or Tributary Name	Abbreviation	Number of Reaches	Stream Length Assessed (ft)	Stream Length Assessed (mi)
Little Rock Creek	LRC	2	23,528	4.5
Little Rock Creek Tributary	LRCT	3	18,150	3.4
Tributary 1	Trib1	1	1,282	0.2
Tributary 2	Trib2	1	2,883	0.5
Tributary 3 (Harvey Creek)	Trib3	4	10,749	2
Totals		**11**	**56,592**	**10.6**

Note: Illinois EPA does not monitor to the level of detail included in this plan. A localized waterbody code system was developed for this plan and therefore, the codes used are not found in the Illinois EPA's *Illinois Integrated Water Quality Report and Section 303d List.*

In Fall of 2019, Applied Ecological Services, Inc. (AES) completed a field inventory of Little Rock Creek and its tributaries. All streams and tributaries were assessed based on divisions into "Stream Reaches" (Table 16; Figure 35). Reaches are defined as stream segments having similar hydraulic, geomorphic, riparian condition, and adjacent land use characteristics. Methodology included walking all or portions of the stream and tributary reaches, collecting measurements, taking photos, and noting channel, streambank, and riparian corridor conditions on Stream Inventory/BMP Data Forms.

LITTLE ROCK CREEK WATERSHED

Figure 35: Stream Reaches



LEGEND

D Little Rock Creek watershed
– Railroads
Roads
VWaterbodies (NHD)

Stream Reach ID	
-- LRCTR1	T1R1
LRCTR2	T2R1
LRCTR3	T3R1
LRCR1	T3R2
--LRCR2	T3R3
	T3R4

Applied Ecological Services, Inc.

AES Project #: 18-0105
Coordinate System:
NAO 83 IL State Plane East
Data Sources:
DeKalb, Kenck1Il Co1.mty

Little Rock Creek Tributary

Little Rock Creek Tributary begins as a channelized ditch that drains agriculture fields north of Wagner Road. Reach 1 (LRCTR1) and flows 5,157 linear feet through a narrow weedy, wetland vegetated buffer before transitioning to second growth, weedy trees such as box elder (*Acer negundo*), willow (*Salix* species), buckthorn (*Rhamnus cathartica*), and honeysuckle (*Lonicera tatarica*) at Reach 2 (LECTR2). Reach 2 is 8,642 linear feet and runs southeast from Wagner Road to Frazier Road in a natural channel. At Frazier Road Little Rock Creek Tributary (Reach 3, LRCTR3) enters a degraded oak savannah/woodland and marsh/sedge meadows and flows for 4,351 linear feet to the convergence with Little Rock Creek.

LRCTR Reach 1

LRCTR Reach 2

LRCTR Reach 3

Little Rock Creek

Little Rock Creek (Reach Code LRC) was divided into 3 distinct "Stream Reaches" beginning at the convergence of Little Rock Creek and Little Rock Creek Tributary and ending at Big Rock Creek (Table 16; Figure 35).

LRC Reach 4

Little Rock Creek Reach 1 and 2 (LRCR1 & LRCR2) are similar reaches. Reach 1 begins where Little Rock Creek and Little Rock Creek tributary converge south of Woodland Drive. Reach 1 winds southeast through approximately 14,071 linear feet within a steep valley of privately-owned woodlands comprised of high quality trees such as sycamore (*Platanus occidentalis*), burr oak (*Quercus macrocarpa*), and hackberry (*Celtis occidentalis*) and woody weedy species such as honeysuckle (*Lonicera tatarica*), American elm (*Ulmus americana*), and sugar maple (*Acer saccharum*). A mesic oak woodland containing burr oak (*Quercus macrocarpa*), red oak (*Quercus rubra*), and chinkapin oak (*Quercus muehlenbergii*) dominates the steep side slopes. Reach 2 is similarly vegetated with steep side slopes and flows through Little Rock Creek Forest Preserve beginning east of Oaks Meadows Court. Reach 2 flows 9,457 linear feet through a breached dam before emptying into Big Rock Creek. Both reaches have natural stream channels with moderate erosion.

Tributary Streams

Three (3) tributary streams are found in the watershed (Table 16; Figure 35). A brief description of each tributary stream is included below.

Tributary 1 (Trib01): This tributary flows for 1,282 linear feet east from E. Sandwich Road east to Little Rock Creek Tributary. It consists of a narrow, channelized ditch which drains agricultural fields and a horse farm.

Tributary 2 (Trib02): This 2,883-linear foot tributary flows north though a natural channel in a wide riparian buffer consisting of old field vegetation (primarily brome grasses and scattered second growth trees) upstream and overgrazed horse pastures downstream.

Tributary 2 *Tributary 3*

Tributary 3 (Trib03), also known as Harvey Creek: Tributary 3, known locally as Harvey Creek, contains four reaches totaling 10,749 linear feet. The channelized Reach 1 begins at Dayton Street and travels northeast through cattail and *Phragmites* marshes in the Harvey Creek Conservation Area and the Sandwich Wastewater Treatment facility. At a private drive south of Griswold Spring Road, Tributary 3 transitions to old field vegetation and second growth trees. The tributary then enters an overgrazed cattle pasture before crossing under Sandy Bluff Road into a steep valley with mesic oak vegetation before entering Little Rock Creek.

Stream Channelization

Naturally meandering streams generally provide riffles and pools that benefit the system by providing various habitats while oxygenating the water during low flow or summer heat. Channelized or ditched streams are often void of or have low-quality riffles and pools. Berms are also common along channelized streams where landowners spoiled soils excavated from the channel. These spoil piles often inhibit natural flooding into adjacent floodplains.

Each stream reach in the watershed was characterized as either having none or low channelization (highly sinuous, no human disturbance), moderate channelization (some sinuosity but altered), or highly channelized (straightened by humans) (Table 17; Figure 36). According to the stream inventory, 72% (40,776 lf) of stream and tributary length is naturally meandering; approximately 11% (5,982 lf) is moderately channelized; 17% (9,834 lf) is highly channelized. The most severe channelization is found on Reach one of Little Rock Creek Tributary and the tributaries 1 and 3, reach 1 where the reaches flow through croplands where agricultural ditching practices are common.

Channelization along Tributary 3 Reach 1

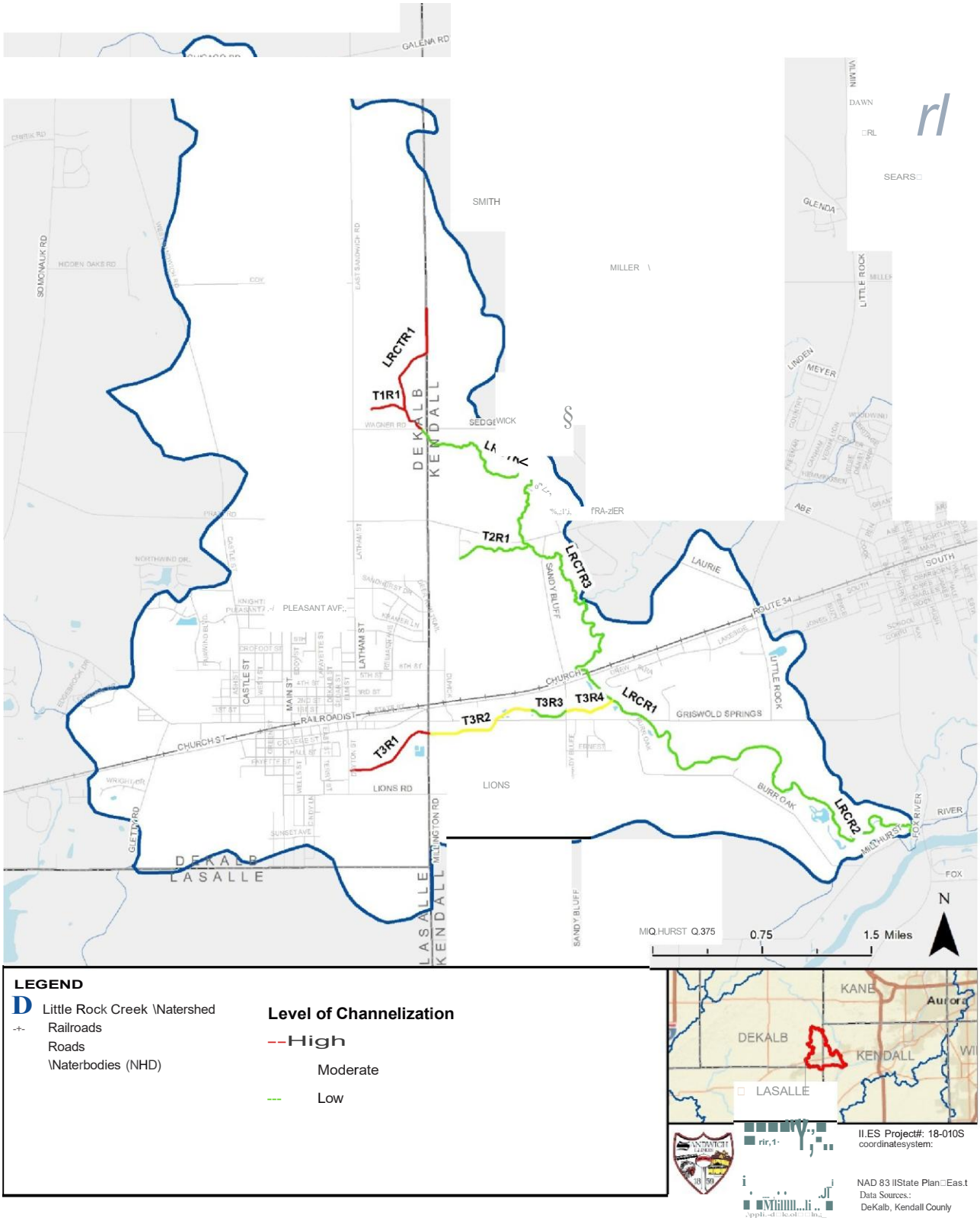
Channelized areas present opportunities for Management Measure projects such as artificial riffle and pool restoration and regrading or breaking of adjacent spoil piles for reconnection of the stream to adjacent floodplains. The Action Plan section of this report addresses opportunities for improving many of the channelized stream reaches.

Table 17. Summary of stream and tributary channelization.

Stream or Tributary Name	Abbrev.	Stream Length Assessed (ft)	None or Low Channelization		Moderate Channelization		High Channelization	
			(feet)	(%)	(feet)	(%)	(feet)	(%)
Little Rock Creek	LRC	23,528	23,528	100%	0	-	0	-
Little Rock Creek Tributary	LRCTR	18,150	12,993	72%	0	-	5,157	28%
Tributary 1	T1	1,282	0	-	0	-	1,282	100%
Tributary 2	T2	2,883	2,883	100%	0	-	0	-
Tributary 3	T3	10,749	1,312	12%	5,982	56%	3,395	32%
Totals		**56,592**	**40,716**	**72%**	**5,982**	**11%**	**9,834**	**17%**

LITTLE ROCK CREEK WATERSHED

Figure 36: Stream Channel,zatwn



Streambank Erosion

Unnatural streambank erosion generally results following an instability in flow rate or volume in the stream channel, human alteration such as channelization, or change in streambank vegetation. Resulting sediment accumulation and transportation downstream can cause significant water quality problems. Streambank erosion is moderate or average in the southern portion of the watershed and is a reflection of increased impervious cover and stormwater runoff within the developed areas.

The location and severity of streambank erosion in the watershed is summarized in Table 18 and depicted on Figure 37. Approximately 53% (29,796 lf) of the total stream and tributary length exhibits no or low bank erosion while moderate erosion is occurring along 47% (26,797 lf) of streambanks. There were no highly eroded streambanks within the watershed.

Moderately eroded streambank along LRC Reach 2

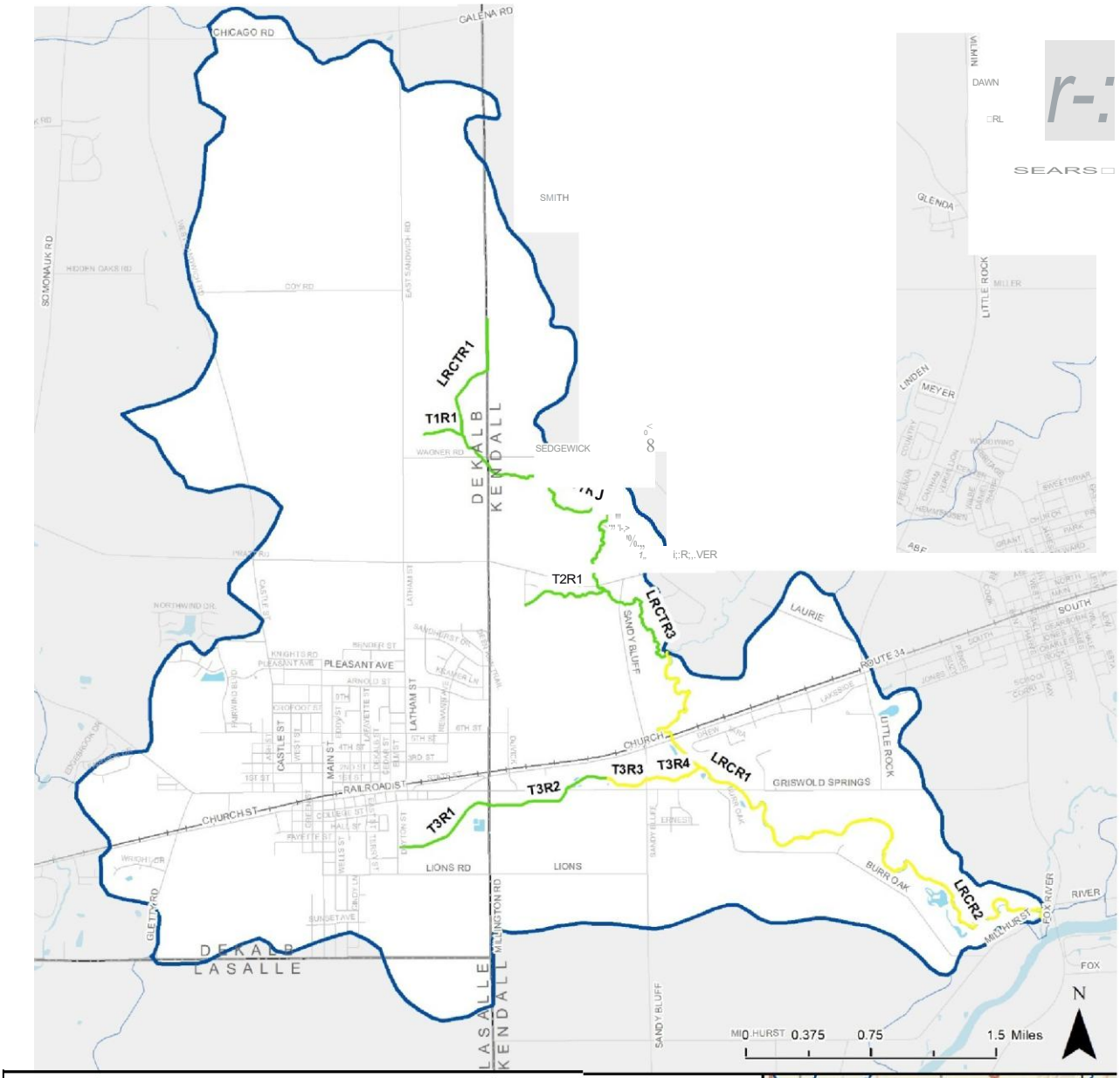
Some moderately eroded streambanks provide excellent opportunities for streambank stabilization projects. The Action Plan section of this report addresses and prioritizes opportunities for reducing streambank erosion.

Table 18. Summary of stream and tributary bank erosion.

Stream or Tributary Name	Abbreviation	Stream Length Assessed (ft)	None or Low Erosion		Moderate Erosion		High Erosion	
			(feet)	(%)	(feet)	(%)	(feet)	(%)
Little Rock Creek	LRC	23,528	0	-	23,528	100%	0	-
Little Rock Creek Tributary	LRCTR	18,150	18,150	100%	0	0%	0	-
Tributary 1	T1	1,282	1,282	100%	0	0%	0	-
Tributary 2	T2	2,883	2,883	100%	0	0%	0	-
Tributary 3	T3	10,749	7,481	70%	3268	30%	0	-
Totals		**56,592**	**29,796**	**53%**	**26,796**	**47%**	**0**	**0**

LITTLE ROCK CREEK WATERSHED

Figure 37: Streambank Erasion

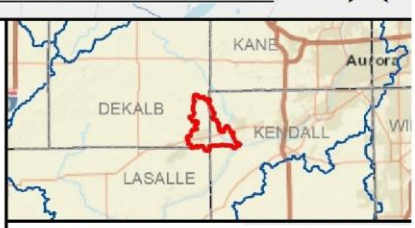


LEGEND

- Little Rock Creek Watershed
- Railroads
- Roads
- Waterbodies (NHD)

Level of Erosion

- Moderate
- Low



AES ProjMt #: 18-0105
Coordinate System:
NAD83 IL State Plane East
Data Source:
DeKalb, Kendall County

Riparian Area Condition

Riparian areas buffer streams by filtering pollutants, providing beneficial wildlife habitat, and connecting green infrastructure. Riparian areas along streams and tributaries were assessed during the stream inventory by noting the "Condition" as it relates to function and quality of plant communities present. Areas in "Good" condition connect hydrologically with streams and tributaries during flood events and have remnant or restored wetland plant communities. "Average" condition riparian areas retain some hydrological connection to the adjacent stream with somewhat degraded plant communities. Areas in "Poor" condition are usually found along channelized streams that have been heavily farmed in the past causing degraded plant communities to establish.

The location and condition of riparian areas in the watershed is summarized in Table 19 and Figure 38. Approximately 29% (along 16,453 linear feet of streams) of the riparian areas are "Poor" quality. Of the remaining reaches, 16,611 linear feet or 29% of riparian areas are in "Moderate" condition and 42% (23,528 linear feet) are in good condition.

Degraded riparian area at Little Rock Creek Tributary, Reach 1

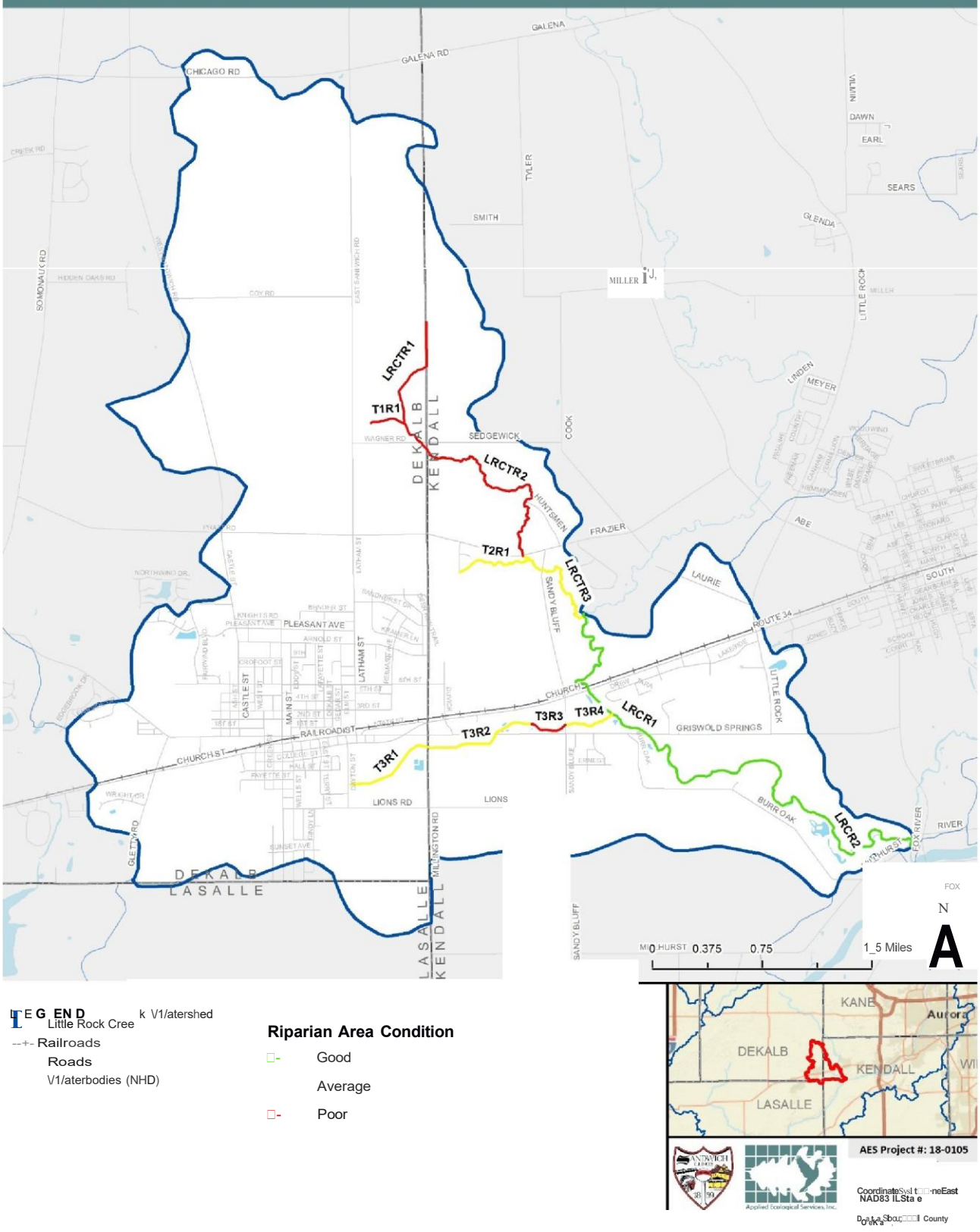
Riparian areas in "Good" condition included undeveloped areas within a steep, natural valley and wide, natural buffers. Riparian areas in "Moderate" condition were typically found along tributaries where farming is no longer practiced within the buffer due to residential development or conversion to natural areas. "Poor" riparian areas are found throughout the watershed; these correlate closely with stream reaches that are highly channelized and more typical agricultural patterns. Invasive species including common reed (*Phragmites australis*), reed canary grass (*Phalaris arundinacea*), common buckthorn (*Rhamnus cathartica*), and box elder (*Acer negundo*) contribute most to degraded conditions. Fortunately, ecological restoration helps eradicate these species and encourages native plant establishment. The Action Plan lists and prioritizes opportunities for improving riparian areas.

Table 19. Summary of stream and tributary area riparian condition.

Stream or Tributary Name	Abbreviation	Stream Length Assessed (ft)	Good Condition		Average Condition		Poor Condition	
			(feet)	(%)	(feet)	(%)	(feet)	(%)
Little Rock Creek	LRC	23,528	23,528	100%	-	0%	-	0%
Little Rock Creek Tributary	LRCTR	18,150	-	0%	4,351	24%	13,799	76%
Tributary 1	T1	1,282	-	0%	-	0%	1,282	100%
Tributary 2	T2	2,883	-	0%	2,883	100%	-	0%
Tributary 3	T3	10,749	-	0%	9,377	0%	1,372	13%
Totals		**56,592**	**23,528**	**42%**	**16,611**	**29%**	**16,453**	**29%**

LITTLE ROCK CREEK WATERSHED

Figure 38: Riparian Area Condition



LEGEND

- Little Rock Creek Watershed
- Railroads
- Roads
- Waterbodies (NHD)

Riparian Area Condition

- Good
- Average
- Poor

3.13.2 Detention Basins

Over the past 30+ years, the drainage system in the northern portions of Sandwich have changed from farmland driven drain tiles, channels, and ditches to one that is driven by runoff from developed areas. Planners and engineers quickly realized the benefits of storing stormwater runoff in detention basins near development. A detention basin is a human-made structure for the temporary storage of stormwater runoff with a controlled release rate. For example, the required controlled release rate for basins in the watershed is regulated by the DeKalb County Stormwater Ordinance between 0.2 and 0.15 cfs/acre for the 100-year frequency rain event. Detention basins can also provide excellent wildlife habitat and improve water quality if designed with the proper configuration, slopes, and water depths then planted with native prairie and wetland vegetation.

Detention basins can be designed and constructed as wet bottom, wetland bottom, or dry bottom and planted with various types of natural or manicured vegetation. Wet and wetland bottom basins typically hold water that is controlled by the elevation of the outlet structure. This design promotes water quality treatment and supports wildlife. Wet bottom basins are usually greater than 3 feet deep and do not have emergent vegetation throughout whereas wetland bottom detention basins are shallow enough to be dominated by emergent wetland plants. Dry bottom basins are designed to drain completely after temporarily storing stormwater following rain events. They can be planted to either turf grasses or naturalized with native species.

The Lower Little Rock Creek watershed has 20 known detention basins (Table 20; Figure 39). Applied Ecological Services, Inc. completed a basic assessment of each detention basin in fall 2019. Assessment methodology included a visit to each site and collection of data relevant to existing conditions. Detailed notes were recorded related to existing ecological/water quality improvement condition and potential retrofit Management Measures for eventual inclusion into the Action Plan section of this report. Results of the inventory and detailed summaries of each detention basin can be found in Appendix C.

The inventory resulted in 14 dry-bottom with turf grass and 6 naturalized wet/wetland bottom basins (Table 20). All of the detention basins in the watershed are located in and surrounding Sandwich. Additionally, of the 20 basins, none provide "Good" ecological and water quality benefits while 6 basins (30%) likely provide "Average" benefits. The remaining 14 basins (70%) likely provide "Poor" ecological and water quality benefits because most were designed simply to meet stormwater storage volume requirements. Designs that also improve water quality and wildlife habitat were not necessarily considered because they are not required under local and federal regulations.

Dry bottom detention basins are the most common type of basin in the watershed. Individual development sites tend to have basins that are all similarly planted. For example, dry bottom basins in a development are planted with turf grass along the basin slopes or are naturalized with native vegetation along the slopes and emergent edge. Basins planted with turf grass were designed with stormwater storage in mind and not necessarily the potential water quality and habitat benefits. Because of this, most homeowner and business associations will likely disapprove of installing water quality retrofits such as native plant buffers unless they can be designed to look formal and need minimal maintenance. All of the 6 wet and wetland bottom detention basins in the watershed are naturalized but due to poor maintenance, they are dominated by weedy and invasive vegetation. Like most dry bottom basins, the side slopes and emergent areas of wet and wetland bottom basins can be retrofitted with native vegetation relatively easily.

All of the dry bottom basins in the watershed are planted with turf grass, providing little to no water quality benefits, wildlife habitat, or infiltration to replenish groundwater. Dry bottom basins planted with turf grass hold water for shorter periods following rain events and infiltrate less water compared to dry bottom basins naturalized with deep rooted vegetation. Many of the dry bottom basins in the watershed present excellent retrofit opportunities. Most dry bottom basins are relatively easy to naturalize with native plantings and concrete structures and drains can be manipulated to store and infiltrate water as desired.

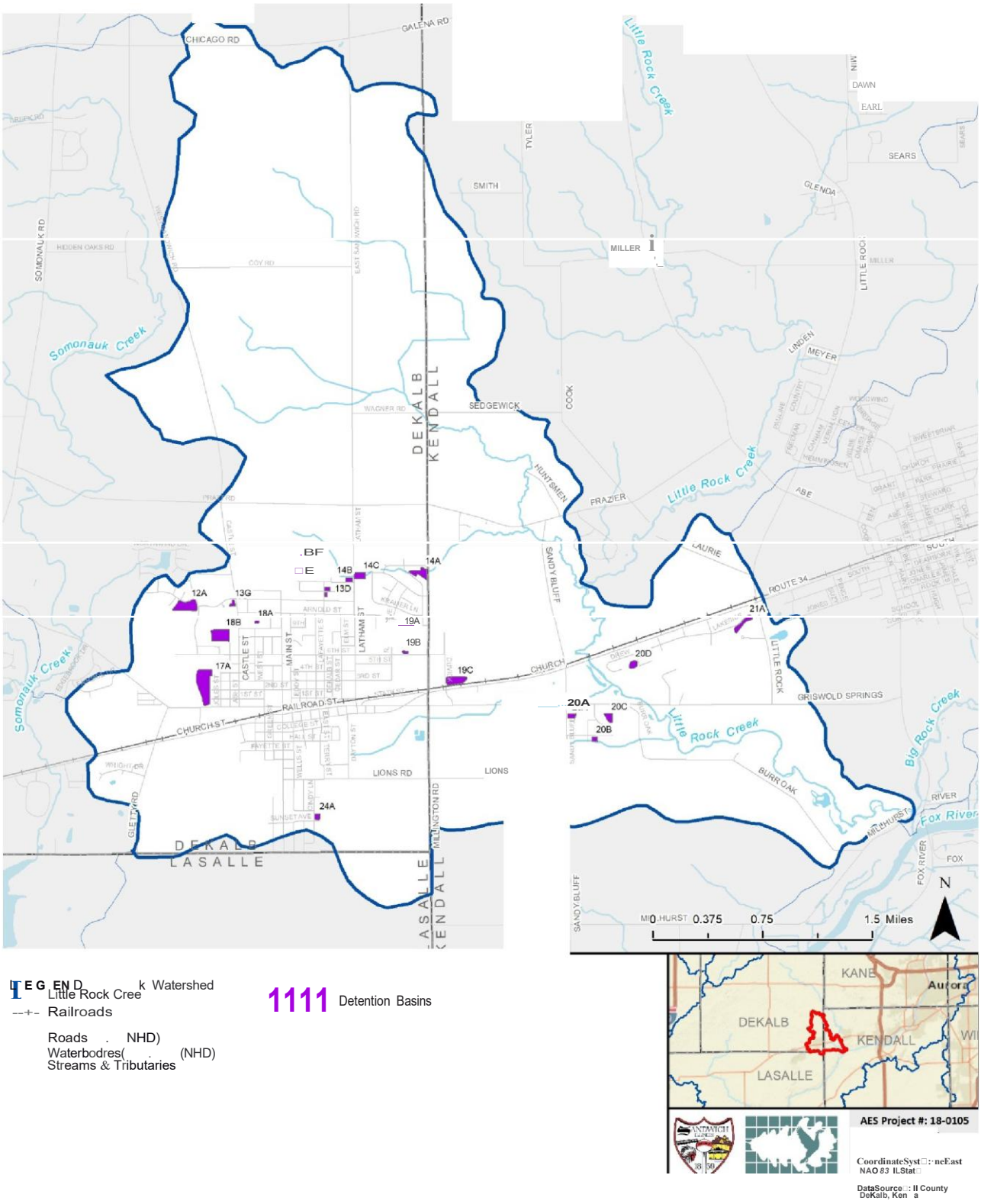
Typical dry bottom detention at N. Latham Street and Sandhurst Drive (14C)

Typical natural wet bottom detention at Northwestern Medicine Valley West Hospital (13F)

Table 20. Summary of detention basin types, ecological condition, and acreage.

AES ID	Basin Type	Ecological Condition	Size (Acres)
12A	Wet	Average	6.0
13D	Dry	Poor	0.9
13E	Dry	Poor	0.9
13F	Wet	Average	9.1
13G	Wet	Average	0.7
14A	Dry	Poor	3.2
14B	Dry	Poor	0.8
14C	Dry	Poor	2.0
17A	Dry	Poor	11.6
18A	Dry	Poor	0.3
18B	Dry	Poor	5.9
19A	Dry	Poor	1.1
19B	Wet	Average	0.4
19C	Wet	Average	4.2
20A	Dry	Poor	0.9
20B	Dry	Poor	0.7
20C	Dry	Poor	1.5
20D	Wetland	Average	1.5
21A	Dry	Poor	2.5
24A	Dry	Poor	0.8

LITTLE RO n Basins EK WATERSHED
Figure 3



LEGEND
Little Rock Cree k Watershed
Railroads
Roads . NHD)
Waterbodres(. (NHD)
Streams & Tributaries

1111 Detention Basins

3.13.3 Wetlands & Potential Wetland Restoration Sites

A diverse network of wetlands and wet prairie remained intact in Lower Little Rock Creek watershed until the late 1830s when European settlers began to alter significant portions of the watershed's natural hydrology and wetland processes. Where it was feasible, wet prairie, sedge meadow, and marsh communities were drained, streams were channelized, and existing vegetation cleared to farm the rich soils. There were approximately 1,776 acres of wetlands (16.8% of the watershed, based on hydric soils) in the watershed prior to European settlement based on the most up to date hydric soils mapping provided by the USDA Natural Resources Conservation Service (NRCS). According to existing wetland inventories, about 309 acres or 17% of the pre-European settlement wetlands remain (Figure 40).

Functional wetlands do more for water quality improvement and flood reduction than any other natural resource. In addition, intact wetlands typically provide habitat for a wide variety of plant and animal species. They also provide groundwater recharge, filter sediments and nutrients, and slowly discharge to streams thereby maintaining water levels in streams during drought periods. General wetland information and mapping is available for the Lower Little Rock Creek watershed via the United States Fish and Wildlife Service's (USFWS) National Wetland Inventory (NWI). Applied Ecological Services, Inc. updated the NWI wetland boundaries and noted the location of wetlands not included in the NWI during a field inventory of the watershed conducted in fall 2019. The wetland data collected during the field inventory was used to map and describe the existing wetlands in the watershed and to help locate potential wetland restoration sites.

Farmed wetland 3A

Most of the wetlands are farmed wetlands drained by tiles that are scattered about the agricultural areas of the watershed and were drained or degraded by farming practices at some point in the last 150 years to the extent that hydrology has changed and invasive species such as purple loosestrife (*Lythrum salicaria*), common and glossy buckthorn (*Rhamnus sp.),* reed canary grass (*Phalaris arundinacea*), and common reed (*Phragmites australis*) now dominate.

Neither DeKalb or Kendall County identify high-quality or ADID wetlands within their jurisdictions and no high-quality wetlands were found during the field inventory.

Noteworthy- Wetland Protection

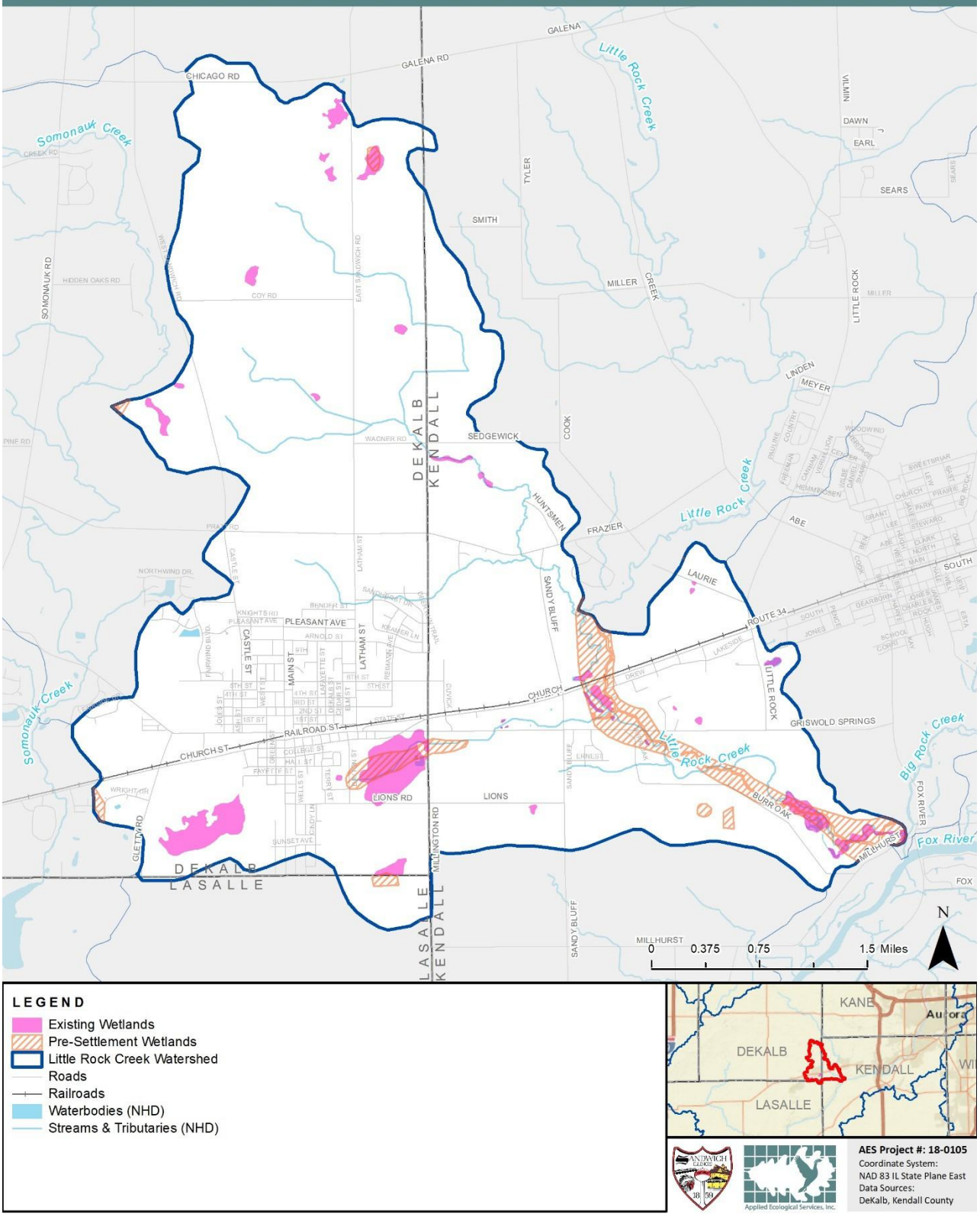
Wetlands connected to "Waters of the United States" are protected in DeKalb County by the U.S. Army Corps of Engineers (USACE) - Rock Island District via section 404 of the Clean Water Act. The USACE will generally require an Individual Permit (IP) for modifications to high quality wetlands although most high-quality wetlands are generally considered unmitigable. In rare cases where mitigation is allowed, as much as a 5:1 mitigation ratio is required. Additionally, high quality wetlands located within developed areas require a 100-foot buffer to aid in protection. Mitigation for impacts to low quality wetlands is set at a 1.5:1 ratio.

The USACE does not have jurisdiction over "Isolated Wetlands." The County and municipalities have jurisdiction over isolated wetlands via countywide ordinances. However, these ordinances do not prevent the net loss of isolated wetlands. It is recommended that local municipalities and counties pass local ordinances to protect isolated wetlands.

Higher quality wetland in Lower Little Rock Creek watershed

LITTLE ROCK CREEK WATERSHED

Figure 40: Pre-European Settlement & Existing Wetlands



Potential Wetland Restoration Sites

Wetland restoration projects are among the most beneficial in the context of improving watershed health. Wetlands are vitally important because they improve basic environmental functions such as storing floodwaters, increasing biodiversity, creating green infrastructure, and improving water quality. The wetland restoration process involves returning hydrology (water) and vegetation to soils that once supported wetlands but no longer do because of human impacts such as tile and ditch draining and/or filling. Potential wetland restoration sites were identified during the fall of 2019 inventory by identifying hydrologic indicators such as sparse vegetation, geomorphic position, standing water and drift deposits.

The inventory resulted in 7 potential wetland restoration sites, ranging in size from 2.5 to 133.0 acres in size and totaling 355.1 acres (Table 21; Figure 41). A detailed summary of wetland restoration recommendations is included and prioritized in the Action Plan section of this report.

Local governments should strongly consider "Conservation Design" that incorporates wetland restoration on parcels slated for future development and parks. Another potential option is to restore wetlands as part of a wetland mitigation bank. In this case, wetlands are restored on private or public land and must meet certain performance criteria before they become "fully certified." Following certification, developers are able to buy wetland mitigation credits from the wetland bank for wetland impacts occurring elsewhere in the watershed. A fully certified acre of restored wetland can sell between $40,000 and $100,000 thousand dollars. Although this may seem like an enormous expense to a developer, it is often cheaper than going through a long permitting process and providing mitigation for impacted wetlands on the development site. It is also possible that in the future Illinois EPA may require more strict nutrient policies for wastewater treatment plants. Wetland banks may increase the opportunity for WWTP owners, with older technology, to meet the new standards through the purchase of "water quality trading credits."

Note: A feasibility study will need to be completed prior to the planning and restoration of any potential wetland restoration.

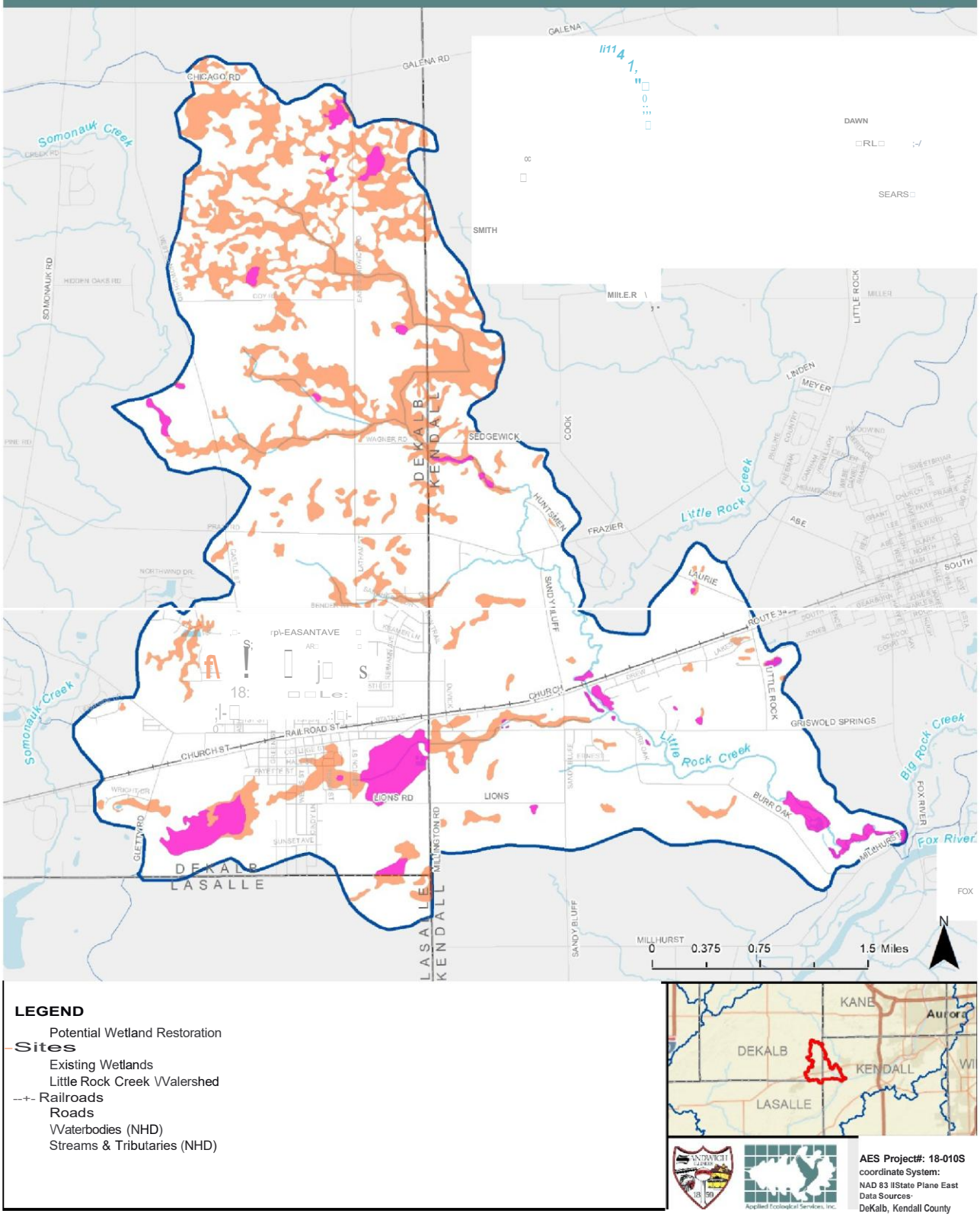
Potential wetland restoration opportunity at Site 13A

Table 21. Site ID, size, and existing condition of potential wetland restoration sites.

AES ID	Size (Acres)	Site description
3A	14.0	Drained wetland in ag, likely tiled
13A	2.5	Drained wetland in ag, likely tiled
13B	132.0	Drained wetland and dry bottom detention basin in ag, likely tiled
23A	112.6	Drained wetland in ag, likely tiled
25A	18.3	Drained wetland in ag, likely tiled
25B	39.0	Drained wetland in ag, likely tiled
27A	36.7	Drained wetland in ag, likely tiled

LITTLE ROCK CREEK WATERSHED

Figure 41: Potential Wetland Restoration Sites



LEGEND

- Potential Wetland Restoration Sites
- Existing Wetlands
- Little Rock Creek Watershed
- Railroads
- Roads
- Waterbodies (NHD)
- Streams & Tributaries (NHD)

AES Project#: 18-010S
coordinate System:
NAD 83 IIState Plane East
Data Sources·
DeKalb, Kendall County

3.13.4 Floodplain & Flood Problem Areas

FEMA 100-Year Floodplain

Functional floodplains along stream and river corridors perform a variety of green infrastructure benefits such as flood storage, water quality improvement, passive recreation, and wildlife habitat. The most important function however is the capacity of the floodplain to hold water following significant rain events to minimize flooding downstream. The 100-year floodplain is defined by the Federal Emergency Management Agency (FEMA) as the area that would be inundated during a flood event that has a one percent chance of occurring in any given year (100-year flood). 100-year floods can and do occur more frequently, however the 100-year flood has become the accepted national standard for floodplain regulatory and flood insurance purposes and was developed in part to guide floodplain development to lessen the damaging effects of floods.

The 100-year floodplain also includes the floodway. The floodway is the portion of the stream or river channel that comprises the adjacent land areas that must be reserved to discharge the 100-year flood without increasing the water surface. Figure 42 depicts the 100-year floodplain and floodway in relation to a hypothetical stream channel.

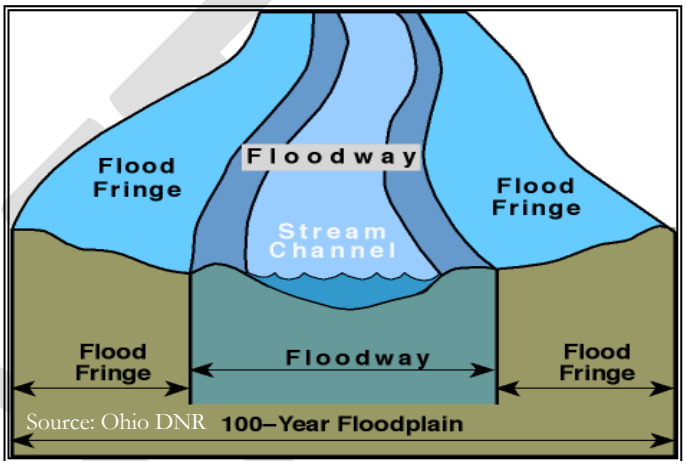


Figure 42. 100-year floodplain and floodway depiction.

As expected, the mapped floodplain in the watershed closely follows Little Rock Creek and its tributaries. Figure 43 depicts the 100-year floodplain which occupies 380 acres or about 4% of the watershed. The most extensive floodplain areas are associated with the wooded riparian areas along Little Rock Creek Reaches 1 and 2.

Documented Flood Problem Areas

The City of Sandwich faces an ongoing battle with various types of flooding and flood problem areas. The Director of Public Works for the City identified the locations of flood problem areas, providing a detailed description of each flood related concern. These flood problem areas are shown on Figure 43 and Table 22. While some of these flood problem areas are addressed through various action plan recommendations, others will need additional remediation beyond the scope of this planning effort.

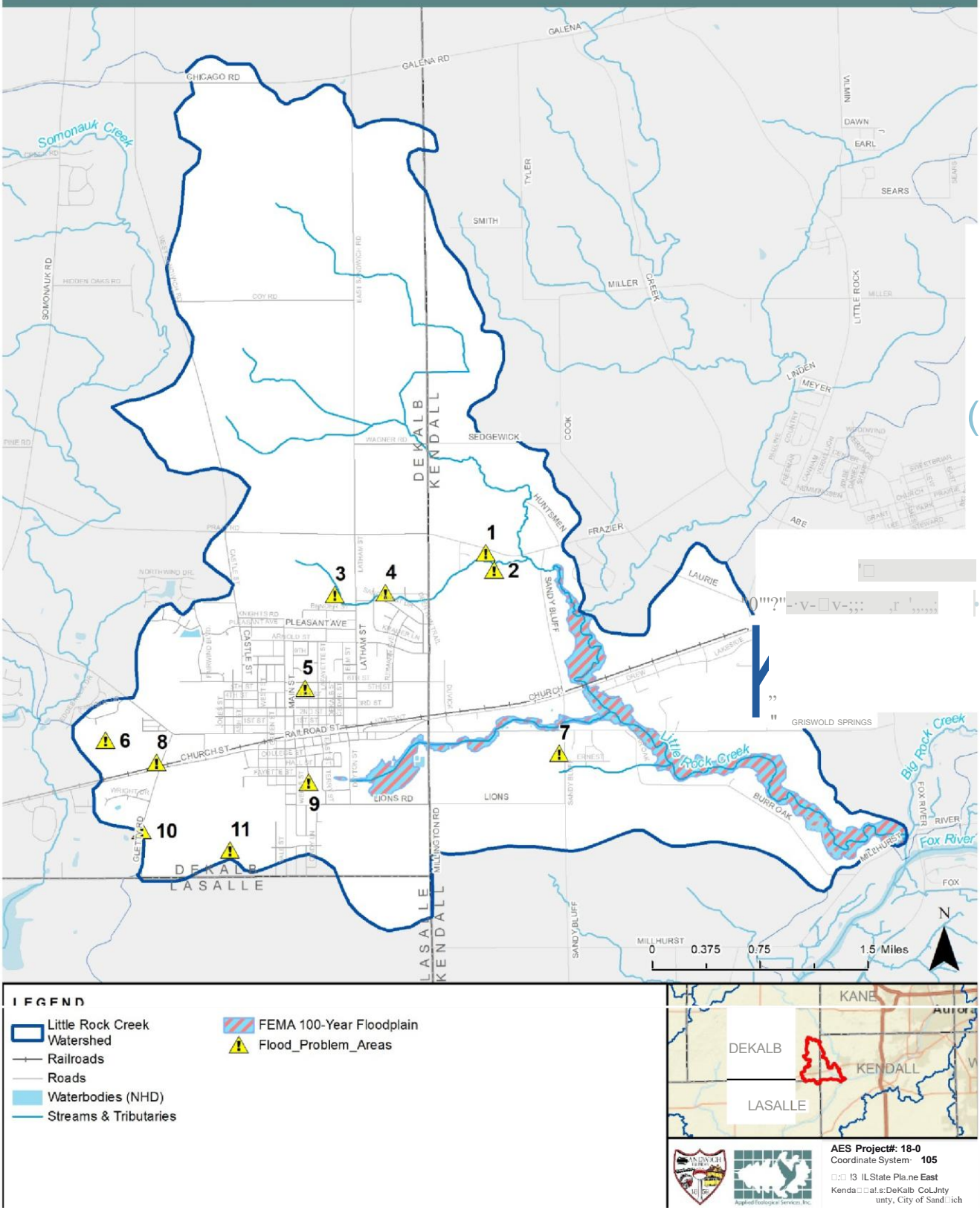
Flooding at Flood Problem Area #4 (Source: T. Horak)

Table 22. Documented Flood Problem Areas.

Site ID	Description of Flooding/Concern
1	A series of culverts and ditches are poorly maintained to accept the piped conveyance from the Sandhurst subdivision.
2	This drainage path is privately owned. The original subdivider of Sandhurst owned this property and created a swale with culverts to convey the runoff from the subdivision. The new property owners have not maintained the swales or culverts.
3	Runoff from the fields collects at Latham Street. A series of detention basins restricts the flow out of the Sandhurst subdivision, and the ponded runoff encroaches on the rear yards of the properties on Bender Street and fills the roadway.
4	An overland flow route across Sandhurst Drive and through the yards within the series of detention basins through Sandhurst. In the more recent 100-year events, the roadway flooding has encroached into the private yards and each event has lasted for several days.
5	With a minimal storm sewer network in this area, runoff enters into the sanitary sewer system and causes basement backups.
6	The swales in Edgebrook Subdivision are insufficient to convey runoff from intense events. This subdivision is also served with septic systems.
7	Runoff from the field on the south side of the road occasionally over tops the Griswold Springs Road pavement and reduces the traveled way to one lane of traffic for several hours.
8	Runoff from the field flows north into the mobile home park and causes flooding. Runoff also enters into the sanitary sewer system.
9	During intense storms, U.S. Route has standing water in the eastbound lane for up to an hour or more.
10	When the existing pond fills, the water surface elevation encroaches on the lots along the property lines. The ponded water impacts the septic systems on the homes.
11	The Davis Lake area is drained through the Northville Sandwich Little Rock Drainage District pumps and storm sewer. When the pumps stop working, the standing water affects the septic systems of several homes and inundates the baseball fields at Memorial Park. The natural outlet over tops Main Street.

LITTLE ROCK CREEK WATERSHED

Figure 43: FEMA 100-Year Floodplain & Flood Problem Areas



3.14 Agricultural Land

Row crop agriculture near Pratt and W. Sandwich Roads

Agricultural land uses dominate much of the watershed outside of the City of Sandwich and include row crops, idle cropland, and pasture. While Illinois is known for its food production, how this land is managed can have a significant effect on water quality. According to the Environmental Protection Agency's (EPAs) National Water Quality Inventory for 2000, "agricultural nonpoint source (NPS) pollution was the leading source of water quality impacts on surveyed rivers and lakes… Agricultural activities that cause NPS pollution include…plowing too often or at the wrong time; and improper, excessive or poorly timed application of pesticides, irrigation water and fertilizer. (EPA, 2013)" According to the nonpoint source pollutant modeling conducted by AES, agricultural land uses are the leading source of both nutrients and sediment in the watershed.

Summarizing agricultural land across the watershed can be difficult because not only do crops change from year to year on some fields, but each farm has unique agricultural practices and equipment at their disposal. The United States Department of Agriculture's (USDAs) National Agricultural Statistics Service produces a yearly, crop-specific inventory of land across the United States based on satellite imagery and the spectral signatures of various land cover types. The USDA 2019 Cropland data for the Lower Little Rock Creek watershed (Table 23; Figure 44) shows that corn was the most abundant cropland type at nearly 34% of the watershed, followed by soybeans at 24%. Fallow or idle cropland made up nearly 8% of the watershed and grassland or pasture areas covered about 3%, with all other crop types combined covering 2%.

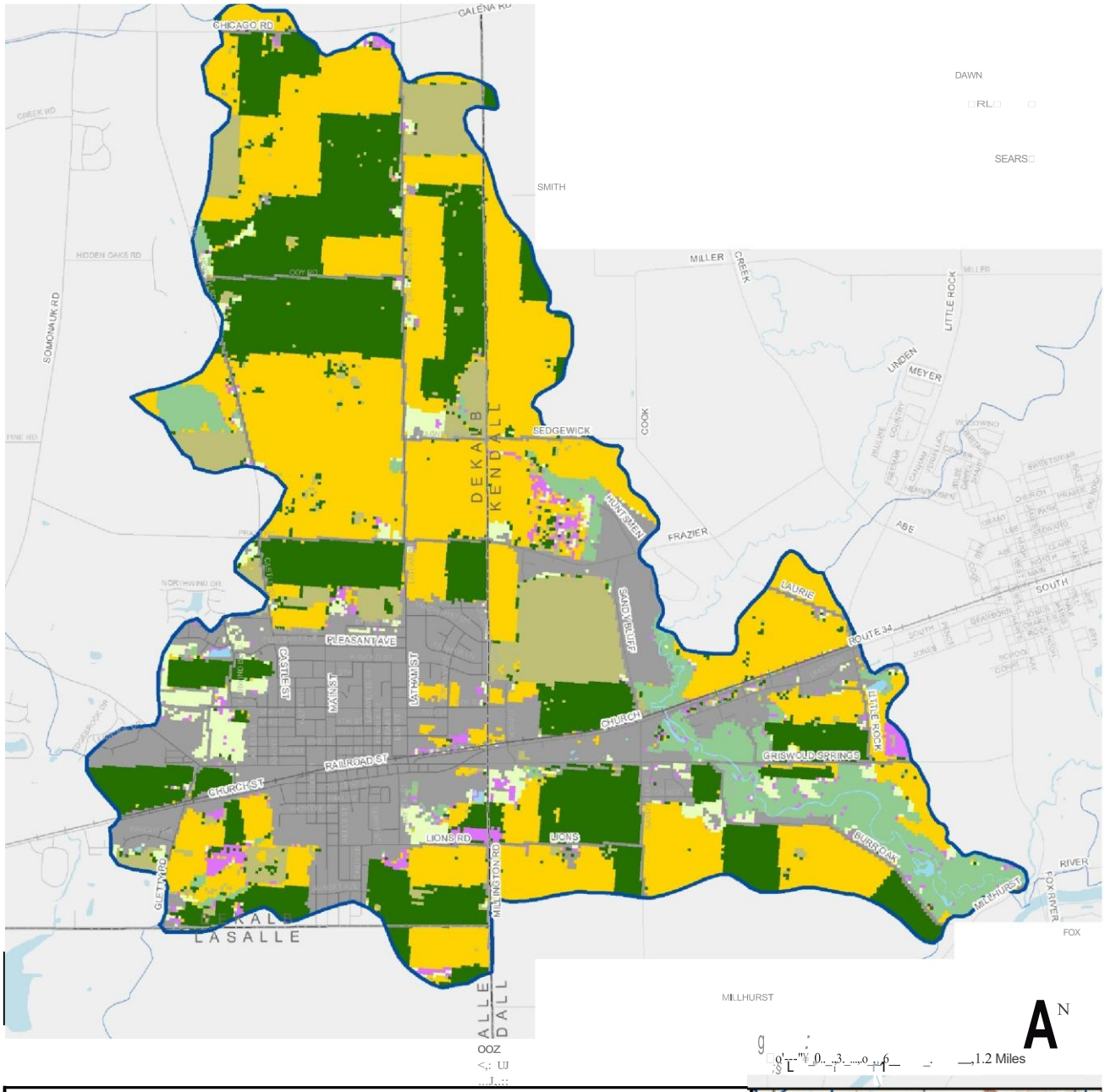
Table 23. USDA 2019 Cropland Data for cropland cover types.

Cropland Type	Acres	Percent of Watershed
Corn	3,556.5	33.7%
Soybeans	2,477.9	23.5%
Developed	2,519.3	23.9%
Fallow/Idle Cropland	792.7	7.5%
Deciduous Forest	645.3	6.1%
Grassland/Pasture	361.5	3.4%
Other	200.3	1.9%
Total Cropland	10,541.1	**100.0%**

There are no combined animal feeding operations (CAFOs) in the watershed, almost no livestock of any kind, and no issues were identified involving livestock during the field inventory.

LITTLE ROCK CREEK WATERSHED

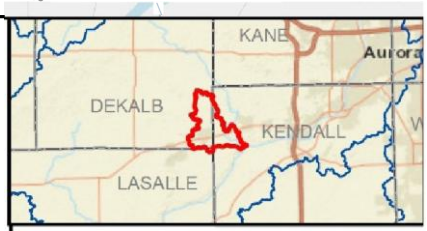
Figure 44. USDA Cropland Data 2019



LEGEND

D Little Rock Creek Watershed **USDA Cropland Data 2019**

- Railroads
- Roads
- Waterbodies (NHD)
- Other (1.9%)
- Corn (33.7%)
- Deciduous Forest (6.1%)
- Developed (23.9%)
- Fallow/Idle Cropland (7.5%)
- Grassland/Pasture (3.4%)
- Soybeans (23.5%)



Applied Ecological Services, Inc.

AES Project.t #: 18-0105
Coordinate System:
NAO 83 IL State Plane East
D□taSource5,: DeKalb County, Kendall County, City of S,Jndwich

In late fall 2019, Applied Ecological Services, Inc. (AES) completed a windshield survey of the watershed, including agricultural land within the Lower Little Rock Creek watershed. Typically, this would include map notations of existing conservation practices (such as vegetated swales, contour cropping, no-till farming, etc.) as well as general agricultural land cover types (such as row crop, hay, or pasture). Typically, areas where additional conservation practices could be implemented would be noted, but in the case of Lower Little Rock Creek watershed the agricultural land was so flat that no swales or gullies were apparent in the field. Unfortunately, 2019 was an unusually wet season, so much so that almost no crops went in on time, some fields were left fallow for the season, and many others followed exceptional planting practices in trying to accommodate the weather. Therefore, AES could not complete the agricultural field inventory to the extent it normally would. Results of the field inventory can be found in Appendix C.

Based on observations during the field inventory, conventional tillage was the dominant tillage practice in the watershed. Conventional tillage is the standard practice in agriculture and involves plowing fields and removing all plant residue from previous crops before planting a new one; relative to other practices, conventional tillage involves the most soil disturbance.

There are several alternatives to conventional tillage, all of which help protect water quality. Conservation tilling or reduced tillage is an effective method of reducing non-point source pollution within agriculture areas. "Conservation tillage is an agricultural management approach that aims to minimize the frequency and intensity of tillage operations" (UC Davis, 2017). Conservation tillage has environmental benefits such as improving soil health, reducing runoff, and limiting the extent of erosion, as well as economic benefits such as less reliance on farm machinery and equipment and overall reduction in fuel and labor costs (UC Davis, 2017). Another tillage practice that can be effective at reducing pollution is mulch tilling which is "any other reduced tillage system that leaves at least one third of the soil surface covered with crop residue (Dunnum, 2016)." A related and even more effective method of reducing non-point source pollution from agricultural areas includes the practice of no-till in which tilling or disturbing the soil is eliminated between harvest of the previous crop to harvest of the current crop (Claassen, 2018).

While no entity regulates or maintains an inventory of drain tiles in the watershed, NRCS provides a map depicting the tile drainage probability of land in Illinois based on soil characteristics (Figure 45). This map was created using the assumption "that very poorly and poorly drained soils that are rapidly permeable to moderately slowly permeable would be very likely to be tile drained. Soils that are somewhat poorly drained, that are rapidly permeable to moderately slowly permeable are likely to be tile drained. Soils that are slowly or very slowly permeable are unlikely to be tile drained (NRCS, 2009)." This data has not been verified and is only for general guidance purposes, but it depicts the likely extent of drain tiles within the watershed. According to NRCS' map, most of the Lower Little Rock Creek watershed is likely to very likely tile drained.

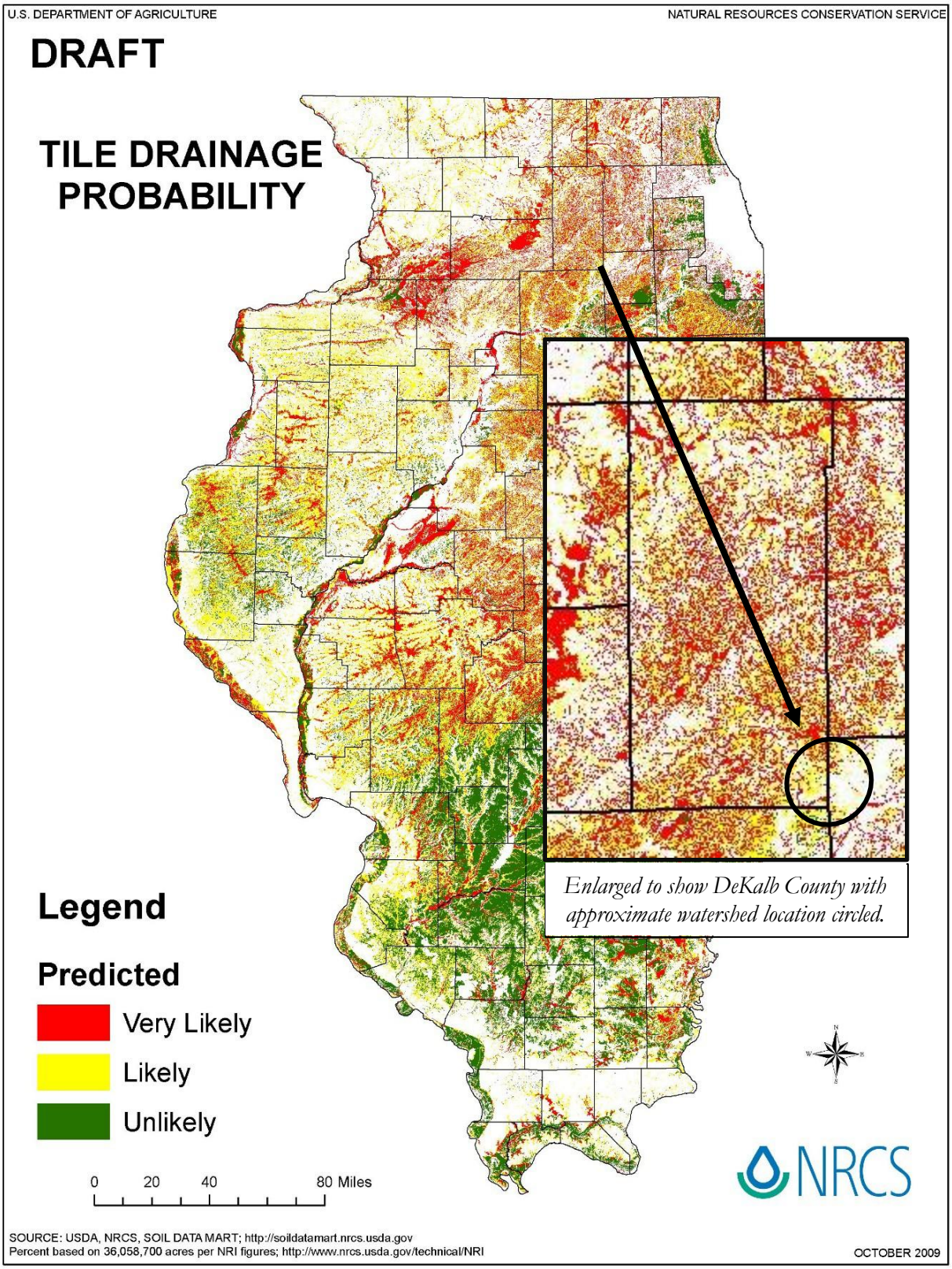


Figure 45. Tile drainage probability in Illinois (Source: NRCS, 2009).

3.15 Groundwater Aquifers, Recharge, & Community Water Supply

Groundwater Aquifers

Groundwater is water that saturates small spaces between sand, gravel, silt, clay particles, or crevices in underground rocks. Groundwater is found in aquifers or underground formations that provide readily available quantities of water to wells, springs, or streams. Groundwater sources available to Northeastern Illinois are found in shallow aquifer units and deep aquifer units (Figure 46). The shallow aquifers are found in unconsolidated sand and gravels within the Quaternary Unit. An impermeable layer of bedrock separates the shallow aquifers from the deep aquifers found in layers of sandstone within the Ancell Unit, Ironton-Galesville Unit, and Mt. Simon Unit. Both shallow and deep aquifers are tapped and used by residences, farms, or entire communities.

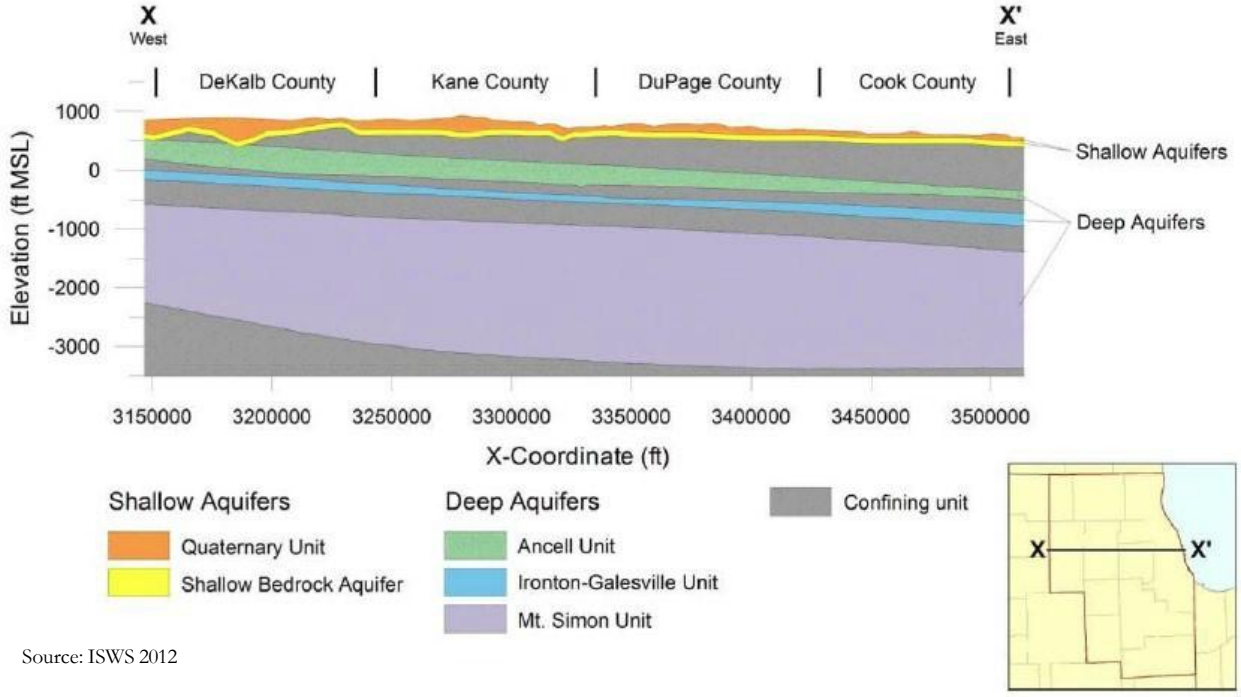


Figure 46. Cross section of the Northeastern Illinois deep and shallow aquifer units.

Groundwater modeling studies conducted for the 11-county Northeastern Illinois Regional Water Supply Planning area by the Illinois State Water Survey (ISWS) (ISWS, 2012) suggests that relatively modest increases in groundwater withdrawals will be seen between 2005 and 2050 of up to about 5 Mgd in the Quaternary and deep bedrock aquifers and available head above the top of the Ancell unit is expected to remain greater than 200 feet in the Lower Little Rock Creek watershed planning area. Modeling also suggests that drawdown could reach 150 feet in the Ancell Unit and up to 700 feet in the Galesville Unit by 2050 (Figure 47). Ultimately, groundwater models suggest that drawdown, changes in stream base flow, and/or changes in the depth of groundwater for deep wells are expected to remain relatively stable in the future relative to areas closer to the Chicagoland region (ISWS, 2012).

Groundwater Recharge

Groundwater recharge is the process by which precipitation reaches and re-supplies the groundwater. Generally, only a portion of precipitation will reach an aquifer. The groundwater

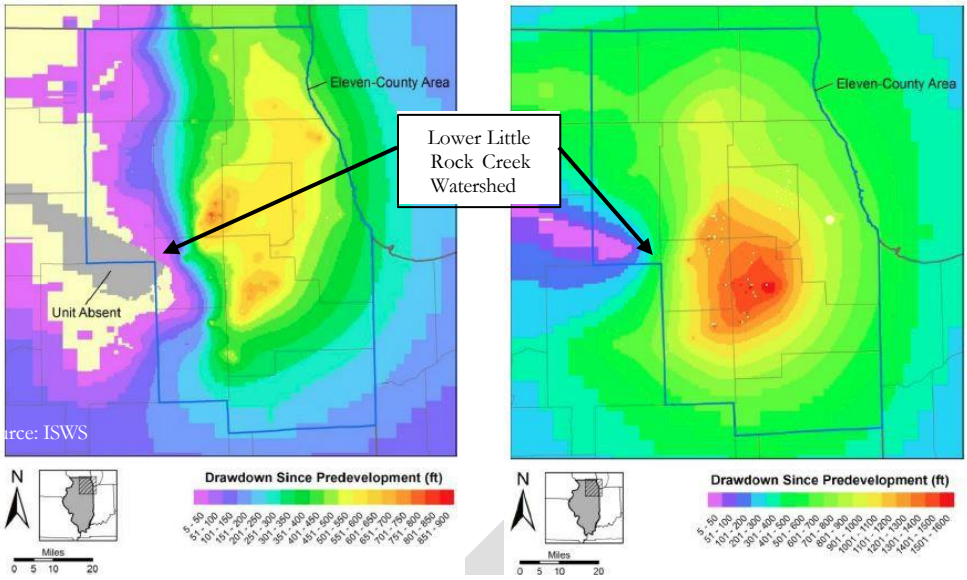


Figure 47. Year 2050 modeled groundwater drawdown in the Ancell Unit (left) and Ironton-Galesville Unit (right).

recharge rate can be affected by a number of factors, "including intensity and amount of precipitation, surface evaporation, vegetative cover, plant water demand, land use, soil moisture content, depth and shape of the water table, distance and direction to a stream or river, and hydraulic conductivity of soil and geologic materials. (IEPA, 2006)"

Unfortunately, no watershed-specific information was available on either the extent of the groundwater recharge potential or groundwater contamination potential in the watershed.

Community Water Supply

Groundwater is an essential resource within the Lower Little Rock Creek watershed as underlying aquifers provide the drinking water supply for many people. The City of Sandwich's water supply comes primarily from deep wells. Outside of Sandwich, private wells provide water to farms and residential developments. Four (4) community water supply wells are located within Lower Little Rock Creek watershed (Table 24). It is important to note that future development projects that include infiltration best management practices will mostly benefit the shallow aquifers and not deep aquifers. There is one Illinois Department of Agriculture Well Decommissioning Program site in the Lower Little Rock Creek watershed. The Site is BMP number 000066 managed by the Kendall County Soil & Water Conservation District.

Table 24. Community water supply wells within Lower Little Rock Creek watershed (Source: IEPA Source Water Assessment Program).

Well ID	CWS Name	Depth (ft)	Status	Aquifer Depth	Year Drilled
11432	Sandwich	650	Active	Deep	1947
11431	Sandwich	600	Active	Deep	1939
20122	IL American- Hollis	200	Active	Shallow	1972
01865	IL American- Hollis	200	Active	Shallow	N/A

3.16 Wastewater Treatment Plant & Septic Systems

Wastewater Treatment Plant

There is one National Pollution Discharge Elimination System (NPDES) permitted wastewater treatment facility discharge in the Lower Little Rock Creek watershed. The City of Sandwich STP facility discharges under NPDES Permit No. IL0030970 and is located at 1120 E. Church Street in Sandwich. Two discharges are covered under the permit: 003 STP Outfall (which regulates normal discharges) and 002 STP Excess Flow Outfall which handles excess flows; both discharges are to Harvey Creek, which is Tributary 3 to Little Rock Creek. The facility is required to stay within established discharge rates for biological oxygen demand, suspended solids, pH, fecal coliform, ammonia nitrogen, and dissolved oxygen. The plant is only required to monitor total phosphorus and total nitrogen. It currently has a designed average flow of 1.5 million gallons per day (MGD) and design maximum flow of 3.75 MGD.

City of Sandwich STP

IL0030970 NPDES permit standards are included in Table 25.

Table 25. IL0030970 NPDES permit requirements for 003 STP Outfall.

Parameter	Load Limits - lbs/day DAF (DMF)		Concentration Limits - mg/L	
	Monthly Ave. (lbs/day)	Daily Max. (lbs/day)	Monthly Ave. (mg/L)	Daily Max. (mg/L)
Flow: 1.5 MGD ave. & 3.75 MGD max.				
CBOD	125 (313)	250 (626)	10	20
Suspended Solids	150 (375)	300 (751)	12	24
pH	Shall be in the range of 6 to 9 Standard Units			
Fecal Coliform	Daily maximum shall not exceed 400 per 100 mL (May through October)			
Ammonia Nitrogen *Apr-May/ Sept-Oct* *Nov-Feb* *March*	 11 (28) 18 (44) 18 (44)	 38 (94) 41 (103) 43 (106)	 0.9 1.4 1.4	 3.0 3.3 3.4
Total Phosphorus	Monitor only			
Total Nitrogen	Monitor only			
Dissolved Oxygen *March-July* *August- February*	 -	 -	Not less than - 5.5	Daily Minimum 5.0 3.5

The same permit authorizes excess flows (002 STP Excess Flow Outfall) need to fall under the following concentration limits (monthly average): BOD – 30 mg/L, Suspended Solids – 30 mg/L, Chlorine residual – 0.75 mg/L, and Fecal Coliform shall not exceed a daily maximum shall not exceed 400 per 100 mL.

Septic Systems

Septic systems are common within the more rural, unincorporated portions of DeKalb and Kendall County. When septic systems are not maintained or fail, they pose real threats to groundwater and surface water quality, especially when they are located near streams or other water bodies. Failing septic systems can contribute high levels of nutrients (phosphorus and nitrogen) and bacteria (fecal coliform) to the environment. The failure rate of septic systems in the watershed is unknown. However, literature sources across the nation indicate a failure rate of approximately 20% (Brown, 1998; Mancl, 1984; Stout, 2003; UKCE, 2012).

While no specific data is available regarding the number of septic systems within the watershed, AES was able to estimate that based on the 2010 census data, there are approximately 247 septic systems in the watershed. This number was calculated based on the assumption that each household outside of a municipal boundary is likely to have a septic system. AES carefully reviewed and fact-checked the validity of this estimating method and is confident it is a reasonably accurate estimate and also used these estimates as part of the STEPL modeling (see Section 4.2). Table 26 depicts the estimated number of rural households/septic systems by subwatershed management unit. Septic systems in DeKalb County are regulated under the Water Wells and Waste and Sewage Disposal section of the DeKalb County Code. In Kendall County, the Environmental Health Services unit of the Kendall County Health Department handles the unsewered portions of Kendall County.

The United States Environmental Protection Agency (USEPA) provides an excellent guide for septic system owners called "A Homeowner's Guide to Septic Systems" (USEPA, 2005). The guide makes it clear that septic system maintenance is the responsibility of the owner. The guide also explains how septic systems work, why and how they should be maintained, and what makes a system fail. Septic system owners or those proposing to install new systems are encouraged to regularly maintain septic systems and seek guidance from DeKalb or Kendall County as needed (accessible at well.septic@dekalbcounty.org for DeKalb County or call (630) 553-8026 in Kendall County).

Table 26. Estimated number of rural households/septic systems by subwatershed management unit.

SMU #	Estimated Number of Rural Households (based on 2010 Census
1	12
2	8
3	10
4	19
5	8
6	4
7	45
8	13
9	5
10	34
11	57
12	32
TOTAL	**247**

4.0 WATER QUALITY & POLLUTANT MODELING ASSESSMENT

4.1 Water Quality

The primary goal of this watershed plan is to guide efforts to protect and restore surface water quality in Lower Little Rock Creek watershed. Section 305(b) of the Federal Clean Water Act requires Illinois and all other states to submit to the USEPA a biennial report of the quality of the state's surface and groundwater resources called the *Illinois Integrated Water Quality Report and Section 303(d) List*. These reports must also describe how Illinois waters meet or do not meet water quality standards specific to each "Designated Use" as defined by the Illinois Pollution Control Board (IPCB). When a waterbody is determined to be impaired, Illinois EPA must list potential causes and sources for impairment in the 303(d) impaired waters list. There are seven "Designated Uses" in Illinois; Illinois EPA has assigned four of these uses to Lower Little Rock Creek *Aquatic Life, Fish Consumption, Primary Contact Recreation,* and *Aesthetic Quality*.

According to Illinois EPA's most recent 2018 *Integrated Water Quality Report and Section 303(d) List*, Little Rock Creek (IEPA Segment Code: IL_DTCA-01) is "Fully Supporting" for *Aquatic Life* and for *Aesthetic Quality*; Little Rock Creek was not assessed for *Fish Consumption* or *Primary Contact Recreation* (Table 27).

Table 27. Illinois EPA Designated Uses and impairments for Lower Little Rock Creek.

Designated Use	Use Attainment	Impaired?	Cause of Impairment	Source of Impairment
Little Rock Creek: IL_DTCA-01				
Aquatic Life	Fully Supporting	No	N/A	N/A
Fish Consumption	Not Assessed	-	-	-
Primary Contact Recreation	Not Assessed	-	-	-
Aesthetic Quality	Fully Supporting	No	N/A	N/A

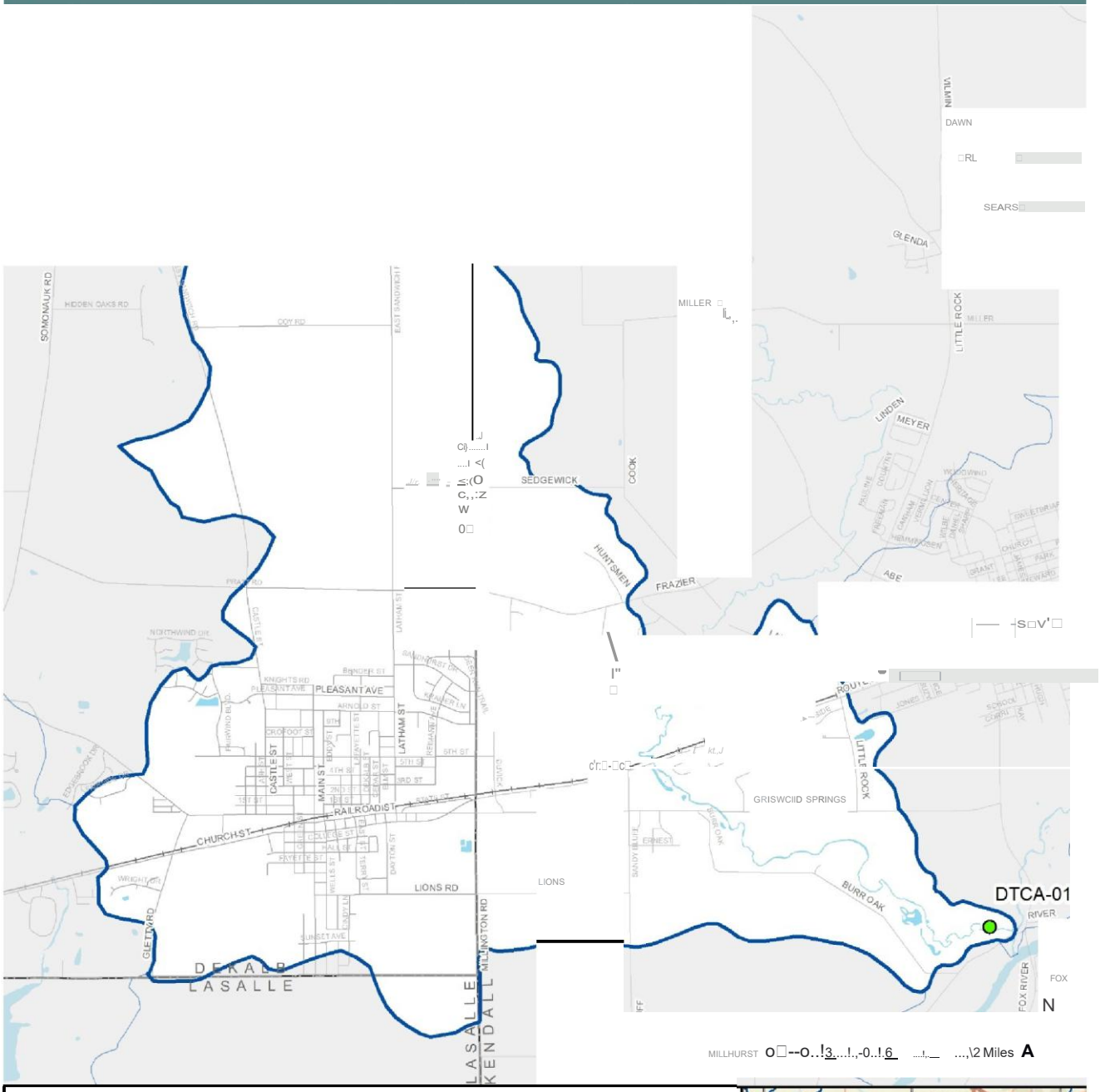
Source: 2018 Illinois EPA 303(d) list

Water Chemistry Monitoring

Lower Little Rock Creek
AES pulled the most recent ten full years of water quality data (2010-2019) available within the watershed and found one monitoring location for that time period – IL_EPA_WQX-DTCA-01. The site was monitored by Illinois EPA and had both Intensive Basin (2012) and Special Study (2017) conducted. Figure 48 depicts the location of the monitoring site where data was collected. The parameters for the Special Study included ammonia-nitrogen, inorganic nitrogen (NO2+NO3), total Kjeldahl nitrogen, total phosphorus, total suspended solids, and volatile suspended solids while the Intensive Basin regime included analysis of up to 70 parameters including all of the parameters from the Special Study as well as pH, chloride, dissolved oxygen and water temperature. The Intensive Basin monitoring regime included 3 rounds of sampling, once each in June, August, and September of 2012, while the Special Study included 4 rounds of sampling, once in July, twice in August, and once in September of 2017.

LITTLE ROCK CREEK WATERSHED

Figure 48: Existing Water Quality Monitoring Locations



LEGEND

D Little Rock Creek Watershed
Railroads
Roads
Waterbodies (NHD)

0 Water Quality Monitoring Locations

AES Project#: 18-0105
Coordinate System:
NAD 83 IL State Plane East
Data Sources: DeK;ilb County, Kendall County, City of Sandwich

While Illinois EPA shows no impairments for Little Rock Creek according to the 2018 *Integrated Water Quality Report and Section 303(d) List* (Table 27), more recent water quality data collected within the Lower Little Rock Creek indicates likely moderate impairment from elevated total phosphorus and total nitrogen.

Average sample results at IL_EPA_WQX-DTCA-01 for pH, dissolved oxygen, total suspended solids, chloride, total phosphorus, ammonia, inorganic nitrogen (NO2+NO3), total Kjeldahl nitrogen, and total nitrogen (calculated) are reported in Table 28. Monitoring results show that phosphorus is above the criteria at 0.145 mg/L and that both inorganic nitrogen and total nitrogen are above the guideline at 3.067 mg/L and 3.223 mg/L, respectively. All other parameters are within the guidelines.

Table 28. Illinois EPA water chemistry data (averages) for sites on Little Rock Creek (2012-2017).

ID Code/ Parameter	Statistical, Numerical, or General Use Guidelines	IL_EPA_WQX-DTCA-01
Average of pH	>6.5 or <9.0*	8.2
Average of Dissolved Oxygen (mg/L)	>5.0 mg/l*	10.6
Average of TSS (mg/L)	<19 mg/l***	8.3
Average of Chloride (mg/L)	<500 mg/l*	65
Average of Phosphorus (mg/L)	<0.0725 mg/l**	0.145
Average of Ammonia (mg/L)	*see TN below*	0.017
Average of NO2+NO3	1.798 mg/L**	3.067
Average of Total Kjeldahl Nitrogen (mg/L)	*see TN below*	0.139
Average of Total Nitrogen (TN) (mg/L), calculated	<2.461 mg/l**	3.223

In addition to the IEPA sampling, Applied Ecological Services (AES) conducted sampling at the IEPA DTCA-01 station to capture baseline water quality and Sample Site AES-02 was established to capture water quality data from the portion of Little Rock Creek that lies upstream of Lower Little Rock Creek watershed. Site DTCA-01 is the most downstream testing site in the watershed and is the most representative of watershed-wide water quality conditions. It is important to note that the upstream Little Rock Creek sample results (AES-02) are included as a measure of the pollutants coming from the upstream portion of Little Rock Creek watershed; these results were used to measure inputs from Little Rock Creek watershed and are not representative of Lower Little Rock Creek water quality conditions. Timeframe and budget allowed for one grab sample at each of the two locations on September 30, 2020. Water chemistry samples were sent to a certified laboratory for analysis for total phosphorus (TP), total nitrogen (TN), and total suspended solids (TSS) and is summarized in Table 29. It is also important to note that stream discharge information was also collected at each site by measuring stream dimensions and flow. Discharge data supplements grab sample data to calculate pollutant loading estimates.

Table 29. AES sample results on September 30, 2020.

ID Code/ Parameter	Statistical, Numerical, or General Use Guidelines	DTCA-01	AES-02*
TSS (mg/L)	<19 mg/l***	1.8	1.2
Phosphorus (mg/L)	<0.0725 mg/l**	0.118	0.056
Total Nitrogen (TN) (mg/L) calculated	<2.461 mg/l**	1.60	1.74
Flow	N/A, cubic feet	17.45	7.31

-Cells highlighted in red exceed recommended statistical, numerical, or General Use guidelines, ND=not detected
* Upstream portion of LRC falls outside of the watershed; these sample results used for estimating loading outside of planning area only and not representative of Lower Little Rock Creek watershed water quality.
** Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion VI (USEPA 2000)
*** Present and Reference Concentrations and Yields of Suspended Sediment in Streams in the Great Lakes Region and Adjacent Areas (USGS 2006)

Lower Little Rock Creek watershed-wide averages for TP, TN, and TSS were calculated by taking all of the available individual sample results for these parameters at site DTCA-01 and averaging them, since this is the most downstream and representative of water quality values in the entire watershed. The watershed-wide average reading was 0.142 mg/l of total phosphorus, 3.020 mg/l of total nitrogen, and 6.5 mg/l of total suspended solids. These watershed-wide averages will be used in the calculation of watershed-wide reduction targets.

Nutrients such as phosphorus and nitrogen are a necessary component of plant growth and are therefore included in many fertilizers. Unfortunately, both have adverse effects on water quality, with phosphorus being particularly detrimental to aquatic systems in excess quantities. These nutrients are applied as fertilizer, either in an agricultural setting or by applicators or residents and the excess nutrients not absorbed by plants are then washed into waterways. Excess nutrients can cause algal blooms, accelerated plant growth, decreasing oxygen levels, and can lead to fish kills. Currently there are no Illinois state standards for nitrogen or phosphorus; however, the USEPA recommends a concentration of less than 2.461 mg/l of total nitrogen and 0.0725 mg/L of total phosphorus in streams.

The ability to control erosion and excess sediment, and thereby total suspended solids, in waterways can be linked to the control of how development is handled as well as the condition of streambanks in the watershed. The construction process generally involves significant land disturbance and ecosystem destruction. The grading of sites, removal of vegetation, rerouting of natural drainage systems, and the addition of impervious surfaces, such as roads and parking lots, all interfere with water quality both in the short and long term. Removing vegetation and trees near the stream or floodplain removes the stability of the soil and increases bank erosion and sedimentation to nearby waterways. Alteration of natural drainage patterns can also significantly reduce the ability of the ecosystem to compensate for such increase in contaminants and sedimentation. Eroding streambanks also contribute additional sediments, particularly during and after rain events as peak flows scour away banks. High suspended sediment levels are problematic when light penetration is reduced, oxygen levels decrease, fish and macroinvertebrate gills are clogged, visual needs of aquatic organisms is reduced, and when sediment settles out in streams and lakes. There is no Illinois state guideline for total suspended solids, but the United States Geological Survey (USGS) recommends TSS do not exceed 19 mg/l for streams in the Lower Little Rock Creek watershed.

Noteworthy- Numeric Water Quality Standards

USEPA expects states to establish *numeric* water quality standards for nutrients (phosphorus and nitrogen) in lakes and streams. Currently, Illinois EPA has a numeric phosphorus standard for lakes and is working on developing nutrient criteria for streams. To date, Illinois EPA has not developed *numeric* standards for turbidity/total suspended solids (TSS) in streams. *Numeric* criteria have been proposed by USEPA (USEPA, 2000) for nutrients based on a reference stream method for the Corn Belt and Northern Great Plains Ecoregion (Ecoregion VI) which includes Lower Little Rock Creek watershed. The values presented in this document generally represent nutrient levels that protect against adverse effects of nutrient over enrichment. The USGS has published a document outlining recommended *numeric* criteria for sediment in streams for Ecoregion VI (USGS, 2006). These criteria are used in this report to assess the quality of Lower Little Rock Creek and tributaries to develop pollution reduction targets and measure future successes, even though Illinois EPA has not adopted these criteria as standards.

Illinois EPA and others have developed *statistical* guidelines for various pollutants other than nutrients and suspended sediment. Illinois also provides General Use water quality standards that apply to almost all waters and are intended to protect aquatic life, wildlife, agriculture, primary contact, secondary contact, and most industrial uses. *Statistical* guidelines and General Use water quality guidelines are also used in this report as a means to measure impairment and to determine pollutant reduction needs in Lower Little Rock Creek watershed.

Biological Monitoring

Biological data provides the primary basis for determining the level of *Aquatic Life* support in streams and is a major source of information for Illinois EPA's *Illinois Integrated Water Quality Report and Section 303(d) List*. Illinois EPA utilizes two indices based on aquatic macroinvertebrate and fish communities in streams. The Macroinvertebrate Biotic Index (MBI) and fish Index of Biotic Integrity (fIBI) are used to evaluate water quality and biological health and to detect and understand change in biological systems that result from the actions of human society. The Illinois EPA uses MBI and fIBI data to determine the *Aquatic Life* support status of streams as shown in Table 30. In addition, the Illinois Department of Natural Resources (IDNR) uses a "Mussel Resource Value" to rate the value of the biotic community.

Table 30. Illinois EPA indicators of *Aquatic Life* impairment using MBI and fIBI scores.

Biological Indicator	**Score**		
MBI	> 8.9	5.9 < MBI < 8.9	≤ 5.9
fIBI	≤ 20	20 < fIBI< 41	≥ 41
Narrative Score	Poor	Fair	Good
Impairment Status - Use Support - Resource Quality			
Impairment Status	Severe Impairment	Moderate Impairment	No Impairment
Designated Use Support	Not Supporting	Not Supporting	Fully Supporting
Resource Quality	Poor	Fair	Good

Source: 2012 *Illinois Integrated Water Quality Report and Section 303(d) List*

Macroinvertebrate Community Monitoring
Aquatic macroinvertebrates are insects that spend all or a portion of their life span in water. No macroinvertebrate monitoring data could be found for the watershed within the last ten years, however RiverWatch performed a macroinvertebrate study near the outlet of Little Rock Creek in 2003 and 2004 and the results were "Fair". Macroinvertebrate Biotic Index scores (MBI) were calculated based on the 2003-2004 macroinvertebrate studies. The MBI is designed to rate water quality using the pollution tolerance of macroinvertebrates and human impacts as an estimate of the degree and extent of organic pollution and disturbance in streams. The Illinois EPA has determined that an MBI score less than 5.9, or "Fair" condition, indicates a stream is not "Fully Supporting" *Aquatic Life*. Overall, macroinvertebrate data for Lower Little Rock Creek indicates that there may be moderate impairment but that the resource quality is "Fair."

Fish Community Monitoring
The fIBI assesses biological health and water quality through several attributes of fish communities found in streams. These attributes fall into such categories as species richness and composition, trophic composition, and fish abundance and condition. After data from sampling stations has been collected, values for the metrics are compared to high quality reference conditions and a rating is assigned to each metric. The sum of these ratings gives a total fIBI score for the site. The Illinois EPA uses fIBI scores to determine *Aquatic Life* impairments and has determined that a score less than 41 indicates a stream is not "Fully Supporting" *Aquatic Life*.

The Illinois Department of Natural Resources and Fox River Study Group have conducted various studies along Little Rock Creek as part of monitoring conditions within the Fox River watershed. A 2017 report showed that fish collections for Little Rock Creek at DTCA-01 resulted in a fIBI score of 53 (Good) in 2017. Furthermore, this score has improved since collection started in 1996, at which point the same location had an fIBI score of 44, and between 2002 and 2017, fIBI scores have remained fairly consistent with scores in the low 50s (IDNR, 2017).

Wastewater Treatment Plant
There is one National Pollution Discharge Elimination System (NPDES) permitted wastewater treatment facility discharge in the Lower Little Rock Creek watershed. The City of Sandwich STP facility discharges under NPDES Permit No. IL0030970 and is located at 1120 E. Church Street in Sandwich. Under its permit, the facility is required to stay within established discharge rates for biological oxygen demand, suspended solids, pH, fecal coliform, ammonia nitrogen, and dissolved oxygen. The plant is only required to monitor total phosphorus and total nitrogen. For the purposes of this plan, the Sandwich facility provided one years' worth (June 2019 - May 2020) of monitoring data for total nitrogen, total phosphorus, and total suspended solids, and the average water quality value for each parameter over that time period is depicted in Table 31. This data is important for generating nutrient loading as discussed in Section 4.2. These levels are well within typical levels for WWTP effluent based on literature (IEPA, 2009). It is important to note that as a *permitted* point source.

Load limits computed based on a design average flow (DAF) of 1.5 MGD.

Table 31. City of Sandwich STP NPDES permit requirements and effluent average water quality values for June 2019 - May 2020.

Parameter	NPDES Requirements	Average Monitoring Value June 2019 - May 2020
Total Nitrogen (TN)	Monitor Only	8.77 mg/l
Total Phosphorus (TP)	Monitor Only	2.75 mg/l
Total Suspended Solids (TSS)	12 mg/l monthly average	6.75 mg/l

4.2 Pollutant Loading Analysis

The USEPA modeling tool called STEPL (Spreadsheet Tool to Estimate Pollutant Loads) was used to estimate the existing nonpoint source load of nutrients (nitrogen & phosphorus) and sediment from Lower Little Rock Creek watershed as a whole and by individual Subwatershed Management Unit (SMU). The model uses land use/cover category types, precipitation, soils information, existing best management practices, and other existing conditions data information. The model outputs average annual pollutant load for each of the land use/cover types. The results of this analysis combined with known outfall information from the City of Sandwich STP and estimated contributions from upstream of Lower Little Rock Creek watershed were used to estimate the total watershed load for nitrogen, phosphorus, and sediment and to identify and map pollutant load "Hot Spot" SMUs. It is important to note that STEPL is not a calibrated model, although every effort was taken to include all current and available data.

The City of Sandwich STP contributes the third highest estimated nitrogen and second highest phosphorus loading to Lower Little Rock Creek watershed (Table 32 & Table 33). Annual nitrogen and phosphorus loading from City of Sandwich STP is estimated at 40,033 lbs/yr and 12,560 lbs/yr respectively. This accounts for about 20% of the total annual load for nitrogen and 33% of the total annual load for phosphorus. The annual load for total suspended solids/sediment (TSS) from the treatments plants is low compared to other sources. It is important to note that the City of Sandwich STP is a *permitted* point source and does an excellent job of staying within its permitted discharge limits.

Table 32. Estimated average annual pollutant load from Sandwich wastewater treatment facility.

Average Flow MGD	Average Concentration (mg/l)			Annual Pollutant Load*		
	TN (mg/l)	TP (mg/l)	TSS (mg/l)	TN Load (lbs/yr)	TP Load (lbs/yr)	TSS (t/yr)
1.5	8.77	2.75	6.75	40,033	12,560	15.4

*Average daily flow (MGD) × average concentration (mg/l) × 3,042 (L-d-lb/gal-y-mg) = average annual load (lbs-t/y)

Lacking a stream gage, average flow data, or water quality monitoring data near where the upstream portion of Little Rock Creek joins the Lower Little Rock Creek watershed, AES conducted one round of grab samples and flow measurements on September 30, 2020 to help estimate the upstream contributions to pollutant loading. Based on the one-time sampling and flow calculations taken, the upstream portion of Little Rock Creek contributed 45% of total nitrogen loading, 20% of total phosphorus loading, and 28% of total suspended solids loading. For the purposes of this watershed plan, AES assumed that these percent contributions were representative of the total overall pollutant loading contributions and used these percentages to back calculate an estimate of total upstream loading. According to this estimate, the upstream portion of Little Rock Creek contributes approximately 91,580 lbs/yr (45%) of nitrogen loading, 7,594 lbs/yr (20%) of phosphorus loading, and 3,451 tons/yr (28%) of sediment loading (Table 33; Figure 49).

The results of the STEPL model run at the watershed scale combined with estimated point source WWTP loading and estimates of pollutant loading coming from the upstream portions of Little Rock Creek indicate that total watershed loading is approximately 203,512 lbs/yr of nitrogen, 37,970 lbs/yr of phosphorus, and 12,326 tons/yr of sediment (Table 33; Figure 49).

Excluding the wastewater contributions to pollutant loading and the upstream portions of Little Rock Creek that is outside of the planning area, cropland contributes the highest loads of nitrogen (50,501 lbs/yr: 70%), phosphorus (14,004 lbs/yr: 79%), and of total suspended solids (TSS) (8,298 tons/yr: 94%). Cropland is expected to be a significant pollutant contributor since it makes up more roughly 68% of the watershed. Urban land uses contribute the second highest nutrient and TSS loads after cropland areas, with 19,465 lbs/yr (27%) of nitrogen, 3,057 lbs/yr (17%) of phosphorus, and 458 tons/yr (5%) of TSS per year. Septic systems contribute the third highest nutrient loads with 1,728 lbs/yr (2%) of nitrogen and 677 lbs/yr (4%) of phosphorus. Streambank erosion contributes the third highest TSS load (70 tons/yr: 1%) to Lower Little Rock Creek. The STEPL model suggests that very few pollutants originate from areas of open water. Complete STEPL Model results and assumptions can be found in Appendix D.

Table 33. Estimated total existing annual pollutant load by source at the watershed scale.

STEPL Source	N Load (lbs/yr)	% of Total Load	P Load (lbs/yr)	% of Total Load	TSS (tons/yr)	% of Total Load
Urban	19,465	10%	3,057	8%	458	4%
Cropland	50,501	25%	14,004	37%	8,298	67%
Water	110	0%	42	0%	34	0%
Septic	1,728	1%	677	2%	0	0%
Streambanks	95	0%	36	0%	70	1%
City of Sandwich STP*	40,033	20%	12,560	33%	15.4	0%
Little Rock Creek upstream of watershed**	91,580	45%	7,594	20%	3,451	28%
Total	**203,512**	100%	**37,970**	100%	**12,326**	100%

*Not included in STEPL model, calculated based on permit reporting.
**Not included in STEPL model, calculated percent of overall pollutant contribution based on one-time water quality and flow monitoring on September 30, 2020

Figure 49. Estimated contributions to total existing pollutant load by source.

Based on the pollutant loading estimates as detailed in Table 33, the nonpoint source share of the total pollutant loading for Lower Little Rock Creek watershed is 35% of the total nitrogen loading, 47% of the total phosphorus loading, and 72% of the total suspended solids loading. The water

quality improvements needed to meet pollutant loading for the permitted pollutant loading attributed to the City of Sandwich STP and the upstream portion of Little Rock Creek watershed are not within the scope of this watershed planning effort. Section 5.0 of this report includes detailed information related to developing pollutant load reduction/ impairment targets only for Lower Little Rock Creek watershed and addressing "Critical Areas" to reach these targets.

The results of the STEPL model were also analyzed for nonpoint source pollutant loads at the Subwatershed Management Unit (SMU) scale. **This analysis does not incorporate the point source pollutant estimates from CITY OF SANDWICH STP or from the upstream portions of Little Rock Creek.** This allows for a more refined breakdown of nonpoint pollutant sources and leads to the identification of pollutant load "Hot Spots". Hot Spot SMUs were selected by examining pollutant load concentration (load/acre) for each pollutant. Next, pollutant concentrations exceeding the 75% quartile and 50% quartile were calculated resulting in "High Concentration" and "Moderate Concentration" nonpoint source pollutant load Hot Spot SMUs and an aggregate pollutant contribution number was calculated based on each SMUs total load per acre (the sum of the load/acre of nitrogen, phosphorus, and sediment). SMUs with a total load concentration of 10.4 or higher were categorized as "High Concentration" pollutant load hot spots, while SMUs scoring a total load concentration between 10.0 and 10.3 were determined to be "Moderate Concentration pollutant load hot spots. Any SMU exhibiting pollutant load concentrations below the 50% quartile contribute a "Low Concentration" of pollutants relative to other SMUs. Table 34 and Figure 50 depict and summarize the results of the SMU scale pollutant loading analysis. Three of the 12 SMUs comprising Lower Little Rock Creek watershed are considered "High Concentration" pollutant load Hot Spots for nitrogen, phosphorus, and sediment based on STEPL modeling. Another three SMUs are considered "Moderate Concentration" pollutant load Hot Spots for various combinations of nitrogen, phosphorus, and sediment. The remaining six SMUs contribute "Low Concentrations" based on modeling.

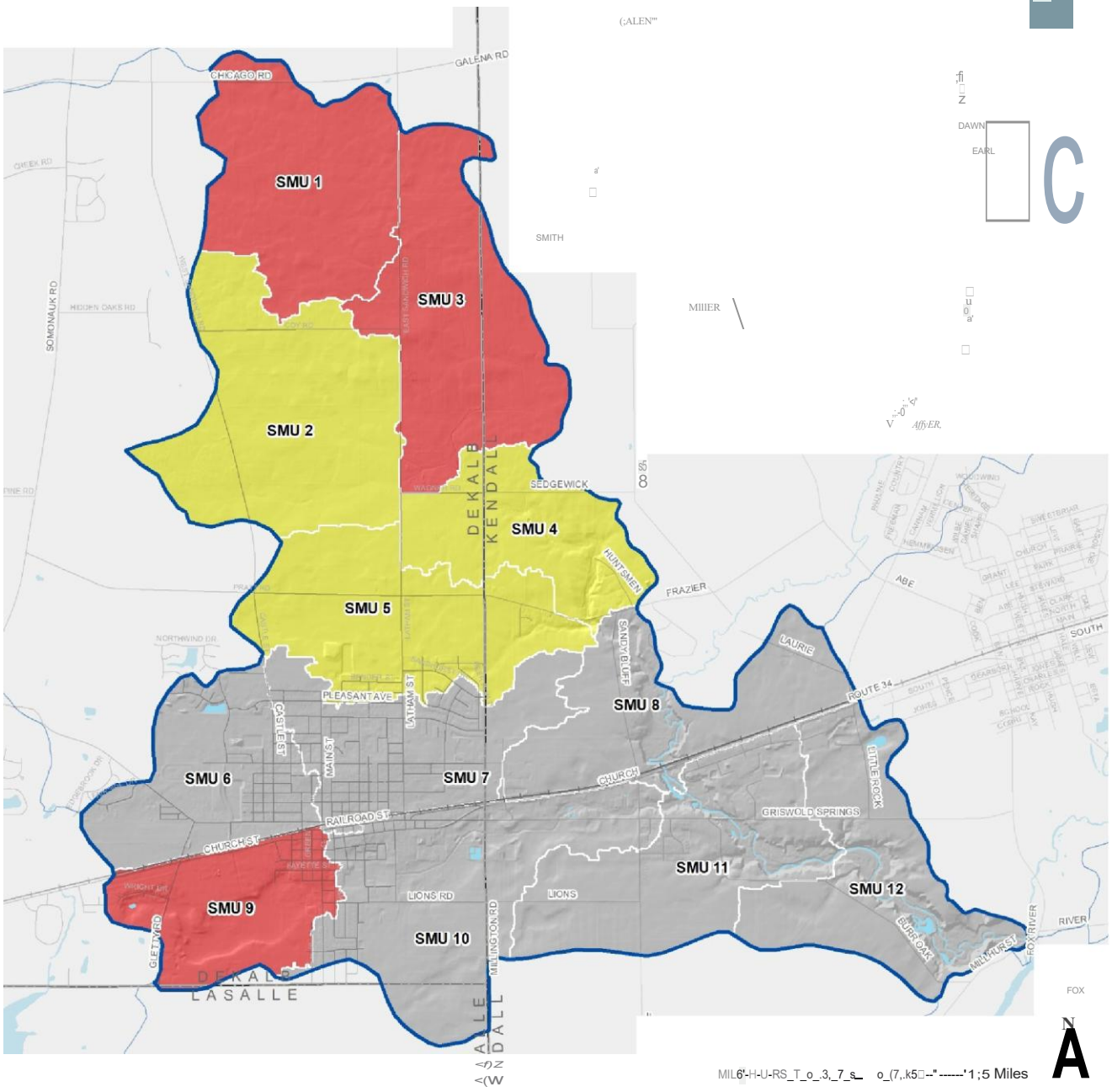
Table 34. Pollutant load "Hot Spot" SMUs.

Hot Spot SMU	Size (acres)	N Load (lbs/yr)	N Load (lbs/yr) /ac	P Load (lbs/yr)	P Load (lbs/yr) /ac	TSS Load (t/yr)	TSS Load (t/yr) /ac	Aggregate Load Concentration
High Concentration Hot Spot SMUs								
SMU 9	606.8	4,844.9	8.0	1,108.5	1.8	509.5	0.8	10.7
SMU 1	942.7	6,936.9	7.4	1,897.8	2.0	1,086.1	1.2	10.5
SMU 3	1,041.8	7,640.9	7.3	2,064.8	2.0	1,170.8	1.1	10.4
Moderate Concentration Hot Spot SMUs								
SMU 2	1,188.3	8,583.5	7.2	2,299.0	1.9	1,289.6	1.1	10.2
SMU 5	962.2	6,972.3	7.2	1,756.5	1.8	904.6	0.9	10.0
SMU 4	631.7	4,480.7	7.1	1,196.4	1.9	642.6	1.0	10.0

SMUs 9, 1, and 3 have the highest aggregate load concentrations relative to the remaining SMUs and are considered "High Concentration" Hot Spot SMUs. For these three SMUs, pollutant loading is driven by agricultural land uses with urban land uses also contributing to SMU 9 load concentrations. SMUs 2, 5, and 4 were determined to be "Moderate Concentration" Hot Spot SMUs. For these three SMUs, pollutant loading is driven by agricultural land uses with urban land uses also contributing to SMUs 4 and 5 load concentrations. All other SMUs (SMUs 6-8 and 10-12) produce "Low Concentrations" of aggregate load concentrations based on the pollutant load "Hot Spot" SMU analysis.

LITTLE ROCK CREEK WATERSHED

Figure 50· Nonpoint Source Pollutant Loading Hot Spot SMU's



LEGEND

D Little Rock Creek watershed

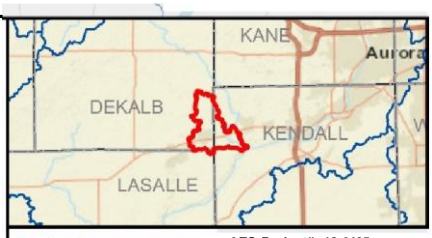
-- Railroads

-- Roads

Waterbodies (NHD)

Nonpoint Source Pollutant Loading Hot SpotSMUs

- High Concentration
- Moderate Concentration
- Low Concentration



AES Project#: 18-0105

Coordin.ite SV$tem:
NAD 83 IL State Plane Es%t
Data Sources: DeKalb County, Kendall County, City of Sandwich

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5.0 CAUSES/SOURCES OF IMPAIRMENT & REDUCTION TARGETS

5.1 Causes & Sources of Impairment

According to Illinois EPA's most recent 2018 *Integrated Water Quality Report and Section 303(d) List*, Little Rock Creek (IEPA Segment Code: IL_DTCA-01) is "Fully Supporting" for *Aquatic Life* and for *Aesthetic Quality*; Little Rock Creek was not assessed for *Fish Consumption* or *Primary Contact Recreation.* Recent water quality data collected within Lower Little Rock Creek indicates likely overall impairment from elevated total phosphorus and total nitrogen. For more detailed information on water quality and designated uses and impairments, see Section 4.1.

There are also non-water quality related impairments in the watershed such as habitat degradation, loss of open space, hydrologic and flow changes, and structural flood damage. Many different causes and sources are related to these impairments.

Table 35 summarizes all *known* or *potential* causes and sources of watershed impairment as documented by Illinois EPA, items identified via Applied Ecological Service's watershed resource inventory, and input from the Watershed Steering Committee who met during the February 17, 2021 Goals Workshop to discuss impairments.

Table 35. *Known* and *potential* causes and sources of watershed impairment.

Illinois EPA or other Impairment	Cause of Impairment	Known or Potential Source of Impairment
Water Quality: Aquatic Life	Nutrients- *known impairment*: (Phosphorus & Nitrogen)	Agricultural row crop runoff; Streambank erosion; Residential, Ag, and commercial lawn fertilizer; Failing septic systems; Inadequate policy; Level of landowner education; Wastewater treatment plants; Buried stream sections (nitrogen)
Water Quality: Aquatic Life	Chlorides (salinity), pesticides/herbicides, emerging contaminants- *Potential future impairment*	Deicing operations on roads & parking lots; Residential, Ag, and commercial herbicide & pesticide use; Inadequate policy; Level of public education; Lack of knowledge and education
Habitat Degradation	Invasive/non-native plant species in riparian and other natural areas, litter in streams & riparian areas- *known impairment*	Spread from existing and introduced populations; Level of public education; Lack of maintenance and management; Lack of volunteer stream groups
Habitat Degradation	Loss and fragmentation of open space/natural habitat due to development - *known impairment*	Inadequate protection policy; Lack of land acquisition funds; Traditional development design; Streambank, channel, and riparian area modification; Lack of appropriate land management; Lack of restoration and maintenance funds; Wetland loss

Illinois EPA or other Impairment	Cause of Impairment	Known or Potential Source of Impairment
Hydromodification and Flow Changes	Alteration of natural drainage channels; impervious surfaces- *known impairment*	Historic channelization and ditching of streams; Drain tiles; Wetland loss; Buried or piped streams; Existing & future urban runoff
Structural Flooding	Alteration of natural drainage channels and wetland loss- *known impairment*	Wetland loss; Channelized streams; Poor detention basin design & function; Existing and future urban impervious surfaces; Agricultural drain tiles; Inaccurately sized stormwater conveyance

5.2 Critical Areas, Management Measures & Estimated Impairment Reductions

For this watershed plan a "Critical Area" is best described as a location in the watershed where existing or potential future causes and sources of an impairment or existing function are significantly worse than other areas of the watershed. Five Critical Area types were identified in Lower Little Rock Creek watershed and include:

1) poorly designed/functional detention basins or detention needs;
2) highly degraded stream and riparian area reaches;
3) large drained wetland complexes;
4) priority green infrastructure protection areas; and
5) other management measure recommendations.

Short descriptions of each Critical Area type are included below. Table 36 includes summaries of the current condition at each Critical Area (by type) and recommended Management Measures with estimated nutrient and sediment load reductions expected. The list of Critical Areas identified in the following paragraphs is a subset of the full management measures as found in the Action Plan section of this report. Figure 51 maps the location of each Critical Area.

Pollutant load reductions are evaluated for the majority of the Critical Area Management Measures based on efficiency calculations developed for the USEPA's Region 5 Model. This model uses "Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual" (MDEQ, 1999) to provide estimates nutrient and sediment load reductions from the implementation of *agricultural* Management Measures. Estimate of nutrient and sediment load reduction from implementation of *urban* Management Measures is based on efficiency calculations developed by Illinois EPA. Illinois EPA pollutant load reduction worksheets for each Management Measure, including Critical Areas, are located in Appendix D.

Critical Detention Basins

Critical detention basins are generally defined as existing basins that provide poor ecological and water quality benefits in areas where these attributes are needed. Six (6) detention basins meet the criteria of a Critical Area based of their location, function, and size. Most of the Critical Area detention basin retrofit recommendations are located within the City of Sandwich. The most common recommendation is to naturalize basins that are currently turf grass with native vegetation

to provide better water quality improvement, greater infiltration, and improve wildlife habitat. A summary of the detention basins in the watershed is included in Section 3.13.

Critical Stream and Riparian Area Reaches

Critical stream and riparian area reaches are those with highly eroded streambanks that are a major source of total suspended solids (sediment) carrying attached phosphorus and nitrogen and/or where buffers adjacent to stream reaches are in poor ecological condition but with excellent ecological restoration and remediation potential to improve water quality and habitat conditions. Streambank stabilization using bioengineering where necessary, installation of artificial riffles in stream, and improved and expanded riparian areas on Critical Area stream reaches will greatly reduce sediment and nutrient transport downstream while improving habitat and increasing oxygen levels. Nine (9) stream reaches totaling 52,428 linear feet were identified as Critical Areas. Section 3.13 includes a complete summary of streams, tributaries, and riparian areas in the watershed.

Critical Wetland Restoration Sites

Critical wetlands restoration sites are generally associated with large areas that were historically wetland prior to European settlement in the 1830s but were drained for agricultural purposes. Many of these historic wetlands can be restored by breaking existing drain tiles and planting with native vegetation. Wetland restorations are among the most recommended projects to improve water quality, reduce flooding, and improve wildlife habitat. Seven (7) Critical Area wetland restoration recommendations were identified in the watershed. Critical Area status was assigned based on location, size, and restoration potential. A detailed summary of the extent of drained wetlands and restoration opportunities in the watershed is included in Section 3.13.

Critical Priority Green Infrastructure Protection Areas

Information obtained from existing and predicted future land use data, potentially restorable wetlands, groundwater recharge potential, highly vulnerable SMUs, and green infrastructure sections of this report led to identification of two (2) priority green infrastructure protection areas totaling 446 acres. Both areas lie immediately to the north of the City of Sandwich and both are currently in agricultural production with the potential to be developed in the near future. While these areas remain in agricultural production, it will be important to ensure that no-till farming is being utilized on those lands. If and when any of the areas are developed, development should follow Conservation Design or Low Impact Development standards and guidelines to help maintain and improve water quality and watershed conditions. This assessment is by no means meant to prevent or deter future urbanization or land use change, but rather to determine which areas might be most in need of utilizing conservation design or low impact development when change does occur so as to protect remaining natural resources, and to identify existing developed lands that could be managed for maximum green infrastructure benefit, restoration, and preservation.

Critical Programmatic Conservation Tillage Practice Changes on Agricultural Land

Additional conservation practices and increases in the extent of reduced tillage practices in the Lower Little Rock Creek watershed are necessary to reduce cropland pollutant loading. Unfortunately, there is no good data available on the existing extent of conservation tillage practices in place, but STEPL modeling was used to determine how additional agricultural management practices might improve water quality and reduce nutrient loading in the watershed. If an additional 19% (1,357 acres) or more of agricultural landowners were to utilize more intensive Conservation Tillage practices (leaving at least 60% residue), this change alone could reduce watershed wide pollutant loads by 5,022 lbs/year of nitrogen, 1,989 lbs/year of phosphorus, and 1,214 tons/year of

sediment. Therefore, increasing high residue conservation tillage on at least 19% of agricultural lands, while not a site-specific recommendation (and therefore not mapped), is considered a Critical Area Management Measure applicable to all agricultural land in the watershed. For more detailed information on Agricultural Management Practice Recommendations, see Section 6.1.13.

Other Critical Management Measures

Several potential Management Measure projects were identified that fit under miscellaneous other categories. In total there were 5 Critical Area projects that fell into the other management measure categories, including 3 Natural area restorations, 1 natural area maintenance site, and the removal of one failed dam. These areas were typically determined to be Critical Areas due to their size, location, and/or ability to reduce pollutant loading and improve habitat in the watershed. More information about other management measure recommendations can be found in Section 6.2.5.

Table 36. Critical Areas, existing conditions, recommended Management Measures, & estimated nutrient and sediment load reductions.

ID #	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency		
			TSS (tons/yr)	TP (lbs/yr)	TN (lbs/ yr)
Detention Basin Retrofits					
14A	Dry detention basin with mowed turf bottom and slopes in poor ecological condition	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish	12	37	125
14C	Dry detention basin with mowed turf bottom and slopes in poor ecological condition	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish	5	7	30
17A	Dry detention basin with mowed turf bottom and slopes in poor ecological condition	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish	57	29	246
18B	Dry detention basin with mowed turf bottom and slopes in poor ecological condition	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish	2	3	18
19C	Wet-bottomed detention basin with naturalized side slopes but in poor ecological condition	Design and implement a project to naturalize basin slopes and turf areas with natives and maintain for three years to establish	19	26	108
21A	Dry detention basin with mowed turf bottom and slopes in poor ecological condition	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish	17	21	155
Stream & Riparian Area Restorations					
LRCR1	14,071 lf of stream exhibiting no channelization, moderate levels of erosion and good overall riparian area condition	Design, permit, and implement a project to remove invasive species from riparian areas, spot stabilize eroding banks where necessary, and restore riparian buffer with native vegetation then maintain for three years to ensure establishment	640	589	1,943
LRCR2	9,458 lf of stream exhibiting no channelization, moderate levels of erosion and good overall riparian area condition	Design, permit, and implement a project to remove invasive species from riparian areas, spot stabilize eroding banks where necessary, and restore riparian buffer with native vegetation then maintain for three years to ensure establishment	509	433	866

ID #	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency		
			TSS (tons/yr)	TP (lbs/yr)	TN (lbs/ yr)
LRCTR1	5,157 lf of stream exhibiting high levels of channelization, no erosion and poor overall riparian area condition	Design and implement a project to remove invasive species from riparian areas and restore with native vegetation then maintain for three years to ensure establishment	36	48	485
LRCTR2	8,642 lf of stream exhibiting low levels of channelization, low levels of erosion and poor overall riparian area condition	Design and implement a project to remove invasive species from riparian areas and restore with native vegetation then maintain for three years to ensure establishment	114	122	569
LRCTR3	4,351 lf of stream exhibiting no channelization, low levels of erosion and average overall riparian area condition	Design and implement a project to remove invasive species from riparian areas and restore with native vegetation then maintain for three years to ensure establishment	50	53	151
T3R1	3,395 lf of stream exhibiting high levels of channelization, low levels of erosion and average overall riparian area condition	Design and implement a project to remove invasive species and restore with native vegetation then maintain for three years to ensure establishment	95	105	785
T3R2	4,086 lf of stream exhibiting moderate levels of channelization, low levels of erosion and average overall riparian area condition	Design and implement a project to remove invasive species and restore with native vegetation then maintain for three years to ensure establishment	97	106	848
T3R3	1,372 lf of stream exhibiting low levels of channelization, moderate levels of erosion and poor overall riparian area condition; cattle have free access to stream	Design, permit, and implement a project to remove invasive species, spot stabilize eroding banks, restore riparian buffer with native vegetation, install fencing to control livestock access to stream, and maintain for three years to ensure establishment	61	58	311
T3R4	1,897 lf of stream exhibiting moderate levels of channelization, moderate levels of erosion and average overall riparian area condition; culverts under Sandy Bluff Rd inhibit fish passage	Design, permit, and implement a project to remove invasive species, spot stabilize eroding banks, restore riparian buffer with native vegetation, restore fish passage, and maintain for three years to ensure establishment	86	80	256

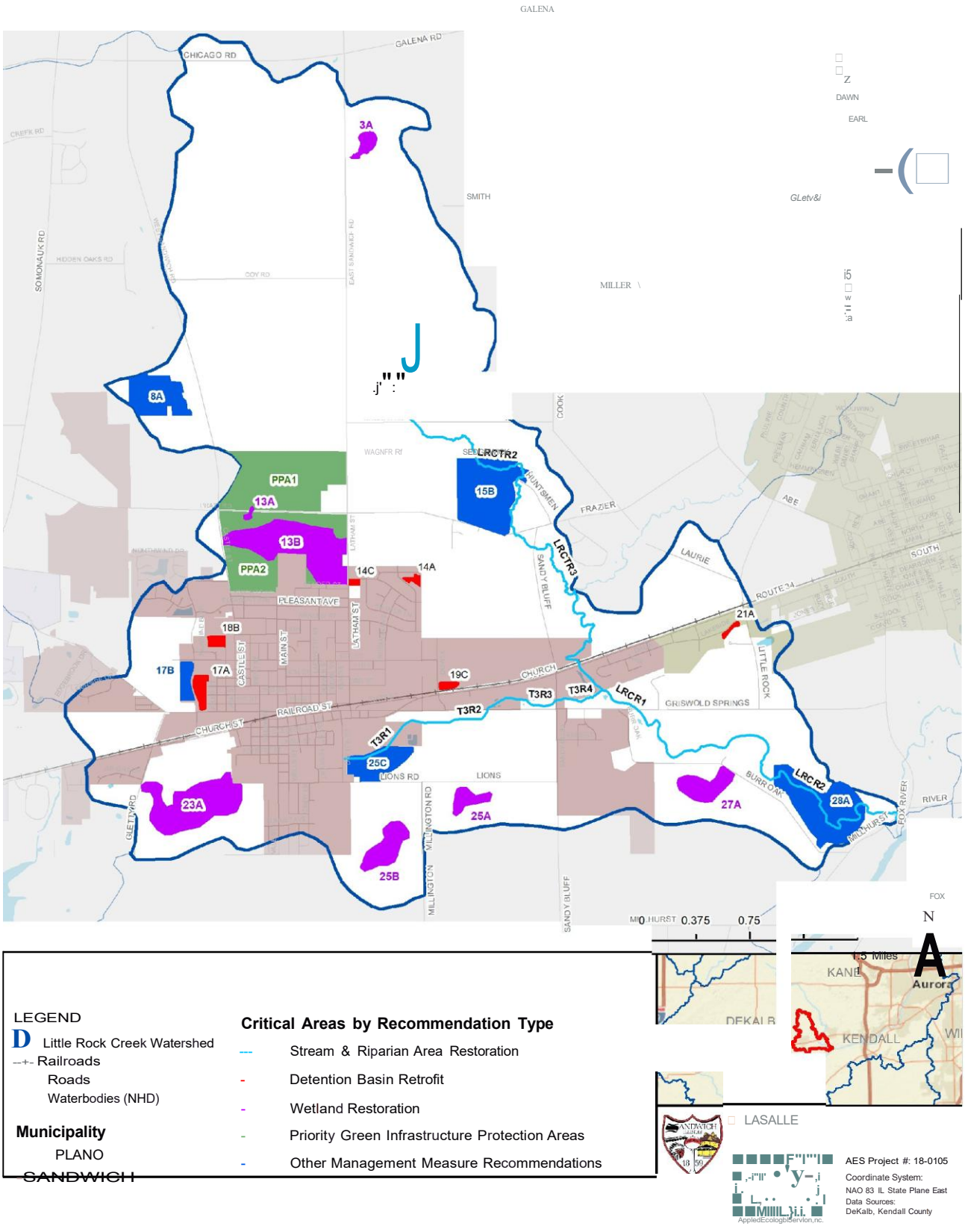
ID #	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency		
			TSS (tons/yr)	TP (lbs/yr)	TN (lbs/ yr)
Wetland Restoration Sites					
3A	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration site.	Design, permit, and construct a project to restore hydrology by breaking drain tiles if necessary, revegetating with native vegetation/seed, and maintaining for three years until established	10	16	203
13A	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration site.	Design, permit, and construct a project to restore hydrology by breaking drain tiles if necessary, revegetating with native vegetation/seed, and maintaining for three years until established	7	13	137
13B	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration and/or mitigation bank.	Design, permit, and construct a project to create wetland storage in farmed area by restoring hydrology via breaking drain tiles if necessary, excavating and installing water control structures for additional water storage, and revegetate with native vegetation.	70	130	1,397
23A	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration and/or mitigation bank	Design, permit, and construct a project to restore hydrology by breaking drain tiles if necessary, revegetating with native vegetation/seed, and maintaining for three years until established	21	39	422
25A	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration and/or mitigation bank	Design, permit, and construct a project to restore hydrology by breaking drain tiles if necessary, revegetating with native vegetation/seed, and maintaining for three years until established	13	24	256
25B	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration and/or mitigation bank	Design, permit, and construct a project to restore hydrology by breaking drain tiles if necessary, revegetating with native vegetation/seed, and maintaining for three years until established	21	39	422

ID #	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency		
			TSS (tons/yr)	TP (lbs/yr)	TN (lbs/ yr)
27A	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration and/or mitigation bank	Design, permit, and construct a project to restore hydrology by breaking drain tiles if necessary, revegetating with native vegetation/seed, and maintaining for three years until established	15	28	304
Priority Green Infrastructure Protection Areas					
PPA1 (13C)	Existing row crop production likely to be developed in the future (also 13C). Includes 13B.	Utilize no-till farming as long as property is in production; utilize conservation design or low impact development if developed	NA	NA	NA
PPA2 (13H)	Existing row crop production that drains south to 13B/PPA1 and likely to be developed in the future (also 13H)	Utilize no-till farming and reduce stormwater flows to nearby Latham flood problem area as long as property is in production; utilize conservation design or low impact development if developed	NA	NA	NA
Programmatic Conservation Tillage Practices on Agricultural Land					
N/A – any/all agricultural land	Conventional tillage likely in use across most of the existing agricultural land (7,140 acres) in the watershed.	Additional Conservation Tillage practices (leaving at least 60% residue on fields) should be implemented on at least 19% (1,357 acres) or more of existing agricultural lands. This recommendation is applicable to any and all agricultural land in the watershed.	1,214	1,989	5,022
Other Management Measures					
8A	Remnant dry-mesic oak woodland overgrown with invasive shrub and tree species	Conduct Natural Resource Inventory and develop management plan then implement management plan to restore oak woodland. Maintain for three years to establish/maintain.	7	10	121
15B	Large old field area with overgrown dry-mesic oak woodland adjacent to stream	Conduct Natural Resource Inventory and develop management plan then implement management plan to restore oak woodland and old field areas. Maintain for three years to establish/maintain.	10	18	178

ID #	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency		
			TSS (tons/yr)	TP (lbs/yr)	TN (lbs/ yr)
17B	Upland area mowed turf area where spoils from detention appear to be placed	Design and implement a project to convert turf to prairie and maintain for three years to establish	33	42	299
25C	Restored wetland complex and wet-mesic prairie at Harvey Creek Conservation Area. Important to maintain control of invasive species long term	Develop and implement maintenance plan to control invasive species and manage long term.	8	13	146
28A	Failed concrete dam and old berm adjacent to and upstream creating artificial slough, with failed crossing just downstream, in Little Rock Creek Forest Preserve	Design, permit, and implement a project to remove dam, crossing, and berms around slough to restore floodplain function. Dam removal will equalize flow upstream and downstream and will allow fish and mussel passage. Project should be completed in conjunction with restoration of Reach LRCR2.	18	53	354

LITTLE ROCK CREEK WATERSHED

Figure 51: Critical Areas



5.3 Watershed Impairment Reduction Targets

Establishing "Impairment Reduction Targets" is important because these targets provide a means to measure how implementation of Management Measures at Critical Areas is expected to reduce watershed impairments over time. Table 37 summarizes the basis for *known* impairments and nonpoint source reduction targets. Since the City of Sandwich STP is a permitted source under IEPA's NPDES permit system and the upstream portions of Little Rock Creek are outside this watershed planning area, their relative contributions to pollutant loading were not included in the calculation of reduction targets. Reduction targets listed in Table 37 are based on documented information, STEPL modeling results, average water quality sampling results at the DTCA-01 monitoring location, and water quality standards and criteria set by the Illinois Pollution Control Board (IPCB, 2011), USEPA (2000), and USGS (2006). It is important to note that the assumption is made that percent decrease in sample concentration (mg/l) needed correlates to the percent reduction in annual load (lbs/yr or tons/yr) for phosphorus, nitrogen, and sediment reduction targets. In addition, Table 37 summarizes the load reduction of phosphorus and nitrogen, expected from addressing Critical Areas.

Based on the results of the water quality inventory (as identified in Section 4.1), a 49% decrease in total nitrogen (TN) and a 19% decrease in total phosphorus (TP) are needed in Little Rock Creek from all sources combined to reach target levels based on recommended *numeric* criteria proposed by USEPA (USEPA 2000), USGS (USGS 2006) and IEPA (2011). No decrease in total suspended solids is needed – TSS is well within target criteria guidelines based on the water quality inventory. Furthermore, based on the pollutant load modeling (Table 37), the relative NPS contribution from Lower Little Rock Creek watershed to total pollutant loads are 35% of nitrogen loading, 47% of phosphorus loading, and 72% of total suspended solids loading.

Watershed-Wide Reduction Targets for Phosphorus and Nitrogen

Watershed-wide phosphorus and nitrogen reduction targets could be attained by addressing Critical Areas alone according to the pollutant reduction calculations. Critical Areas alone would remove 4,131 lbs/yr (101% of the target) and 16,157 (347% of the target) of phosphorus and nitrogen, respectively. **No estimate is shown for total suspended solids because, based on IEPA data and the water quality inventory, it is not an issue in the watershed;** however, Critical Area recommendations alone would remove approximately 3,247 tons/yr of sediment from the watershed.

Additional watershed-wide reduction targets were established for habitat degradation, hydromodification and flow changes, and the identified flooding flood problems. Habitat degradation and hydromodification and flow changes targets could be met by implementing riparian area restoration and by restoring wetlands. Each of the eleven flood problem areas will need to be addressed on a case by case basis to meet targets.

Table 37. Basis for *known* impairments, nonpoint source reduction targets, & impairment reduction from Critical Areas.

Impairment: Cause of Impairment	Basis for Impairment	NPS Reduction Target	Reduction from Critical Area	Target Attainable?
Watershed-Wide Reduction Targets				
Water Quality/Aquatic Life: Phosphorus in Lower Little Rock Creek	17,816 lbs/yr of NPS total phosphorus loading based on STEPL model & 0.142 mg/l of total phosphorus based on water quality samples for Little Rock Creek from all sources & 47% relative NPS contribution to total phosphorus loading	**>22.9% or 4,095 lbs/yr reduction in phosphorus** loading to achieve 0.0725 mg/l total phosphorus USEPA numeric criteria for streams in Ecoregion VI	123 lbs/yr or 3% reduction from critical detention basin retrofits	
			1,594 lbs/yr or 39% reduction from critical stream & riparian area reaches	
			289 lbs/yr or 7% reduction from critical wetland restorations	
			136 lbs/yr or 3% reduction from critical other management measures	
			1,989 lbs/yr or 43% reduction from programmatic conservation tillage practice changes on at least 19% of agricultural land	
TOTAL			**4,131 lbs/yr or 101% total phosphorus reduction from all Critical Areas**	**Yes**
Water Quality/Aquatic Life: Nitrogen in Lower Little Rock Creek	71,899 lbs/yr of NPS nitrogen loading based on STEPL model & 3.020 mg/l of total nitrogen based on water quality samples for Little Rock Creek from all sources & 35% relative NPS contribution to total nitrogen loading	**>6.5% or 4,655 lbs/yr reduction in nitrogen** loading to achieve 2.461 mg/l total nitrogen USEPA numeric criteria for streams in Ecoregion VI	682 lbs/yr or 15% reduction from critical detention basin retrofits	
			6,214 lbs/yr or 133% reduction from critical stream & riparian area reaches	
			3,141 lbs/yr or 67% reduction from critical wetland restorations	
			1,098 lbs/yr or 24% reduction from critical other management measures	
			5,022 lbs/yr or 108% reduction from programmatic conservation tillage practice changes on agricultural land	
TOTAL			**16,157 lbs/yr or 347% total nitrogen reduction from all Critical Areas**	**Yes**
Habitat Degradation: Invasive/non-native plant species in riparian areas and loss and fragmentation of open space/natural habitat	16,453 lf of riparian areas are currently in poor condition	**16,453 linear feet or 29%** of riparian areas ecologically restored	52,428 lf or 93% of riparian areas restored along critical riparian areas	Yes
Hydromodification and Flow Changes	Increase in flow and channel volumes; 1,467 acres (83%) of wetlands lost since pre-settlement	**7 critical wetlands restored** accounting for 355 acres	355 critical wetland acres restored	Yes

Impairment: Cause of Impairment	Basis for Impairment	NPS Reduction Target	Reduction from Critical Area	Target Attainable?
Identified Flood Problem Areas	11 flood problem areas	**11 or 100% of** flood problem areas addressed	Not Applicable*	Yes

* Addressed in Action Plan section of report

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6.0 MANAGEMENT MEASURES ACTION PLAN

Earlier sections of this plan summarized the Lower Little Rock Creek watershed's characteristics and identified causes and sources of watershed impairment. This section includes an "Action Plan" developed to provide stakeholders with recommended "Management Measures" (Best Management Practices) to specifically address plan goals at general and site-specific scales. The Action Plan is divided into two subsections:

- *Programmatic Measures:* general remedial, preventive, and policy watershed-wide Management Measures that can be applied across the watershed by various stakeholders.

- *Site-Specific Measures:* actual locations where Management Measure projects can be implemented to improve surface and groundwater quality, green infrastructure, and flooding.

The recommended programmatic and site-specific Management Measures provide a solid foundation for protecting and improving watershed conditions but should be updated as projects are completed, or other opportunities arise. Lead implementation stakeholders are encouraged to organize partnerships with key stakeholders and develop various funding arrangements to help delegate and implement the recommended actions. The key stakeholders in the watershed are listed in Table 38. Note: all recommendations in this Section are for guidance only and not required by any federal, state, or local agency.

Table 38. Key Lower Little Rock Creek watershed stakeholders/partners.

Key Watershed Stakeholder/Partner	Abbreviation
City of Plano	Plano
City of Sandwich	Sandwich
DeKalb County	DeKalb Co.
DeKalb County Community Foundation	DCCF
DeKalb County Soil and Water Conservation District	DCSWCD
Illinois Department of Natural Resources	IDNR
Illinois Environmental Protection Agency	IEPA
Kendall County	Kendall Co.
Kendall County Forest Preserve District	KCFPD
LaSalle County	LaSalle Co.
Sandwich Park District	SPD
Sandwich Stormwater Treatment Plan	SSTP
The Conservation Foundation	TCF
United States Army Corps of Engineers	USACE
United States Fish & Wildlife Service	USFWS

6.1 Programmatic Management Measures Action Plan

Numerous types of programmatic Management Measures are recommended to address watershed objectives for each plan goal. The following pages include recommended measures that are applicable throughout the watershed and information needed to facilitate implementation of specific actions. A brief summary of the general programmatic measure types is included below:

Policy: Local, state, and federal government can help prevent watershed impairments in various ways through policy but specifically by adopting and/or supporting (via a resolution) the Lower Little Rock Creek Watershed-Based Plan, implementing green infrastructure policy, requiring conservation developments for new developments, protecting groundwater, reducing road salt usage and lawn fertilizers, requiring natural detention basins and naturalization of existing basins, and allowing use of native vegetation/landscaping.

Non-Structural: This includes a broad group of practices that prevent impairment through maintenance and management of Management Measures or programs that are ongoing in nature and designed to control pollutants at their source. Such programs include many of the agricultural programs available to farmers and street sweeping.

Structural: This includes a broad group of practices that prevent impairment via installation of in-the-ground measures. This plan focuses on implementation of naturalized stormwater measures/retrofits, permeable paving, vegetated filter strips/buffers, natural area restoration, wetland restoration, and use of rainwater harvesting devices.

Educational: Outreach is important to inform the public related to environmental impacts of daily activities and to build support for watershed planning and plan implementation. Topics typically address watersheds, water quality, land management, pet waste management, lawn fertilizer use, good housekeeping, etc.

6.1.1 Policy Recommendations

Various recommendations are made throughout this report related to how local governments can improve the condition of Lower Little Rock Creek watershed through policy. Policy recommendations focus on improving watershed conditions by preserving green infrastructure, protecting groundwater, minimizing road salts, minimizing lawn fertilizer, sustainable management of stormwater, and allowances for native landscaping. To be successful, the Lower Little Rock Creek Watershed-Based Plan would need to be adopted and/or supported by local communities. The process of creating and implementing policy changes can be complex and time consuming. And, although there are numerous possible policy recommendations for the watershed, the following policy recommendations are considered the most important and highest priority for implementation.

Plan Adoption and/or Support & Implementation Policy Recommendations

- Watershed Partners adopt and/or support (via a resolution) the Lower Little Rock Creek Watershed-Based Plan and incorporate plan goals, objectives, and recommended actions into comprehensive plans and ordinances.

Green Infrastructure Network Policy Recommendations

- Each municipality consider incorporating the identified Green Infrastructure Network (GIN) into comprehensive plans and development review maps.

- Utilize tools such as protection overlays, setbacks, open space zoning, conservation easements, conservation and/or low impact development, etc. in municipal comprehensive plans and zoning ordinances to protect environmentally sensitive areas on identified Green Infrastructure Network parcels.
- Utilize tools such as Development Impact Fees, Stormwater Utility Taxes, Special Service Area (SSA) Taxes, etc. to help fund implementation of plan and future management of green infrastructure components where new and redevelopment occurs.
- Require developers to protect sensitive natural areas, restore degraded natural areas and streams, and then encourage donation of natural areas and naturalized stormwater management systems to a public agency or conservation organization for long term management with dedicated funding such as Development Impact Fees, Stormwater Utility Taxes, Special Service Area (SSA) Taxes, etc. In general, it is not recommended that these features be turned over to HOA's to manage where possible, as they lack the resources and experience to do so effectively.
- Establish incentives for developers who propose sustainable or innovative approaches to implement the watershed-based plan, including priority for preserving green infrastructure and using naturalized stormwater treatment trains.
- Encourage mitigation for wetlands lost prior to allowing development within the watershed.

Groundwater Policy Recommendations

- Encourage extensive stormwater management practices that clean and infiltrate water in any development or redevelopment.
- Limit impervious cover within new and redevelopments occurring within Subwatershed Management Units 2, 4, 5, 8, 9, and 10 which are ranked as highly vulnerable to future impervious cover.

Road Salt Policy Recommendations

- Encourage each municipality/township to supplement existing programs with deicing best management practices such as utilizing alternative deicing chemicals, anti-icing or pretreatment, controlling the amount and rate of spreading, controlling the timing of application, utilizing proper application equipment, equipment calibration, and educating/training deicing employees.
- Establish additional new best management practice recommendations based on the results of various ongoing studies and research being produced by Illinois Tollway to reduce, re-use, and offset the impacts of winter roadway operations. These include converting invasives to energy, to harvest cattails for the purpose of removing excess nutrients, potentially quantifying chloride removal, re-using the plant mass for compost or compressed into an Energy product or potentially using the byproducts of the biomass as a replacement for beet juice on roadways (Illinois Tollway, 2019; Paap, 2019; and Wetlands Research, 2019).

Lawn Fertilizer and Paving Policy Recommendations

- Require local governments to extend phosphorus regulation to non-commercial applicators, require soil testing pre-application, or ban out-right.
- Require local governments to ban coal tar sealants within their jurisdiction.
- Require local governments to permit the use of pavement alternatives such as permeable pavers in appropriate areas.

Stormwater Management Facility Policy Recommendations

- Require new development and redevelopment to use stormwater management techniques/ facilities that serve multiple functions including storage, water quality benefits, infiltration, and wildlife habitat.
- Require the use of reduced runoff volume from new and retrofitted detention basins.
- Require local governments to allow stormwater trees or create a stormwater tree program.

Native Landscaping/Natural Area Restoration

- Allow native landscaping within local ordinances.
- Ensure local "weed control" ordinances do not discourage or prohibit native landscaping.
- Include short- and long-term management with performance standards for restored natural areas and stormwater features within new and redevelopment.

6.1.2 Dry & Wet Bottom Detention Basin Design/Retrofits, Establishment, & Maintenance

Detention basins are best described as human made depressions for the temporary storage of stormwater runoff with controlled release following a rain event. There are 18 detention basins in Lower Little Rock Creek watershed, and most are associated with residential and urban development. Most existing wet bottom basins are essentially ponds planted with turf grass along the slopes, and the majority of the dry bottom basins are similarly planted with turf grass from end to end. These attributes do not promote water quality improvement, good infiltration, or wildlife habitat capabilities.

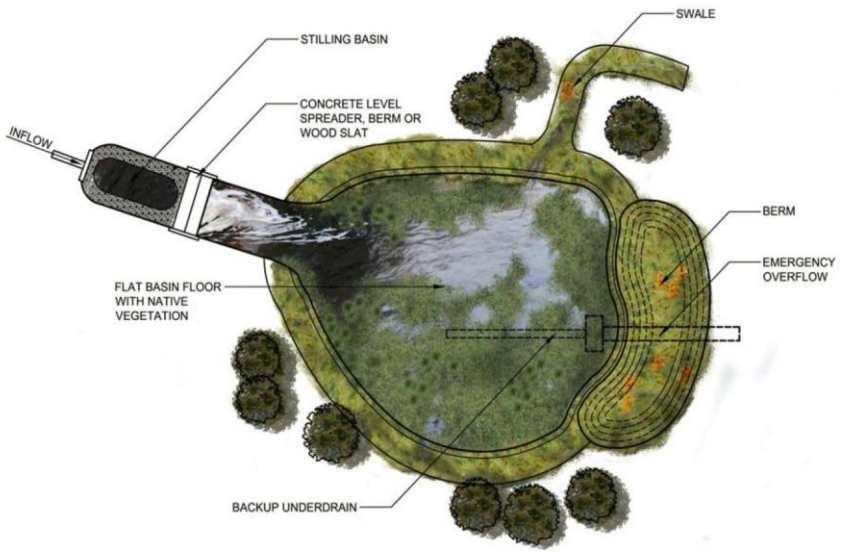


Figure 52. Naturalized dry bottom infiltration basin design.

Studies conducted by several credible entities over the past two decades reveal the benefits of detention basins that serve multiple functions. According to USEPA, properly designed dry bottom infiltration basins reduce total suspended solids (sediment) by 58%, total phosphorus by 26%, and total nitrogen by 30%. Wet bottom basins designed to have wetland characteristics reduce total suspended solids (sediment) by 78%, total phosphorus by 44% and total nitrogen by 20% (MDEQ, 1999).

Detention Basin Recommendations

Future detention basin design within the watershed should consist of naturalized basins that serve multiple functions, including appropriate water storage, water quality improvement, natural aesthetics, and wildlife habitat. There are also a large number of opportunities to retrofit existing dry or wet bottom detention basins by incorporating minor engineering changes and naturalizing with

native vegetation. Site-specific retrofit opportunities are identified in the Site-Specific Action Plan.

Location, design, establishment, and long-term maintenance recommendations for naturalized detention basins are included below. Note: requirements of the DeKalb County Stormwater Ordinance and Kendall County Stormwater Management Plan, such as volume and release rates, will apply to the design recommendations included below.

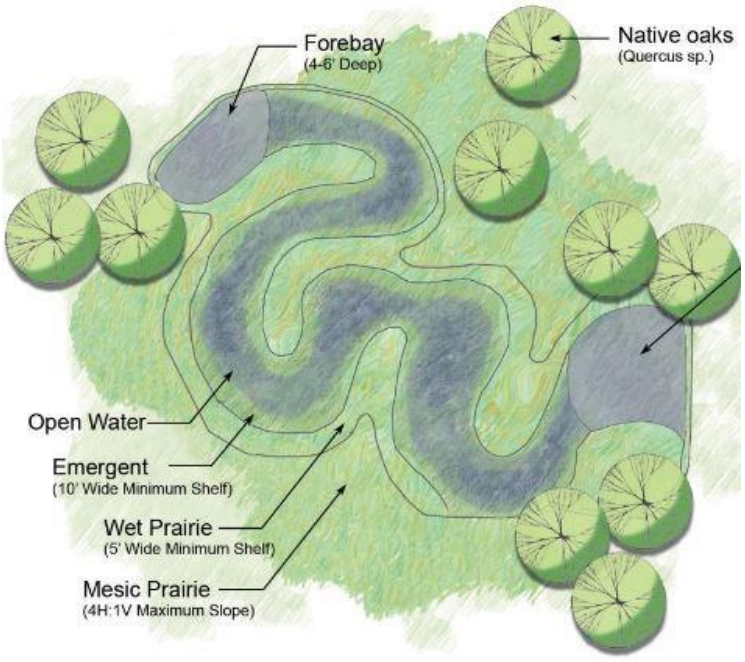


Figure 53. Naturalized wet bottom detention basin design.

Detention Location Recommendations

- Naturalized detention basins should be restricted to natural depressions or previously drained hydric soil areas and adjacent to other existing green infrastructure in an attempt to aesthetically fit and blend into the landscape. Use of existing isolated wetlands for detention should be evaluated on a case-by-case basis.
- Basins should not be constructed in any average to high quality ecological community.
- Outlets from detentions should not enter sensitive ecological areas.

Detention Design Recommendations

- One appropriately sized, large detention basin should be constructed across multiple development sites rather than constructing several smaller basins.
- Side slopes should be no steeper than 4H:1V, at least 25 feet wide, planted to native mesic prairie, and stabilized with erosion control blanket. Native oak trees *(Quercus sp.*) and other fire-tolerant species should be the only tree species planted on the side slopes.
- Dry bottom basins should be planted to mesic or wet-mesic prairie depending on site conditions.
- A minimum 5-foot-wide shelf planted to native wet prairie and stabilized with erosion control blanket should be constructed above the normal water level in wet and wetland bottom basins. This area should be designed to inundate after every 0.5-inch rain event or greater.
- A minimum 10-foot-wide shelf planted with native emergent plugs should extend from the normal water level to 2 feet below normal water level in wet and wetland bottom basins.
- Permanent pools in wet and wetland bottom basins should be at least 4 feet deep.
- Irregular islands and peninsulas should be constructed in wet and wetland bottom basins to slow the movement of water through the basin. They should be planted to native mesic or wet prairie depending on elevation above normal water level.

- A 4-6-foot-deep forebay, accessible to operations & maintenance crews, should be built at inlet(s) of wet/wetland bottom basins to capture sediment; a 4-6-foot-deep micropool should be constructed at the outlet to prevent clogging.

Short Term (3 Years) Native Vegetation Establishment Recommendations

In most cases, the developer or owner should be responsible for implementing short term management of detention basins and other natural areas to meet a set of performance standards. Generally speaking, a minimum of three years of management is needed to establish native plant communities within detention basins. Measures needed include mowing during the first two growing seasons following seeding to reduce annual and biennial weeds. Spot herbiciding is also needed to eliminate problematic non-native/invasive species such as thistle, reed canary grass, common reed, purple loosestrife, and emerging cottonwood, willow, buckthorn, and box elder saplings. In addition, the inlet and outlet structures should be checked for erosion and clogging during every site visit. Table 39 includes a three-year schedule appropriate to establish native plantings around naturalized detention basins.

Table 39. Three-year vegetation establishment schedule for naturalized detention basins.

Year 1 Establishment Recommendations
Mow prairie areas to a height of 6-12 inches in May, July, and September.
Spot herbicide non-native/invasive species throughout site in late May and again in August/September. Target thistle, reed canary grass, common reed, purple loosestrife, and all emerging woody saplings.
Check for clogging and erosion control at inlet and outlet structures during site visit & after >1" rain event.
Year 2 Establishment Recommendations
Mow prairie areas to a height of 12 inches in June and August.
Spot herbicide non-native/invasive species throughout site in May and again in August/September. Target thistle, reed canary grass, common reed, purple loosestrife, and emerging woody saplings.
Plant additional emergent plugs if needed and reseed any failed areas in fall.
Check for clogging and erosion control at inlet and outlet structures during site visit & after >1" rain event.
Year 3 Establishment Recommendations
Spot herbicide non-native/invasive species throughout site in May and again in August/September. Target thistle, reed canary grass, common reed, purple loosestrife, and emerging woody saplings.
Check for clogging and erosion control at inlet and outlet structures during site visits & after >1" rain event.

Long Term (3 Years +) Native Vegetation Maintenance Recommendations

Long term management of most detention basins associated with development should be the responsibility of the homeowner or business association or local municipality. Often, these groups lack the knowledge and funding to implement long term management of natural areas resulting in the decline of these areas over time. Future developers should be encouraged to donate naturalized detention basins and other natural areas to a local municipality or conservation organization for long term management who receive funding via a Special Service Area (SSA) tax. Table 40 includes a cyclical long-term schedule appropriate to maintain native vegetation around detention basins.

Table 40. Three-year cyclical long-term maintenance schedule for naturalized detention basins.

Year 1 of 3 Year Maintenance Cycle
Conduct controlled burn in early spring. Mow to height of 12 inches in November if burning is restricted.
Spot herbicide problematic non-native/invasive species throughout site in mid-August. Specifically target thistle, reed canary grass, common reed, and emerging woody saplings such as willow, cottonwood, buckthorn, and box elder.
Check for clogging and erosion control at inlet and outlet structures during site visits & after >1" rain event.
Year 2 of 3 of Maintenance Cycle
Spot herbicide problematic non-native/invasive species throughout site in August. Specifically target thistle, reed canary grass, common reed, and emerging woody saplings such as willow, cottonwood, buckthorn, and box elder.
Mow prairie areas to a height of 6-12 inches in November.
Check for clogging and erosion control at inlet and outlet structures during site visits & after >1" rain event.
Year 3 of 3 of Maintenance Cycle
Spot herbicide problematic non-native/invasive species in August. Specifically target thistle, reed canary grass, common reed, and emerging woody saplings. Cutting & herbiciding stumps of some woody saplings may also be needed.
Check for clogging and erosion control at inlet and outlet structures during site visits & after >1" rain event.
Cycle begins again with Year 1 of Maintenance Cycle above

6.1.3 Rain Gardens

Rain gardens have become a popular new way of creating a perennial garden that cleans and infiltrates stormwater runoff from rooftops and sump pump discharges. A rain garden is a small shallow depression that is typically planted with deep rooted native wetland vegetation. These small gardens can be installed in a variety of locations but work best when located in existing depressional areas or near gutters and sump pump outlets. Not only do rain gardens clean and infiltrate water, they also provide food and shelter for many birds, butterflies, and insects. Rain gardens are typically 100-300 square feet in size, should be installed outside of wetlands and floodplains, and planted with native plants to improve water quality and habitat benefits. They should be placed at least 10 feet away from any building or structure and need to be excavated to a depth of 18-24 inches below the exiting grade. Soil amendments are recommended to ensure support of native plants. After installation, rain gardens require ongoing maintenance to ensure they are performing properly.

Rain garden adjacent to single family home

The intent of a rain garden program for residents is to encourage and provide an incentive for applicants to install rain gardens on private property to "micro-manage" stormwater runoff as close to the source (like downspouts, driveways, sump pump discharges) as possible. Typically, this incentive comes in the form of a cost-share program designed to reimburse residents for a portion of the costs incurred by installing a rain garden on their property.

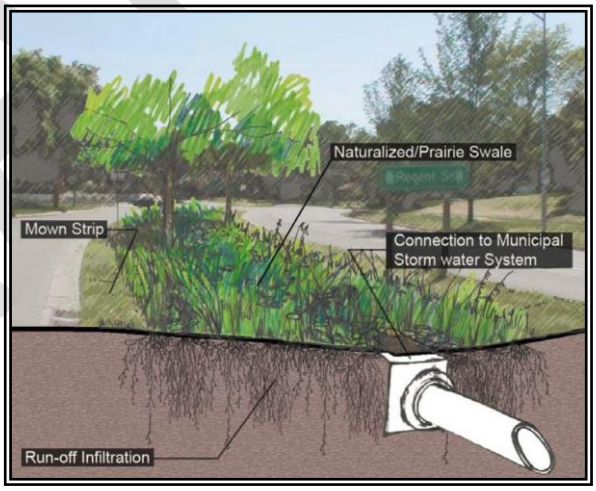
Rain Garden Recommendations

Information programs in the watershed should focus on teaching residents and businesses the beneficial uses of rain gardens. Local governments, schools, and public agencies in the watershed should also install demonstration rain gardens as a way for the general public to better understand their application. Local governments could hold rain garden training seminars and potentially provide partial funding to residents and businesses that install rain gardens.

6.1.4 Vegetated Swales (Bioswales)

Vegetated swales, also known as bioswales, are designed to convey water and can be modified slightly to capture and treat stormwater for the watershed. Vegetated swales are designed to remove suspended solids and other pollutants from stormwater running through the length of the swale. The type of vegetation can dramatically affect the functionality of the swale. Turf grass is not recommended because it removes less suspended solids than native plants. In addition, vegetated swales can add aesthetic features along a roadway or trail. They can be planted with wetland plants or a mixture of rocks and plant materials can be used to provide interest.

Swales can be designed as either wet or dry swales. Dry swales include an underdrain system that allows filtered water to move quickly through the stormwater treatment train. Wet swales retain water in small wetland like basins along the swale. Wet swales act as shallow, narrow wetland treatment systems and are often used in areas with poor soil infiltration or high water tables.



Dry vegetated swale rendering with engineered soils

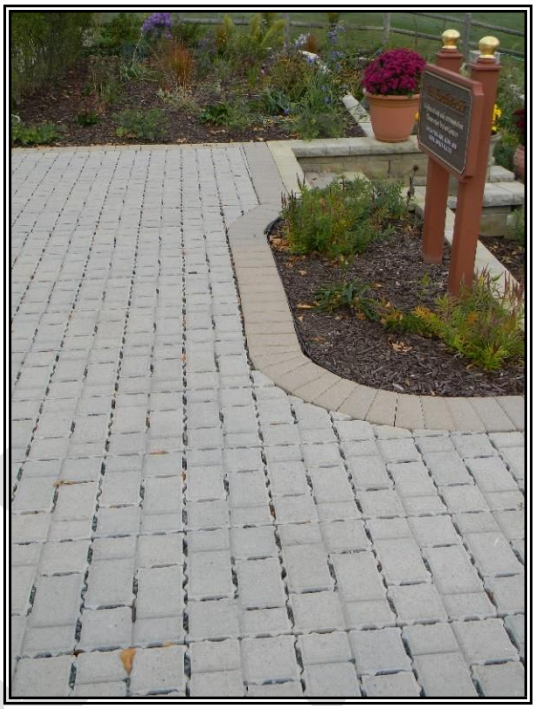
Water quality is improved by filtration through engineered soils in dry swales and through sediment accumulation and biological systems in wet swales. According to USEPA, vegetated swales reduce total suspended solids (sediment) by 65%, total phosphorus by 25%, and total nitrogen by 10% (MDEQ, 1999).

Vegetated Swale Recommendations

Vegetated swales should be used in place of pipes or curbs in new and redevelopment where feasible. Swales can easily be integrated into various urban fabrics with curb cuts for water to access them from roadways, or they can be added between existing lots or in the grassy parkways between roads and sidewalks. Typically, swales are used in lower density settings where infiltration might be maximized. Dry swales should be used for smaller development areas with small drainages. Wet swales should be used along larger roadways, small parking areas, and commercial developments.

6.1.5 Pavement Alternatives

Pervious concrete, permeable asphalt, and paver systems are potential alternatives to conventional asphalt or concrete parking lots and roadways. These alternatives allow for natural infiltration of the water by allowing water that falls on the surface to flow to a storage gallery through holes in the pavement. Areas that are paved with pervious pavement produce less stormwater runoff than conventionally paved areas.



Pervious pavers installed adjacent to a park

Traditionally, the quantity and quality of water running off of paved and other impermeable surfaces are the primary reason for the need for stormwater treatment. Pavement alternatives reduce runoff rates and volumes and can be used in almost every capacity in which traditional asphalt, concrete, or pavers are used.

Pavement alternatives capture first flush rainfall events and allow water to percolate into the ground. Pavement alternatives treat stormwater through soil biology and chemistry as the water slowly infiltrates. Groundwater and aquifers are recharged and water that might otherwise go directly to streams will slowly infiltrate, reducing flooding and peak flow rates entering drainage channels. Studies documented by USEPA show that properly designed and maintained pervious pavements reduce total suspended solids (sediment) by 90%, total phosphorus by 65%, and total nitrogen by 85% (MDEQ, 1999).

In recent years, concerns have been raised about the environmental effects of the use of coal-tar sealants. Coal-tar sealant is a surface treatment typically applied to protect asphalt on driveways and parking lots which contains polycyclic aromatic hydrocarbons (PAHs). PAHs are a group of chemicals that have been linked to cancer in humans and have been shown to be toxic to aquatic life and damaging to the environment (Needleman, 2015). According to studies, "PAHs are significantly elevated in stormwater flowing from parking lots and other areas where coal-tar sealcoats were used as compared to stormwater flowing from areas not treated with the sealant (USEPA, 2016)." Pervious concrete, permeable asphalt, and paver systems are all potential alternatives to the need for coal-tar sealants. Additionally, several states and municipalities have banned the use and/or sale of coal-tar sealants to further protect their communities.

Pavement Alternatives Recommendations

Future development and redevelopment in the Lower Little Rock Creek watershed should consider the use of pavement alternatives, particularly for parking lots that receive high levels of public use. Pavement alternatives can be used in a variety of settings including parking lots, parking aprons, private roads, fire lanes, alleys, residential driveways, sidewalks, and bike paths. It is important to note that there are limitations to using pavement alternatives based on subsoil composition and they do require annual maintenance to remain effective over time.

6.1.6 Vegetated Filter Strips

Vegetated filter strips are shallowly sloped vegetated surfaces that remove suspended sediment, and nutrients from sheet flow stormwater that runs across the surface. This Management Measure is often referred to as a buffer strip. The type of vegetation can dramatically affect the functionality of the filter strip. Filter strips can either be planted or can be comprised of existing vegetation. Turf grass should be avoided as it removes less total suspended solids than filter strips planted with native vegetation.

Filter strip along municipal building in Algonquin, Illinois

The wider they are the more effective filter strips are because the amount of time water has for interception/ interaction with the plants and soil within the filter strip is increased. When installed and functioning properly, the USEPA has documented that filter strips can reduce total suspended solids (sediment) by 73%, total phosphorus by 45%, and total nitrogen by 40% (MDEQ, 1999).

Vegetated Filter Strip Recommendations

Vegetated filter strips work in a variety of locations. Vegetated filter strips in rural and urban areas should be installed along streams, lakes, or ponds. Additionally, they can be used adjacent to buildings and parking lots that sheet drain. The water would then pass through the vegetated filter strip and into a waterway, such as a vegetated swale, stream, lake, pond, or other stormwater feature.

6.1.7 Natural Area Restoration & Native Landscaping

Natural area restoration and native landscaping are essentially one in the same but at different scales. Natural area restoration involves transforming a degraded natural area into one that exhibits better ecological health and is typically done on larger sites such as nature/forest preserves. Native landscaping is done at smaller scales around homes or businesses and is often formal in appearance. Both require the use of native plants to create environments that mimic historic landscapes such as prairie, woodland, and wetland. Native plants are defied as indigenous, terrestrial or aquatic plant species that evolved naturally in an ecosystem. The use of native plants in natural area or native landscaping is well documented. They adapt well to environmental conditions, reduce erosion, improve water quality, promote water infiltration, do not need fertilizer, provide wildlife food and habitat, and have minimal maintenance costs.

Native landscaping near residential home

Several environmental agencies support the use of native plants including Illinois Nature Preserves Commission (INPC), Illinois Department of Natural Resources (IDNR), Forest Preserve District of DeKalb County (FPDDC), Kendall County Forest Preserve District (KCFPD), DeKalb and Kendall County Soil and Water Conservation Districts, U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), National Wildlife Federation (NWF), and The Conservation Foundation (TCF).

Natural Area Restoration/Native Landscaping Recommendations
Large residential lots with existing natural components such as oak woodlands and wetlands and golf courses provide many of the best opportunities for natural area restoration and native landscaping at a larger scale. Homeowners interested in restoring natural areas or implementing native landscaping can find guidance through the agencies listed above or by contacting a local ecological consulting company. Backyard habitats can be certified through the National Wildlife Federation's Certified Wildlife Habitat program or the Conservation Foundation's Conservation@Home program.

Part of one golf course, Edgebrook County Club, falls within the watershed boundary. This golf course could improve its function as green infrastructure by implementing natural area restoration into existing designs. The Audubon Cooperative Sanctuary Program (ACSP) is an education and certification program that helps golf courses protect the environment by providing guidance for outreach and education, resource management, water quality and conservation, and wildlife habitat management. A golf course becomes certified under the program when implementing and documenting recommended environmental management practices. Annual program membership fees are $200.

6.1.8 Wetland Restoration

Over 1,467 acres or 83% of the historic wetlands in Lower Little Rock Creek watershed have been lost to farming and other development practices since European settlement in the 1830s. Wetlands are essential for water quality improvement and flood reduction in any watershed and also provide habitat for a wide variety of plant and animal species.

Wetland restoration at Carrington Reserve Conservation Development in West Dundee, Illinois

Over 357 acres of drained wetland were discovered in areas of the watershed where wetland restoration might be possible but many of these areas are located on land that is currently in agricultural production and in some cases, areas slated for future residential development. The wetland restoration process involves returning hydrology (water) and vegetation to soils that once supported wetlands. The USEPA estimates that wetland restoration projects can reduce suspended solids (sediment) by 77.5%, total phosphorus by 44%, and total nitrogen by 20% (MDEQ, 1999).

Wetland Restoration Recommendations

Local governments should strongly consider requiring "Conservation Design" that incorporates wetland restoration on parcels slated for future development. Another potential option is to restore wetlands as part of a wetland mitigation bank where wetlands are restored on private land and become "fully certified." Then, developers are able to buy wetland mitigation credits from the wetland bank for wetland impacts occurring elsewhere in the watershed. It is also possible that in the future, Illinois EPA may require more strict nutrient policies for wastewater treatment plants. Wetland banks may provide an opportunity for WWTP owners to buy "water quality trading credits." The Site-Specific Action Plan section of this report identified sites where wetland restoration might be feasible.

6.1.9 Stormwater Trees/Tree Planting Program

Trees provide extensive evapotranspiration and cooling benefits, improve water and air quality, provide habitat, increase property values, and improve aesthetics in urban landscapes (see Figure 54). Trees play a valuable role in trapping absorbing stormwater, reducing pollutants, and holding soils in place during rain events and help to recharge groundwater supplies. A 25-foot canopy diameter tree can process the runoff of a 2,400 square foot adjacent impervious surface (EPA, 2016). Depending on the size and species, one tree can store 100 gallons or more of stormwater (Fazio, 2010).

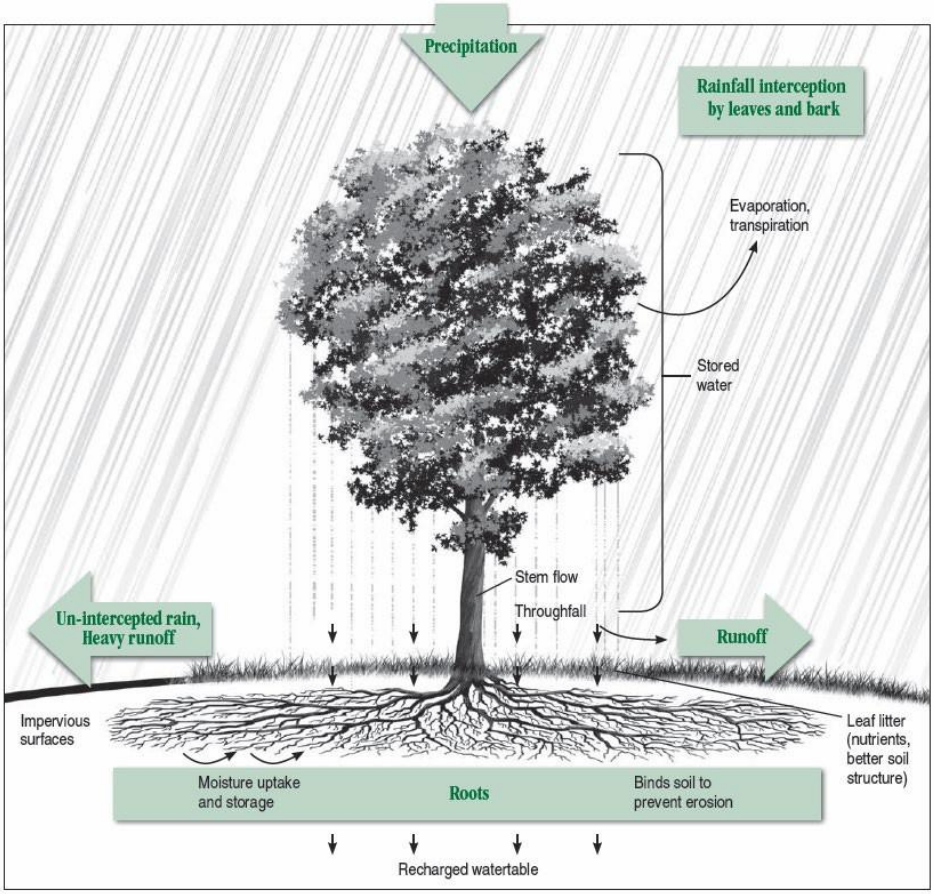


Figure 54. Illustration of how trees help with stormwater management (Source: Fazio, 2010).

Implementing a successful stormwater tree program can be complicated. Space and soil quality constraints can often be the limiting factors on whether a site is appropriate for installing

stormwater trees. Other constraints include finding an appropriate species of tree, steep slopes, utility lines, impervious surfaces and pre-existing structures. With a little planning and engineering, many of these constraints can be overcome. In 2016, the USEPA produced a Technical Memorandum on Stormwater Trees that provides detailed information on the benefits and challenges to implementing an effective Stormwater Tree program and maintaining the trees over time. This report is available on the USEPA's website at https://www.epa.gov/green-infrastructure/stormwater-trees.

Municipalities in the watersheds should consider adopting a stormwater tree or tree planting program where these are not already in place.

6.1.10 Street Sweeping & Yard Waste Management

Street sweeping is often overlooked as a Management Measure option to reduce pollutant loading in watersheds. With over 69 miles of roads in the watershed, municipal street sweeping programs could help reduce non-point source pollutants from urban areas in Lower Little Rock Creek watershed. Street sweeping works because pollutants such as sediment, trash, road salt, oils, nutrients, and metals that would otherwise wash into stormsewers and streams following rain events are gathered and disposed of properly. The USEPA and Center for Watershed Protection (CWP) report similar pollutant removal efficiencies for street sweeping; weekly street sweeping can remove between 9% and 16% of sediment and between 3% and 6% of nitrogen and phosphorus (MDEQ, 1999; CWP 2007).

Routine street sweeping is an effective Management Measure

Yard waste, such as grass clipping and leaf litter, can also impact water quality when not managed correctly. "Grasscycling and composting are two techniques homeowners can use to reduce waste disposal and possible water contamination as well as save time, money and energy while returning valuable nutrients back into their lawns and gardens. (Gibb, 2012)" Composting of yard waste and grasscyclying (the practice of leaving grass clippings on a lawn while mowing) can keep nutrients such as nitrogen in place. When grasscycling or composting, it is important to keep clippings on the lawn and off sidewalks, driveways, or other impervious surfaces where they might otherwise get washed into adjacent drainage systems or become a safety hazard (Gibb, 2012).

Street Sweeping & Yard Waste Management Recommendations

It is likely that the municipalities in the watershed already implement street sweeping to some degree. The frequency of street sweeping is a matter of time and budget and should be determined by each municipality. Weekly street sweeping would provide the best results, but bi-weekly sweeping is cited as being sufficient in most cases. Homeowners should also compost yard waste and practice grasscycling at home.

6.1.11 Stream & Riparian Area Restoration & Maintenance

Channelization is fairly limited in Lower Little Rock Creek watershed, while moderate stream erosion is more common throughout the lower reaches within the watershed. Stream surveys reveal that about 47% (26,796 lf) of stream length in the watershed is moderately eroded and 28% (15,816 lf) is moderately to highly channelized. In addition, riparian areas adjacent to streams are suffering as 29% are in poor ecological condition.

Stream restoration project in Barrington, IL

Stream and riparian area restorations are one of the best Management Measures that can be implemented to improve water quality and the overall health of the watershed. This work involves improvements to a stream channel using artificial pool-riffle complexes, streambank stabilization using a combination of bioengineering with native vegetation and hard armoring with rock if needed, and adjacent riparian area improvements via removal of non-native vegetation and replacement with native species. These practices are typically done together as a way to improve water quality by reducing sediment transport, increasing oxygen, and improving habitat. The USEPA reports that as much as 90% of sediment, phosphorus, and nitrogen can be reduced following stream restoration. The downside to stream restoration is that it is technical and expensive. Stream restoration projects include detailed construction plans, often complicated permitting, and construction that must be done by a qualified contractor.

With so many individual landowners with parcels intersecting Little Rock Creek and its tributaries, routine maintenance of stream systems is challenging. In many cases, landowners simply do not have the knowledge or are not physically capable of maintaining streams on their property. Stream maintenance includes an ongoing program to remove blockages caused by accumulated sediment, fallen trees, etc. and is a cost-effective way to prevent flooding and streambank erosion.

Riparian buffers are defined as land adjoining any water body including ponds, lakes, streams, and wetlands. In 2010 the Southeastern Wisconsin Regional Planning Commission (SEWRPC) produced a document entitled "Managing the Water's Edge: Making Natural Connections" (SEWRPC, 2010). The research presented in SEWRPC's document was conducted to determine if an optimal riparian buffer design or width could be determined that effectively reduces pollutants, provides water quality protection, helps prevent channel erosion, provides adequate fish and wildlife habitat, enhances environmental corridors, augments baseflow, and moderates water temperature.

Interestingly, no consensus of optimal buffer width could be determined but what is apparent is that many riparian corridors no longer fulfill their potential due to encroachment by agricultural and urban development. SEWRPC's document summarizes how to maximize both water quality protection and conservation of aquatic and terrestrial wildlife populations using buffers as shown in Figure 55.

As described in SERWPC's document, implementing the green infrastructure network to connect open space and other natural area features should be embraced and the minimum goal of 75 feet should be achieved where feasible whereby 75% minimum of the total stream length should be naturally vegetated to protect the functional integrity of the water resource and 75 foot wide minimum riparian buffers are recommended from the top edge of each stream bank that are naturally vegetated to protect water quality.

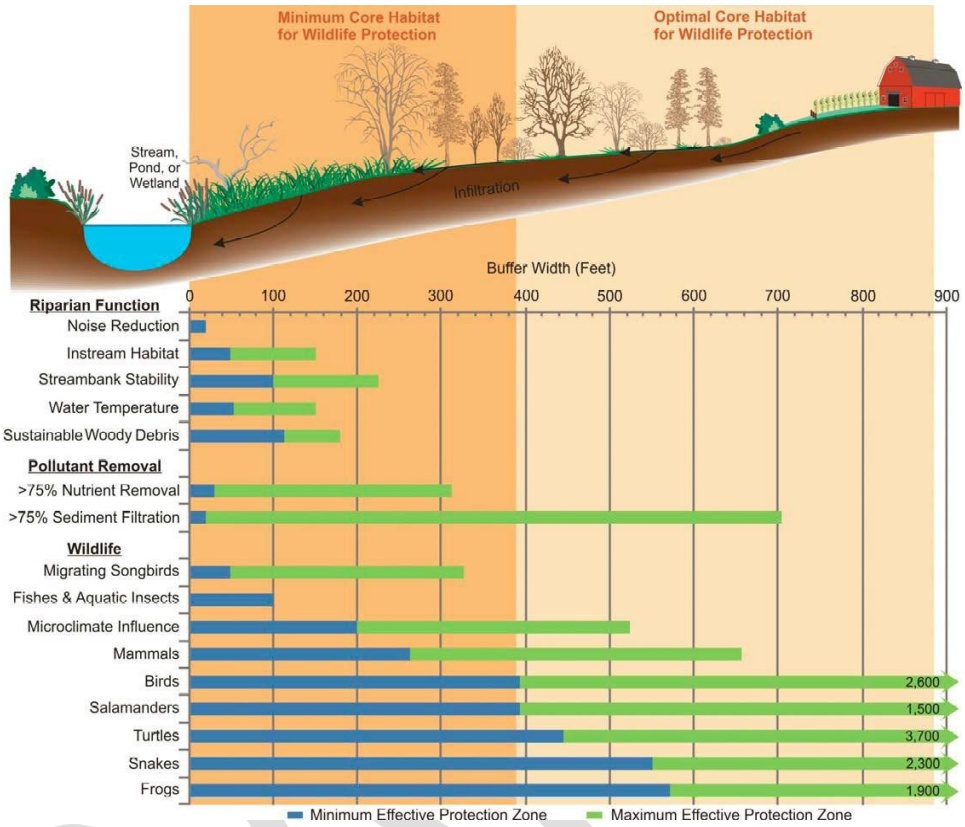


Figure 55. Riparian function, pollutant removal, and wildlife benefits for various buffer widths (Source: SEWRPC) 2010).

Stream & Riparian Area Recommendations

There are many opportunities to implement stream and riparian area restoration in the watershed. These opportunities are identified in the Site-Specific Action Plan. All stream and riparian area opportunities are identified in the Site-Specific Action Plan. The Lake County Stormwater Management Commission (LCSMC) is a leader in the Chicagoland area when it comes to managing stormwater and has developed an excellent guide for riparian owners called "Riparian Area Management: A Citizen's Guide." This short flyer can be found on Lake County's website and is intended to educate landowners about debris removal and riparian landscaping. It is also important to note that not all debris in streams is harmful. The American Fisheries Society has created a short document called "Stream Obstruction Removal Guidelines" which is meant to clarify the appropriate ways to maintain obstructions in streams to preserve fish habitat.

6.1.12 Septic System Maintenance

Septic systems and onsite wastewater treatment systems (OWTS) are common in the more rural portions of the Lower Little Rock Creek watershed; it is estimated that roughly 247 septic systems likely exist in the watershed. Septic systems in DeKalb County are regulated under the Water Wells and Waste and Sewage Disposal section of the DeKalb County Code. In Kendall County, the Environmental Health Services unit of the Kendall County Health Department handles the unsewered portions of Kendall County. When septic systems are not maintained and subsequently

fail, they can contribute high levels of nutrients and bacteria to the surrounding environment. The

failure rate of septic systems in the watershed is unknown. However, literature sources across the nation indicate a failure rate of approximately 20% (Brown, 1998; Mancl, 1984; Stout, 2003; UKCE, 2012). According to the pollutant loading analysis, septic systems are likely contributing 1,728 lbs/yr (1%) of total nitrogen loading and 677 lbs/yr (2%) of total phosphorus loading in the watershed.

Septic System Recommendations
Septic owners in DeKalb or Kendall County should contact the DeKalb or Kendall County Health Department to schedule a septic system inspection to ensure that they are designed and operating properly. The Counties also provide additional guidelines and restrictions for septic system owners including restrictions on the proximity of lawn sprinkler systems, upgrade requirements for hot tubs, garbage grinders, or building additions, and how landscaping might affect septic systems. More information and resources are available online at https://health.dekalbcounty.org/services/well-septic/ (DeKalb County) or http://www.kendallhealth.org/environmental-health/septic-systems-homeowner/ (Kendall County). In addition, the United States Environmental Protection Agency (USEPA) provides an excellent guide for septic system owners called "A Homeowner's Guide to Septic Systems (USEPA, 2005)." The guide explains how septic systems work, why and how they should be maintained, and what makes a system fail.

6.1.13 Agricultural Management Practices

Agriculture is an integral part of the Lower Little Rock Creek watershed and is by far the most dominant land use, covering a total of 7,140 acres or 68% of the watershed. Pollutant loading estimates using USEPA's STEPL model point to cropland as the largest non-point source contributor of nutrient and sediment loading in the watershed, with estimates at 50,501 lbs/yr of nitrogen (37% of total loads), 14,004 lbs/yr of phosphorus (45% of total loads), and 8,298 tons/yr of sediment (32% of total loads). As such, watershed-wide changes to agricultural practices can have a dramatic effect on pollutant loading in the watershed. Fortunately, there are numerous agricultural measures and funding sources that can be utilized by farmers to implement practices on their land to improve water quality and soil health, while reducing soil and nutrient losses. Many recommended programs are offered through the DeKalb and Kendall County Soil and Water Conservation Districts, U.S. Department of Agriculture (USDA), Natural Resource Conservation Program (NRCS), and the Farm Service Agency (FSA). These agencies are discussed in depth in Section 3.5.

USDA NRCS- Environmental Quality Incentive Program (EQIP)
The NRCS's Environmental Quality Incentive Program (EQIP) is a voluntary conservation program that provides technical and financial assistance to individuals/entities to address soil, water, air, plant, animal and other related natural resource concerns on their land. EQIP offers financial and technical help to assist participants to install or implement structural and management practices on eligible agricultural land. As the most popular and most utilized conservation program offered by NRCS, EQIP assists thousands of producers annually in working towards: reducing contamination from agricultural sources such as animal feeding operations, efficiently utilizing nutrients and therefore reducing input costs and nonpoint source pollution, and increasing soil health to improve resiliency to drought and increasingly volatile weather.

This program is available to farmers, ranchers, and forest landowners who own or rent agricultural land. EQIP assistance can be used for agricultural operations such as: conventional and organic agriculture, specialty and commodity crops, forestry and wildlife, livestock operations, and historically underserved farmers. Historically underserved farmers including beginning farmers,

farmers with limited resources or those in socially disadvantaged groups, as well as military veterans, are eligible for increased or advance payments following changes in the 2018 Farm Bill.

Conservation Tillage (no till) farming

Other expansions of EQIP under the 2018 Farm Bill include expanding eligibility regarding with whom NRCS can enter into an EQIP contract. Under these expansions, NRCS can enter into contracts with water management entities when they are in support of water conservation or an irrigation efficiency project. Eligible entities include: States, irrigation districts, ground water management districts, or other similar entities.

Beginning in 2020, States may provide increased EQIP payment rates for high-priority practices. Eligible high-priority practices include those that address specific causes of ground or surface water impairment relating to excessive nutrients, address the conservation of water to advance drought mitigation and declining aquifers, meet other environmental priorities and other priority resource concerns identified in habitat or other area restoration plans, or is geographically targeted to address a natural resource concern in a specific watershed. NRCS State Conservationists may designate up to 10 practices to be eligible for increased payments.

No-till is a land management option within the EQIP program and is the leading recommendation for farmers in Lower Little Rock Creek watershed. With no-till, the land is left undisturbed from harvest through planting, preserving a canopy of crop residue on the surface to protect the soil from erosion. Along with soil conservation benefits, high fuel prices are driving a switch to no-till for many farmers. Eliminating tillage passes reduces both fuel and labor expenses (USDA, 2020).

Agricultural Conservation Easement Program (ACEP)

The Agricultural Conservation Easement Program (ACEP) was created in the 2014 Farm Bill through the combination of the previously separate Wetlands Reserve Program (WRP), Grassland Reserve Program (GRP), and Farm and Ranch Lands Protection Program (FRPP). These programs were originally ratified in 1990, 1996, and 2002 Farm Bills respectively.

The Agricultural Conservation Easement Program assists landowners, land trusts, and other entities protect, restore, and enhance wetlands, grasslands, and working farms and ranches through conservation easements. There are two components to ACEP, the Agricultural Land Easements

component and the Wetland Reserve Easement component. The NRCS Agricultural Land Easements component helps American Indian tribes, state and local governments, and nongovernmental organizations protect working agricultural lands and limit non-agricultural uses of the land. NRCS Wetland Reserve Easements component, helps to restore, protect, and enhance enrolled wetlands through the purchase of easements and assistance in restoration (NSAC, 2019).

ACEP - Wetland Reserve Easements (WRE)
The Wetlands Reserve Easement program (WRE) is a voluntary program offering farmers the opportunity to protect, restore, enhance, and protect wetlands on their property. The NRCS provides technical and financial support to help landowners with their wetland restoration efforts. The goal of NRCS is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program. This program offers landowners an opportunity to establish long-term conservation and wildlife practices and protection.
Land that's eligible for enrollment in ACEP as a Wetland Reserve Easement includes farmed or converted wetland that can be successfully restored as natural wetland habitat in a cost-effective manner. NRCS prioritizes applications for Wetland Reserve Easements based upon their potential for protecting and enhancing habitat for migratory birds and other wildlife.

NRCS enters into purchase agreements with eligible landowners which include the right to develop and implement a wetland reserve restoration easement plan. These plans aim to restore, protect, and enhance the functions and value of the site's wetlands.

Landowners who choose to enroll land in a Wetland Reserve Easement may sell a conservation easement or enter into a cost-share restoration agreement with NRCS to restore and protect wetlands. These easement options include:

- Permanent Easements – These are conservation easements in perpetuity, with NRCS paying 100 percent of the value of the easement to purchase it, and 75 to 100 percent of the cost to restore it.
- 30-Year Easements – Under 30-year easements, NRCS pays 50 to 75 percent of the value of the easement to purchase it, and 50 to 75 percent of the cost to restore it.
- Term Easements – The length of term easements is determined by applicable state laws. NRCS pays 50 to 75 percent the value of the easement to purchase, and 50 to 75 percent of the cost to restore it.
- 30-Year Contracts – 30-year contracts are only available to enroll acreage owned by American Indian Tribes, and program payment rates are similar to that of 30-year easements.

Landowners and NRCS then develop a plan for the restoration and maintenance of the wetland. As a requirement of the program, landowners voluntarily limit future use of the land, yet retain private ownership.

ACEP's wetlands component also includes a wetlands reserve enhancement partnership option (formerly known as the Wetlands Reserve Enhancement Program, WREP) through which NRCS partners with states, non-governmental organizations, or Native American Tribes to protect, restore, and enhance high priority wetlands.

This partnership option is a voluntary program in which NRCS, and eligible partners sign an agreement to leverage resources in restoring high priority wetland protection, restoration, and

enhancement to improve habitat for migratory birds and other wildlife. Benefits include wetland restoration and protection of critical areas, ability to cost-share restoration or enhancement beyond NRCS requirements through leveraging resources, and the ability to participate in the management and monitoring of projects with the support of the NRCS's expertise in restoration practices.

Wetland reserve easements enable landowners to reduce impacts from flooding, recharge groundwater, enhance and protect wildlife habitat and provide outdoor recreational and educational opportunities. As with the original WREP, producers can retain grazing rights as part of a wetland easement if the grazing activity is consistent with long-term wetland protection and enhancement goals for which the easement was established. The easement payment would be reduced by an amount equal to the grazing value (USDA, 2020).

ALE- Agricultural Land Easements (ALE)
The purpose of the Agricultural Land Easement (ALE) component is to protect farms and ranches from development, specifically to ensure farm viability for future generations, and to conserve grazing land, rangeland, pasture and shrub land. NRCS provides financial assistance to eligible partners for purchasing Agricultural Land Easements that protect the agricultural use and conservation values of eligible land.

In the case of working farms, the program helps farmers and ranchers keep their land in agriculture. The program also protects grazing uses and related conservation values by conserving grassland, including rangeland, pastureland and shrubland. Eligible partners include American Indian tribes, state and local governments and non-governmental organizations that have farmland, rangeland or grassland protection programs.

For Agricultural Land Easements, NRCS can contribute up to 50 percent of the fair market value of the agricultural land easement. Where NRCS determines that grasslands of special environmental significance will be protected, NRCS may contribute up to 75 percent of the fair market value of the agricultural land easement. Eligible entities can now include cash contributions, landowner contributions, or other non-USDA federal funding to satisfy the match requirements.

The 2018 Farm Bill removed the requirement that all agricultural land easement enrollments under ACEP must have a conservation plan, it is now required only for the portions of the agricultural land easement that are highly erodible cropland.

Additionally, the 2018 Farm Bill adds a new priority in evaluating proposals for easements that maintain agricultural viability. This priority includes easements that allow a producer to: productively operative a farm or ranch on the protected land; maintain the long-term affordability of the protected land; maintain an economically sustainable farm business on the land; and maintain the land in a way that enables its agricultural use for future generations.

The 2018 Farm Bill also allows for entities holding an ALE to add deed terms that address mineral development. In instances when mineral development rights are reserved and exercised under ACEP, the activity should be consistent with the conservation and agricultural purposes of the land and all provisions of the program.

Under the agricultural land easement component, ACEP funds are provided to non-profits (such as land trusts), state and local agencies, and Indian tribes to purchase easements. Agricultural land

easements are permanent; in states that do not allow permanent easements, the easements will be as long-term as allowed by law.

To qualify for an ALE the easement must have prime, unique, or productive soil (or contain historical or archaeological resources, protect grazing uses by restoring and conserving land, or further a state or local policy consistent with program purposes.) The easement must also be either cropland, rangeland, or grassland; contain forbs or shrub land for which grazing is the predominant use; be located in an area which is historically grassland, forbs, or shrubs and could provide ecologically significant habitat; or be pastureland or non-industrial private forestland which contributes to economic viability of a parcel and serves as a buffer to protect such land from development (USDA, 2020).

Farm Service Agency (FSA)- Conservation Reserve Program (CRP)
The USDA Farm Service Agency's (FSA) CRP is a voluntary program that contracts with agricultural producers so that environmentally sensitive agricultural land is devoted to conservation benefits. The Food Security Act of 1985, as amended, authorized CRP. The program is implemented by FSA on behalf of USDA's Commodity Credit Corporation. In exchange for a yearly rental payment, farmers enrolled in the program agree to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality. Contracts for land enrolled in CRP are 10-15 years in length.

CRP participants establish long-term, resource-conserving vegetative species, such as approved grasses or trees (known as "covers"), to control soil erosion, improve the water quality and enhance wildlife habitat. The long-term goal of the program is to re-establish valuable land cover to help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat. CRP protects millions of acres of American topsoil from erosion and is designed to safeguard the nation's natural resources. By reducing water runoff and sedimentation, CRP protects groundwater and helps improve the condition of lakes, rivers, ponds and streams. The vegetative covers also make CRP a major contributor to increased wildlife populations in many parts of the country.

Additionally, there is a CRP Grasslands program which helps landowners and operators protect grassland, rangeland, and pastureland while maintaining the areas as grazing lands. The program emphasizes support for grazing operations, plant and animal biodiversity, and grassland and land containing shrubs and forbs under the greatest threat of conversion.

Grass waterway on highly erodible agricultural land

The following conservation practices are eligible under CRP, and thus land must be suitable for any of these practices: Grass Waterway, Shallow Water Area for Wildlife, Contour Grass Strip, Filter Strip, Riparian Buffer, Denitrifying Bioreactor on Filter Strip and Riparian Buffer, Saturated Filter Strip and Riparian Buffer, Habitat Buffers for Upland Birds, Wetland and Buffer SAFE Practices, Wetland

Restoration on Floodplain and Non-Floodplain, Prairie Strips, Windbreaks, Shelterbelts, Living

Snow Fences, Marginal Pastureland Wetland Buffer and Wildlife Habitat Buffers, Long Leaf Pine Establishment, Duck Nesting Habitat, Pollinator Habitat, Bottomland Timber Establishment on Wetlands, Farmable Wetlands Program (FWP) Constructed Wetland, FWP Aquaculture Wetland Restoration, FWP Flooded Prairie Wetland, Farmable Wetlands and Farmable Wetland Buffer, and Wellhead Protection Area Practices.

In order to be eligible for the CRP, the landowner must have owned or operated the land for at least 12 months prior to submitting the offer (or there are certain extenuating circumstances). Cropland must be planted to an agricultural commodity, have a weighted average erosion risk of eight or higher, be enrolled in a CRP contract currently, or be located in a CRP conservation priority area; there are no CRP conservation priority areas in the watershed.

Enrollment in CRP is offered in the form of general enrollment or continuous enrollment. In general enrollment, during annual enrollment periods, producers have the opportunity to offer land for the program which is then ranked according to the factors of the Environmental Benefits Index. This index considers: wildlife habitat benefits resulting from covers on enrolled land, water quality benefits, on-farm benefits from reduced erosion, long-term benefits that will endure beyond the contract period, air quality benefits from reduced wind erosion, and cost. Under continuous enrollment, environmentally sensitive land may be enrolled at any time though is not subject to competitive bidding (FSA, 2019).

Other Agricultural Recommendations

Additional conservation practices and increases in the extent of reduced tillage practices in the Lower Little Rock Creek watershed are necessary to reduce cropland pollutant loading. Unfortunately, there is no good data available on the existing extent of conservation tillage practices in place, but STEPL modeling was used to determine how additional agricultural management practices might improve water quality and reduce nutrient loading in the watershed. If an additional 19% (1,357 acres) or more of agricultural landowners were to utilize more intensive Conservation Tillage practices (leaving at least 60% residue), this change alone could reduce watershed wide pollutant loads by 5,022 lbs/year of nitrogen, 1,989 lbs/year of phosphorus, and 1,214 tons/year of sediment. ***Therefore, increasing high residue conservation tillage on at least 19% of agricultural lands, while not a site-specific recommendation, is considered a Critical Area Management Measure applicable to all agricultural land in the watershed.***

Principles of Soil Health

Improving water quality in runoff from agricultural lands can often be achieved by maintaining soil health and following soil health principles. There are five principles of soil health; they include soil armor, minimizing soil disturbance, plant diversity, continual live plant/root, and livestock integration. Armoring the soil refers to cover for the soil and controls erosion and evaporation rates, maintains soil temperatures, reduces compaction, suppresses weed growth and provides habitats for species. Minimizing soil disturbance reduces erosion, increases infiltration, and helps keep organic matter in the soil. Diversifying crop rotations can improve biodiversity, improves infiltration and nutrient cycling, and reduces pests. Providing some type of live plant root on a year-round basis is important for building soil health, ensuring that there is food for the soil web continuously throughout the year. Finally, integrating animals or livestock in the form of grazing can help balance the carbon to nitrogen ration, manage crop rotation, and help suppress weeds by fulfilling the natural symbiotic relationships between plants, animals, and the soil web (Fuhrer, 2018).

Landowners should work with their local USDA-NRCS representative and cropping consultant to implement a system that will work for them.

Regenerative Agriculture

Regenerative agriculture promotes a method of farming that promotes the regeneration of topsoil, improves water quality, increases biodiversity, and supports carbon sequestration in effort to mitigate the effects of climate change (Terra Genesis International, 2016). The practice is guided by a holistic approach of making appropriate, context-specific recommendations for farmers based on agroecology and restoration ecology methodologies with the goal of rebuilding quantity and quality of topsoil while creating equitable and just relationships amongst all stakeholders. By rebuilding soil organic matter and soil health, yields should increase and fewer inputs should be needed over time. Simultaneously, the improved biomass helps to sequester carbon and offset greenhouse gases, while the reduced disturbance of the soil improves water quality (Regeneration International, 2019). Many of the practices involved are recommended by NRCS, the DeKalb and Kendall County Soil and Water Conservation Districts, and the principles of soils health. Potential practices include "no-till/minimum tillage techniques, the use of cover crops, crop rotations, compost, and animal manures, the inoculation of soils with composts or compost extracts to restore soil microbial activity, and managed grazing (CSU Chico, 2017)."

The regenerative agriculture approach, research, and methodologies are ever evolving and need to be tailored to the context of individual farms. Many sources of additional information are available including online resources available from Regeneration International, Terra Genesis International, and California State University – Chico, among others.

Subsurface (Tile) Drainage Best Management Practices- Drainage Water Management

Subsurface drain tiles are a commonly used practice by farmers to help lower the water table of poorly drained fields and/or wet areas within fields. Unfortunately, nitrogen and phosphorus often find their way into tiles through cracks and macropores in the soil. The tiles then carry these nutrients to local streams.

Drainage Water Management, or management of the water table through control structures at drain tile outlets, is an approach to reduce the amount of nutrients that exit the tile lines. DWM is the process of managing the timing and the amount of water discharged from agricultural drainage systems. DWM is based on the premise that the same drainage intensity is not required at all times during the year. This is accomplished by adjusting the control structure so that the water table rises after harvest to limit drainage during the off-season. The water table can then be lowered a few weeks prior to planting in spring. The water table can also be raised in midsummer to store water for crops. With DWM, both water quality improvement and production benefits are possible. Water quality benefits are derived by minimizing unnecessary drainage, reducing the amount of nitrate that leaves farm fields. Producers who use DWM enjoy being able to better control their drainage water instead of the water controlling them (Cooke, 2004).

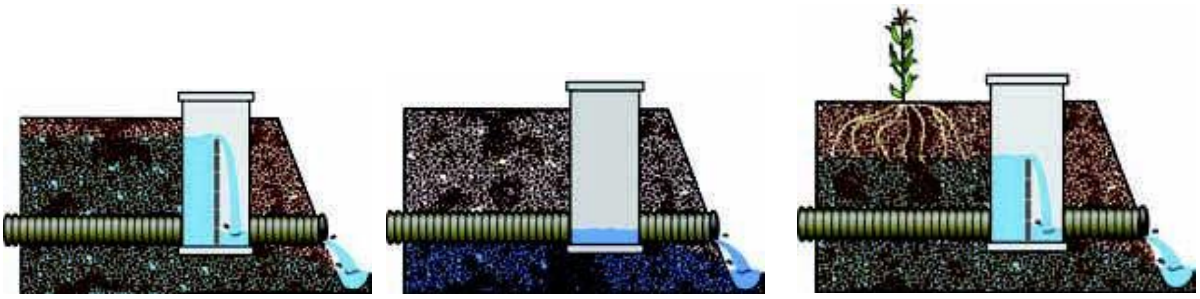


Figure 56. Use of tile control to raise water table after harvest (left), drawdown prior to seeding (middle), and raised again in midsummer (right) (Source: Purdue University)

To ensure successful implementation of a DWM system on agricultural tile drainage, it is essential to have a DWM Plan. A properly prepared DWM plan considers landscape, soils, slope, and current or planned drainage systems as well as the size and location of water control structures and detailed sets of instructions for their operation and maintenance. This includes identification of the zones of influence for each water control structure and the target water elevations for each of the seasonal land uses. The Golden Rule of Drainage (as advocated by NRCS) is: Only release the amount of water necessary to ensure trafficable conditions for field operations and to provide an aerated crop root zone- any drainage in excess of this rule likely carries away nitrate and water that is no longer available for crop uptake (NRCS, 2020).

Subsurface (Tile) Drainage Best Management Practices- Subsurface Bio-Reactors

While properly designed and installed subsurface drainage tiles can reduce sediment and phosphorus losses on fields, they can expedite the movement of nitrate-nitrogen to nearby surface waters. BMPs such as subsurface Bioreactors seek to mitigate this issue by providing a subsurface solution to a subsurface problem. Bioreactors consist of a substrate (gravel and a carbon source, typically woodchips, though alternative substrates are being researched) placed underground through which tile water flows. The systems are designed to maintain drainage effectiveness and, once installed, do not require additional land to be taken out of production. The reactors are constructed such that during periods of high flow, the bioreactor is bypassed and water flows through the tile as usual.

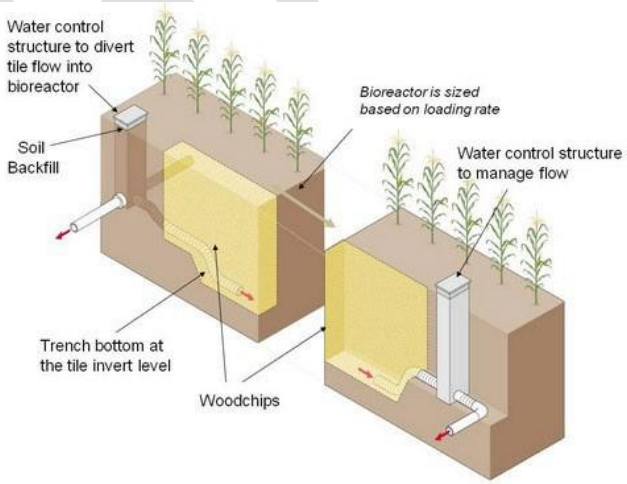


Figure 57. Subsurface Bioreactor (Source: Frankenberger.)

Bioreactors work by providing a carbon source on which soil organisms colonize. These colonies consume the carbon from the woodchips, and "breathe in" the nitrate from the water which is then "breathed out" as nitrogen gas which enters the atmosphere (similar to how humans breathe in oxygen and breathe out carbon dioxide (Frankenberger, 2020).

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Waste (Manure) Management

Livestock production within the agricultural industry is a producer of waste materials that need management. These wastes primarily include manure from livestock; livestock manure is rich in plant nutrients. Manure that is properly applied increases soil fertility and may also improve soil physical properties, improperly applied manure can contaminate surface water and groundwater. In order to protect water quality while maximizing nutrient efficiency, producers must select the relevant best management practice for their crops.

The NRCS has produced the *Agricultural Waste Management Field Handbook* (AWMFH) to provide specific guidance for planning, designing, and managing systems where agricultural wastes are involved. It can help assist agricultural producers in organizing a comprehensive plan that results in the integration of waste management into overall farm operations. Material in this handbook covers a wide range of activities from incorporating available manure nutrients into crop nutrient budgets to proper disposal of waste materials that do not lend themselves to resource recycling (NRCS, 2020).

Generally speaking, one of the most important manure best management practices is the development of a nutrient management plan; this involves accounting for all sources of crop-available nitrogen, performing manure testing to determine nutrient content, determining manure application rates based on crop nitrogen needs, and then applying fertilizer to manured fields only when needed to satisfy crop nutrient needs (UIUC - Extension, 2020).

Best management practices should be applied to the application of manure as well as the stockpiling and storage. When applying manure, generally speaking, attention should be given to not apply manure to sites with excessive slopes or highly erodible soils, or frozen or saturated soils. Manure should only be applied with properly calibrated equipment. Manure should be incorporated into soils as soon as possible after application to reduce losses. Other considerations are the establishment of a buffer zone of at least 100 feet between manure application and water resources, and the planting of permanent vegetation strips between surface waters and croplands to filter runoff. Similarly, manure stockpiles and livestock enclosures should be at least 100 feet away from any water supply, additionally vegetated filter strips should be established around the downhill side of stockpiles and enclosures. Stormwater should be redirected such that flow through stockpiles and enclosures is eliminated or reduced; and enclosures should be frequently cleaned (Colorado State University, 2020).

Agricultural Recommendations

Additional conservation practices and increases in the extent of reduced tillage practices in the Lower Little Rock Creek watershed are necessary to reduce cropland pollutant loading. AES recommends encouraging cropland landowners to increase their participation in reduced tillage, no-till, or high-residue conservation tillage practices on their lands, including recommendations for an additional 19% or more of agricultural landowners to utilize more intensive Conservation Tillage practices (leaving at least 60% residue). AES also recommends that agricultural landowners practice the principles of soil health and regenerative agriculture on their lands.

6.1.14 Downspout Disconnection/Rainwater Harvesting & Re-use

Downspout disconnection and rain barrel programs help reduce the amount of clean water that is used as well as reduce the amount of wastewater discharged to streams. Water harvesting and re-use via rain barrels and cisterns are important options to decrease the amount of stormwater runoff in a watershed. It is a simple, economical solution that can be done by any homeowner or business. On most homes and buildings, the water from roofs flows into downspouts and then onto streets, parking areas, or into storm sewers. Disconnecting downspouts and using either rain barrels or cisterns for re-use later can reduce the flood levels in local streams.

Rain barrel adjacent to residential home

Water re-use differs based on the type of storage and water treatment. A rain barrel is typically attached to a downspout and collects water for later use, such as irrigation purposes. In many areas, irrigation can account for almost 50 percent of residential water consumption. Re-using water collected in a rain barrel is a great way of minimizing water consumption and reduce water bills.

A cistern also stores water from rooftop runoff to be used later. However, a cistern is often larger, sealed, and the water can be filtered for a wider variety of uses. Cistern water can be used many outdoor uses such as lawn and garden watering, irrigation, car washing, and window cleaning.

The primary purpose of rain barrels and cisterns is water storage. Rain barrels typically store 55 gallons each. Cisterns can store greater amounts. Rain barrels and cisterns also reduce outdoor water demand in summer months by reducing the potable water used for irrigation or other outdoor household uses.

Rainwater Harvesting & Reuse Recommendations

Education programs in the watershed should focus on teaching residents and businesses the beneficial uses of downspout disconnection, rain barrels and cisterns. Local governments in the watershed should aim to install similar demonstration projects as a way for the public to better engage in their water use and re-use around residential homes. Local governments and conservation organizations such as the DeKalb and Kendall County Soil and Water Conservation Districts, the DeKalb County Community Foundation, and the Kendall County Forest Preserve District should sponsor programs where residents and businesses can purchase rain barrels.

6.1.15 Conservation & Low Impact Development

Conservation design facilitates development density needs while preserving the most valuable natural features and ecological functions of a site. It does this by reducing lot size, especially lot width, while increasing the available land area to allow for open space and natural resources (Figures 58 - 61). The open space is typically preserved or restored as natural areas that are integrated with newer natural Stormwater Treatment Train features and recreational trails and serve as an amenity to

the entire development. The open space allows the residents to feel like they have larger or more private lots because most of the lots adjoin the open space system.

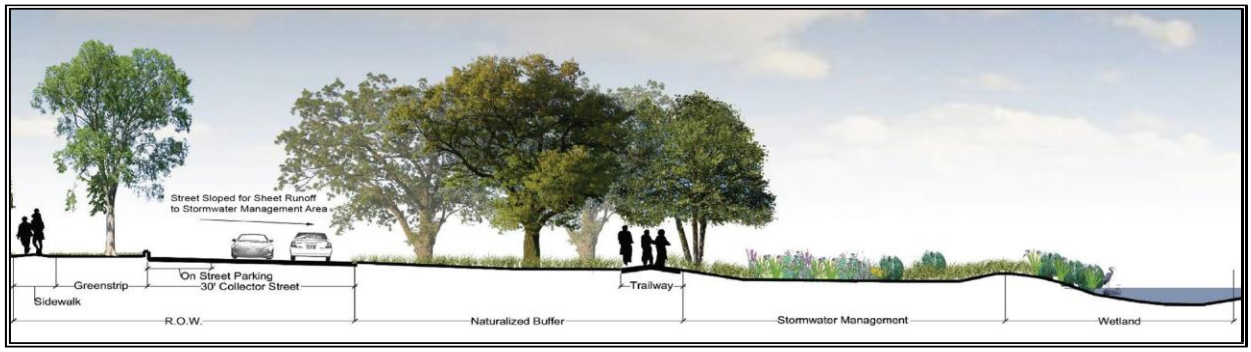


Figure 58. Stormwater Treatment Train within Conservation Development.

Figure 59. Traditional vs. Conservation Development Design (Elkhorn, WI).

Such flexibility is intended to retain or increase the development rights of the property owner and the number of occupancy units permitted by the underlying zoning designation, while encouraging environmentally responsible development. Conservation design is most appropriate in areas having natural and open space resources to be protected and preserved such as floodplains, groundwater recharge areas, wetlands, woodlands, streams, wildlife habitat, etc. It can also be used to preserve and integrate agricultural uses into the land pattern. The approach first considers the natural landscape and ecology of a development site rather than determining design features on the basis of pre-established density criteria. The general steps included below are generally followed when designing the layout of a development site:

Step 1: Identify natural resources, conservation areas, open space areas, physical features, and scenic areas and preserve and protect these areas from any negative impacts generated as a result of the development.

Step 2: Locate building sites to take advantage of open space and scenic views by requiring smaller lot sizes or cluster housing as well as to protect the development rights of the property owner and the number of occupancy units permitted by the underlying zoning of the property.

Figure 60. Conservation/Low Impact development design

Step 3: Design the transportation system to provide access to building sites and to allow movement throughout the site and onto adjoining lands; roads should not traverse sensitive natural areas.

Step 4: Prepare engineering plans which indicate how each building site can be served by essential public utilities.

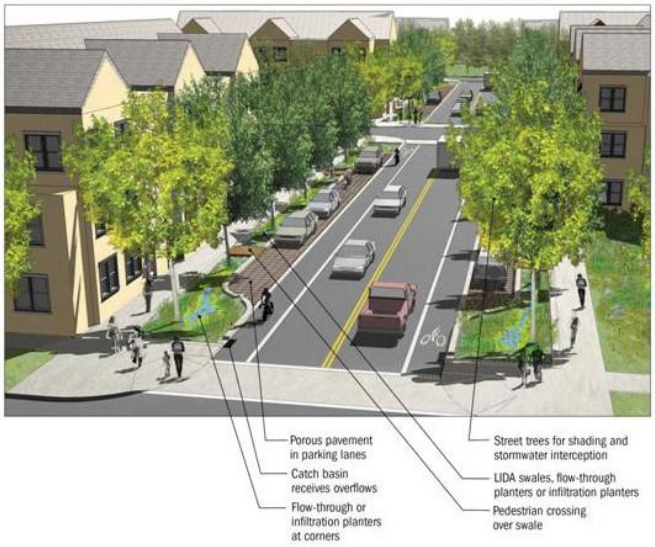


Figure 61. Greener Streetscape using LID practices. Source: *"Greening the Code"* Washington County, OR

Low Impact Development (LID)

Low impact development (LID) focuses on the hydrologic impact of development and tries to maintain pre-development hydrologic systems, treating water as close to the source as possible (see Figure 61). LID principles can be incorporated into development or stormwater ordinances and used in new development or retrofitting existing developments. Green infrastructure systems are created to mimic natural processes that promote water infiltration, native plant evapotranspiration, and stormwater reuse.

Low impact development seeks to keep stormwater out of pipes and instead keep the entire infrastructure more natural and above ground. Solutions start at the lot scale such as rain gardens and overflows to swales adjacent to roads. Larger impervious areas, such as a commercial development may utilize constructed wetlands for stormwater storage while adding value to the area by enhancing aesthetics, site interest and the ecology. Entities such as Milwaukee Metropolitan

Sewerage District have been influential in determining pollutant reductions for various LID methodologies.

Economics of Conservation Developments and Low Impact Development

Both conservation developments and low impact development (LID) are not only environmentally sound choices, but economical ones for both developers and municipalities. Conservation design can produce some of its biggest cost savings in infrastructure costs such as site preparation, stormwater management, site paving, and sidewalks (Conservation Research Institute, 2005). According to a study conducted by Applied Ecological Services, Inc., the average savings created by choosing conservation development over more traditional footprints is 24% (Table 41) (AES, 2007). Not only do lots in conservation developments typically cost less to install, but they also "carry a price premium … and sell more quickly than lots in conventional subdivisions (Mohamed, 2006)." Another study conducted in Concord, Massachusetts found that over an eight-year period, a cluster development with protected open space had a 2.6% higher annual appreciation rate over "residential properties with significantly larger private yards, but without the associated open-space (Lacy, 1990)."

Table 41. Savings of Conservation Development over Traditional Subdivision Design for ten Midwestern conservation development projects.

Positive numbers are savings of Conservation Development over Traditional.
Negative numbers are costs of Conservation Development over Traditional.

Project:	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Average
ITEM											
Grading	-$214,740	$257,832	$1,813,726	$2,215,025	$1,856,206	$1,862,988	$796,705	$291,957	$302,497	$2,852,312	51.00%
Roadway	$84,702	$18,754	-$16,477	-$130,230	$1,464,599	$1,187,386	$205,168	$9,231	-$9,963	$801,484	18.00%
Storm Sewer	$181,611	$31,220	$6,648	$89,676	$974,689	$547,184	$210,289	$65,501	$110,021	$678,302	40.00%
Sanitary Sewer	$41,614	-$4,365	$0	-$203,064	$850,962	$224,776	$72,436	-$15,502	$5,960	$423,458	6.00%
Water	$44,483	-$4,671	-$63,680	-$215,881	$905,157	$240,064	$76,815	-$16,257	$5,973	$451,084	5.00%
Ecological	-$56,500	-$74,857	-$277,472	-$400,321	-$407,131	-$625,084	-$160,341	-$93,954	-$264,513	-$380,992	-154.00%
Amenities	$17,572	-$16,202	-$94,399	-$226,216	$552,667	$221,666	$7,825	-$15,749	-$39,274	$266,982	6.00%
Contingencies	$132,055	$51,928	$342,087	$282,247	$1,549,287	$914,745	$302,225	$56,307	$27,675	$1,273,157	24.00%
Total Savings	$660,277	$259,639	$1,710,433	$1,411,235	$7,746,436	$4,573,725	$1,511,124	$281,534	$138,377	$6,365,787	
Total Percent Savings	19.00%	20.00%	33.00%	15.00%	43.00%	32.00%	25.00%	15.00%	4.00%	37.00%	24.30%*
Cost Savings Per Lot	$8,725.00	$6,978.00	$147,012.00	$29,012.00	$7,904.00	$20,077.00	$7,346.00	$4,078.00	$4,959.00	$67,676.00	$30,376.70

* Total Savings Percentage is *not* the percentage savings of all individual Items added together, because dollar-values of Items are different.
Visit www.appliedeco.com for more detailed info.

While low impact development covers a range of stormwater practices, it has some of the same cost benefits as conservation design. Typically LID practices "can cost less to install, have lower operations and maintenance costs, and provide more cost-effective stormwater management and water-quality services than conventional stormwater controls (ECONorthwest, 2007)." Similar to conservation design, cost savings from utilizing LID practices can be found as a reduction in the amount of drainage infrastructure and land disturbance required; additionally, property values can be increased by 12 - 16% (UNH Stormwater Center, 2011).

There is also evidence that combining both conservation and low impact development practices through holistic site design can create deeper cost savings for developers as well as increased ecosystem benefits – particularly by combining clustered site designing and naturalized stormwater management systems (Conservation Research Institute, 2005). Not only do conservation and low impact development practices provide a more economical possibility for developers and municipalities, but they can improve water quality, habitat, and property values in the watershed.

6.1.16 Green Infrastructure Network Planning

A green infrastructure network provides communities with a tool to identify and prioritize land use or conservation opportunities and plan development that benefits both people and nature by

providing a framework for future growth. It identifies areas not suitable for development, areas suitable for development but that should incorporate conservation or low impact design standards, and areas that do not affect green infrastructure. Park Districts, Forest Preserve Districts, IDNR, and watershed stakeholders can use green infrastructure plans for trail routing, open space linkages, and natural area restoration decisions. Residents can use green infrastructure recommendations to reduce runoff from their properties and to see how their properties fit into the larger network. A Green Infrastructure Network for the watershed was developed in Section 3.11.

Green Infrastructure Network *implementation* has several actions:

- Protect specific unprotected green infrastructure parcels through acquisition, regulation, and/or incentives.
- Incorporate conservation or low impact design standards on green infrastructure parcels where development is planned.
- Limit future subdivision of green infrastructure parcels.
- Implement long-term management of green infrastructure.

Green Infrastructure Recommendations

A Green Infrastructure Network can only be realized by coordinated planning efforts of local municipalities, park districts, developers, and private landowners. Stakeholders should follow the recommended process below to initiate and implement the Green Infrastructure Network for the Lower Little Rock Creek watershed.

1) Include all green infrastructure parcels in updated community comprehensive plans and development review maps.
2) Utilize tools such as protection overlays, setbacks, open space zoning, conservation easements, conservation and/or low impact development, etc. on all green infrastructure parcels.
3) Utilize tools such as Development Impact Fees, Stormwater Utility Taxes, Special Service Area (SSA) Taxes, etc. to help fund future management of green infrastructure components where new and redevelopment occurs.
4) Identify important unprotected green infrastructure parcels not suited for development then protect and implement long term management.
5) Work with private landowners along stream/tributary corridors to manage their land for green infrastructure benefits.
6) Use the Green Infrastructure Network to identify new trails and trail connections.

Any property owner can improve green infrastructure too. Stakeholders can create a safe place for wildlife by providing a few simple things such as food, water, cover, and a place for wildlife to raise their young. The National Wildlife Federation's Certified Wildlife Habitat® and the Conservation Foundation's Conservation@Home programs can help get you started. Creating a rain garden, or a small, vegetated depression, to capture water is another way of promoting infiltration while beautifying your yard and providing additional habitat. Disconnecting your roof downspouts and capturing that runoff in rain barrels not only reduces the amount of runoff entering streams, but also serves as a great source of water for irrigating your yard.

If a portion of a stream runs through your backyard, here are some tips to help properly manage your piece of the green infrastructure network:

1. *A natural, meandering stream is a happy stream* - Work with experts to restore degraded streams.

2. *Remove non-native species* - Identify and remove plants that are out of place.
3. *Plant native buffers* - Plants adapted to the Midwest climate can help control erosion by stabilizing banks, while buffers protect the health of streams.
4. *No dumping* - Avoid dumping yard waste and clear heavy debris jams.
5. *Manage chemical use* - Avoid over fertilizing lawns or spilling/dumping chemicals near waterways.

For more detailed information, check out the Lake County Stormwater Management Commission's booklet, "Riparian Area Management: A Citizen's Guide," at www.lakecountyil.gov/stormwater.

6.1.17 Water Quality Trading & Adaptive Management

While Illinois has not yet set up policies or a system to implement water quality trading or adaptive management, nearby Wisconsin has developed policies and a number of resources for both and their guidance could be used as a model or example to follow in Illinois. The following information is cited directly from a Wisconsin Department of Natural Resources (WDNR) document entitled "A Water Quality Trading How to Manual" (WDNR 2013).

Water Quality Trading presents a way for municipal and industrial NPDES permit holders to demonstrate compliance with water quality-based effluent limitations. Generally, trading involves a point source facing relatively high pollutant reduction costs compensating another party to achieve less costly pollutant reduction with the same or greater water quality benefit. In other words, trading provides point sources with the flexibility to acquire pollutant reductions from other sources in the watershed to offset their point source load so that they will comply with their own permit requirements, while simultaneously helping to fund water quality improvements nearby. Trading is not a mandatory program or regulatory requirement, but rather a market-based option that may enable some industrial and municipal facilities within the watershed to meet regulatory requirements more cost-effectively. With ever-tightening water quality standards and restrictions going into effect, trading may become economically preferable to other compliance options.

There are many benefits to trading:

1. Permit compliance through trading may be economically preferable to other compliance options.
2. New and expanding point source discharges can utilize trading to develop new economic opportunities in a region, while still meeting water quality goals.
3. Permittees, and the point and nonpoint sources that work cooperatively with them, can demonstrate their commitment to the community and to the environment by working together to protect and restore local water resources.

Adaptive management is sometimes confused with trading, since both options allow permittees to work with nonpoint or other point sources of phosphorus in a watershed to reduce the overall phosphorus load to a given waterbody. In Wisconsin, which has developed a numeric phosphorus criterion, adaptive management is solely focused on phosphorus compliance and improving water quality so that the applicable phosphorus criterion is met. Trading is not limited to phosphorus and may be used to meet limits for any pollutant for which a criterion has been established. Trading focuses on compliance with a discharge *limit* while adaptive management focuses on compliance with phosphorus *criteria.*

Water quality trading has seven components: pollutant, trading participants, pollution reduction credit, credit threshold, trade ratio, location, and timing (Figure 62). Each of these components must be adequately addressed in a trading strategy. The "pollutant" is simply the contaminant being traded. The "trading participants" are entities involved in the trade. "Credit" is the amount of a given pollutant that is available for trading. "Credit Threshold" is the amount of pollutant reduction that needs to be achieved before credits are generated. "Trade ratios" are put in place due to uncertainty margins. "Location" refers to the fact that the credit user and generator must discharge to the same waterbody. "Timing" is important because credits must be generated before they can be used to offsite the pollution.

Figure 62. Water quality trading components (source: WDNR).

For more information and guidance on water quality trading and adaptive management, see Wisconsin Department of Natural Resources (WDNR) document entitled "A Water Quality Trading How to Manual" (WDNR, 2013).

6.2 Site-Specific Management Measures Action Plan

Site Specific Management Measure (Best Management Practice [BMP]) recommendations made in this section of the report are backed by findings from the watershed field inventory, overall watershed resource inventory, and input from stakeholders. In general, the recommendations address sites where watershed problems and opportunities can best be addressed to achieve watershed goals and objectives. The Site-Specific Management Measures Action Plan is organized by the jurisdiction in which recommendations are located making it easy for users to identify the location of project sites and corresponding project details. It is important to note that project implementation is voluntary and there is no penalty or reduction in future grant opportunities for not following recommendations. Site Specific Management Measures were identified within the following jurisdictional boundaries and are included in the Action Plan:

- *City of Sandwich*
- *City of Plano*
- *DeKalb County*
- *Kendall County*

Management Measure categories in the Site-Specific Management Measures Action Plan include:

- *Detention Basin Retrofits & Maintenance*
- *Streambank & Riparian Area Restoration*
- *Wetland Restoration*
- *Priority Green Infrastructure Protection Areas*
- *Other Management Measures*

Descriptions and location maps for each Management Measure category follow. Table 44 includes useful project details such as site ID#, Location, Units (size/length), Existing Condition, Management Measure Recommendation, Pollutant Load Reduction Efficiency, Priority, Owner/Responsible Entity, Sources of Technical Assistance, Cost Estimate, and Implementation Schedule.

Project importance, technical and financial needs, cost, feasibility, and ownership type were taken into consideration when prioritizing and scheduling Management Measures for implementation. High, Medium, or Low Priority was assigned to each recommendation. "Critical Areas" as discussed in Section 5.2 are all High Priority and highlighted in red on project category maps and the Action Plan table. For this watershed plan a "Critical Area" is best described as a location in the watershed where existing or potential future causes and sources of an impairment or existing function are significantly worse than other areas of the watershed. Implementation schedule varies greatly with each project but is generally based on the short term (within 1-10 years) for High Priority/Critical Area projects and 10-20+ years for medium and low priority projects. Maintenance projects are ongoing.

The Site-Specific Management Measures Action Plan is designed to be used in one of two ways.
Method 1: The user should find the respective jurisdictional boundary (listed alphabetically in Table 44) then identify the Management Measure category of interest within that boundary. A Site ID# can be found in the first column under each recommendation that corresponds to the Site ID# on a map (Figures 63-67) associated with each category.

Method 2: The user should go to the page(s) summarizing the Management Measure category of

interest then locate the corresponding map and Site ID# of the site-specific recommendations for that category. Next, the user should go to Table 44 and locate the

jurisdiction where the project is located, then go to the project category and Site ID# for details about the project.

Pollutant Load Reduction Estimates

Where applicable, pollutant load reductions and/or estimates for total suspended solids (TSS), nitrogen (TN), and phosphorus (TP) were evaluated for each recommended Management Measure based on efficiency calculations developed for the USEPA's Region 5 Model. This model uses "Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual" (MDEQ, 1999) to provide estimates of sediment and nutrient load reductions from the implementation of *agricultural* Measures. Estimate of sediment and nutrient load reduction from implementation of *urban* Measures is based on efficiency calculations developed by Illinois EPA.

Estimates of pollutant load reduction using the Region 5 Model are measured in weight/year (tons/yr for total suspended solids and lbs/yr for nitrogen and phosphorus). The model was generally used to calculate weight of pollutant reductions for all recommended Management Measures where calculation of such data is applicable. In summary, pollutant reductions were calculated for 20 detention basin retrofit & maintenance projects, 7 wetland restoration projects, 11 stream & riparian area restoration projects, and 6 other management measure recommendations. Additionally, pollutant reductions for agricultural management recommendations were calculated at the watershed level and applicable to any/all agricultural land in the watershed. Spreadsheets used to determine pollutant load reductions can be found in Appendix D.

For context and as a general guide, estimated percent removal of total suspended solids, nitrogen, and phosphorus based on the Region 5 Model are depicted for various Management Measures in Table 42.

Table 42. Region 5 Model percent pollutant removal efficiencies for various Management Measures.

Management Measures	TSS	TN	TP
Vegetated Filter Strips	73%	40%	45%
Wet Pond/Detention	60%	35%	45%
Wetland Detention	77.5%	20%	44%
Dry Detention	57.5%	30%	26%
Infiltration Basin	75%	60%	65%
Streambank/Lake Shoreline Stabilization	90%	90%	90%
Weekly Street Sweeping	16%	6%	6%
Porous Pavement	90%	85%	65%
Manure Waste Management	na	80%	90%

Watershed-Wide Summary of Action Recommendations

All Management Measures, Information & Education Plan (Section 7.0), and Monitoring Plan (Section 9.1) recommendation information is condensed by Category in Table 43. This information provides a watershed-wide summary of the "Total Units" (size/length), "Total Cost," and "Total Estimate of Pollutant Load Reduction" if all the recommendations in the Management Measures Action Plan, Education Plan, and Monitoring Plan are implemented. Key points include:

- 3,116.7 acres of ecological restoration with a total cost of $5,632,800.

- 56,593 linear feet of stream and riparian area restoration costing $4,195,000.
- 4,397 pounds/year of phosphorus (TP) would potentially be reduced each year, representing 107% of the 4,095 pounds/year Reduction Target identified in Section 5.3.
- 17,308 pounds/year of nitrogen (TN) would potentially be reduced each year, representing 372% of the 4,655 pounds/year Reduction Target identified in Section 5.3.
- 3,384 tons/year of total suspended solids (TSS) would potentially be reduced each year, despite not needing a Reduction Target (as detailed in Section 5.3).
- Education programs will cost at $6,600 annually to implement (see Section 7.0).
- All existing monitoring should continue, and no new monitoring is needed (see Section 9.1).

Table 43. Watershed-wide summary of Management Measures recommended for implementation.

Management Measure Category	Total Units (size/length)	Total Cost	Estimated Load Reduction		
			TSS (t/yr)	TP (lbs/yr)	TN (lbs/yr)
Detention Basin Retrofits & Maintenance	55 acres	$870,800	210	297	1,335
Stream & Riparian Area Restoration					
Streams	56,593 lf	$4,195,000	1,486	1,266	2,526
Riparian Areas	656 acres		239	416	4,175
Wetland Restoration	355 acres	$2,887,000	157	289	3,141
Priority Green Infrastructure Protection Areas	446 acres	na	na	na	na
Programmatic Agricultural Management Practices					
Additional Conservation Tillage practices (residue >60%) on 19% of any/all agricultural land	1,357 acres	na	1,214	1,989	5,022
Other Management Measures					
3 Natural area restorations	70.1 acres	$1,040,000	50	70	598
1 Natural area maintenance	47.4 acres	$20,000	8	13	146
1 swale retrofit	0.7 acres	$35,000	2	4	11
1 failed-dam removal	129.5 acres	$780,000	18	53	354
Information & Education Plan	Entire Plan	$6,600/yr	na	na	na
Water Quality Monitoring Plan	Entire Plan	N/A	na	na	na
TOTALS	**3,116.7 acres**	**$5,632,800**	**3,384 tons/yr**	**4,397 lbs/yr**	**17,308 lbs/yr**
	56,593 lf	**$4,195,000**			
	Education	**$6,600/yr**			
	Monitoring	**N/A**			

6.2.1 Detention Basin Retrofits & Maintenance Recommendations

During the inventory, 20 detention basin retrofit opportunities were identified in Lower Little Rock Creek watershed, predominantly in the City of Sandwich since that is the most urbanized portion of the watershed. Most detention basins provide little by way of water quality improvement, infiltration capability, and wildlife habitat. In the future it is recommended that new standards for detention basins be implemented in local and county development ordinances (see Section 6.1.2). Applied Ecological Services, Inc. (AES) conducted an inventory of detention basins in fall 2019. The results of the detention basin inventory are summarized in Section 3.13. Detailed field investigation datasheets and maps can be found in Appendix C.

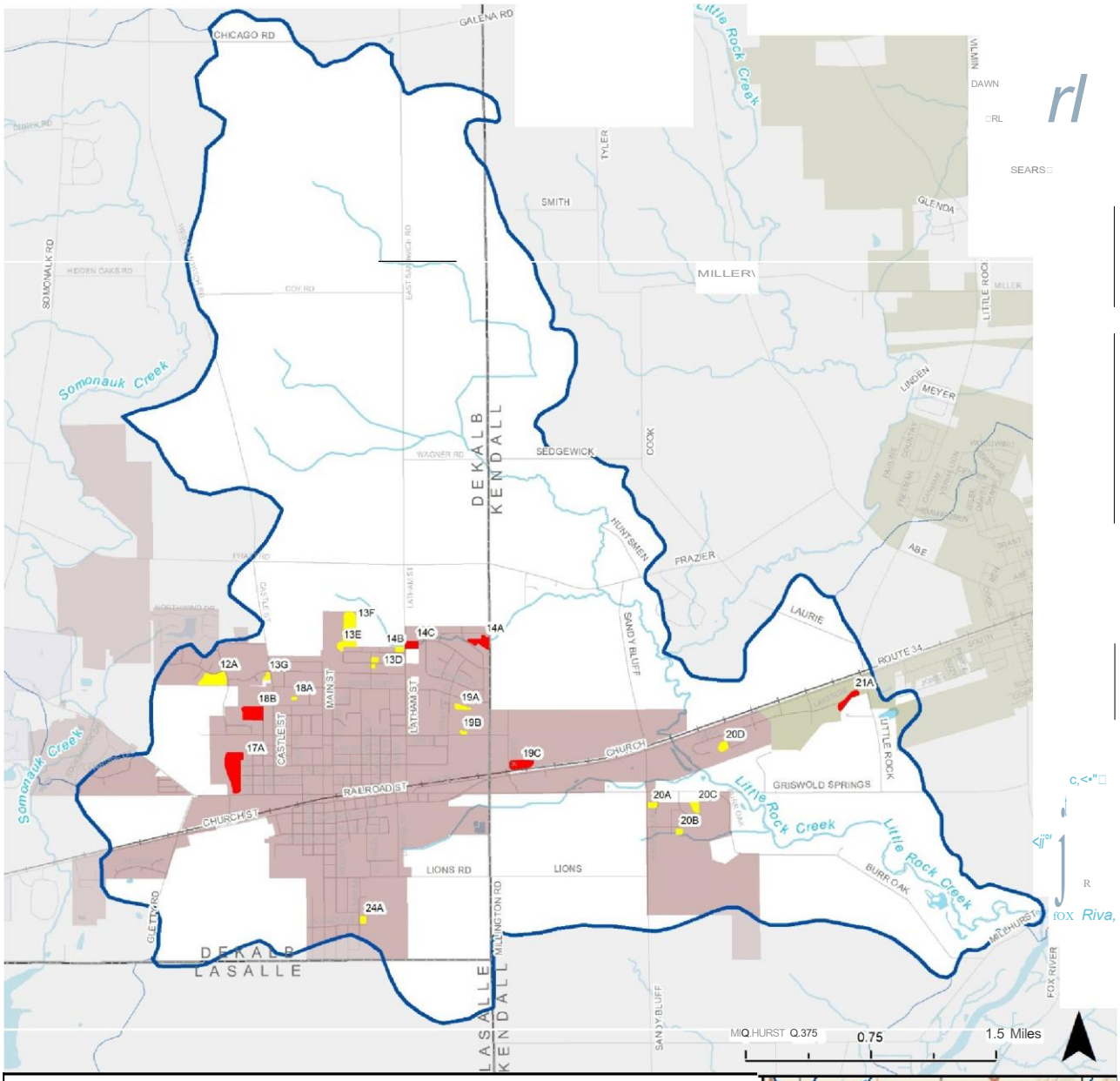
The type and ecological condition of the detention basins in the watershed varies. The inventory resulted in 14 dry-bottom with turf grass and 6 naturalized wet/wetland bottom basins. Additionally, of the 20 basins, none provide "Good" ecological and water quality benefits, while 6 basins (30%) likely provide "Average" benefits. The remaining 14 basins (70%) likely provide "Poor" ecological and water quality benefits because most were designed simply to meet stormwater storage volume requirements.

The majority of detention basins are located within the City of Sandwich. Many of the wet and dry detention basins are planted with mown turf grass side slopes. Many of the basins in the watershed present excellent retrofit opportunities. Most would be relatively easy to naturalize with native plantings and concrete structures and drains in dry basins can be manipulated to store and infiltrate water as desired.

All recommended detention basin retrofits and/or maintenance recommendations are shown in Figure 63 by priority and Site ID# which correspond with the ID# used in the field investigation. Details about each recommendation can be found in the Action Plan Table (Table 44) within the appropriate jurisdictional boundary. In total there were 6 high priority and 14 medium priority detention basins in the watershed. All of the High priority recommendations are considered "Critical Areas." Many of these are basins with significant problems or present a good opportunity for retrofitting. Medium priority is generally assigned to smaller private basins and those with fewer problems or maintenance needs. In some cases, basins are assigned higher priority based on location and/or ability to treat polluted stormwater runoff. There were no Low priority detention basin retrofit recommendations.

LITTLE ROCK CREEK WATERSHED

Figure 63: Detention Basin Retrofit Recommendations



LEGEND

D Little Rock Creek Watershed
--+- Railroads
Roads
Waterbodies (NHD)
Streams & Tributaries (NHD)

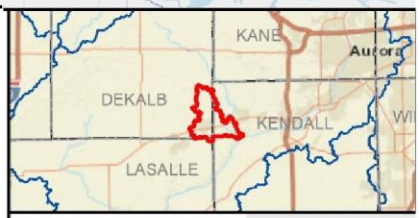
Priority

- Critical Area/High Priority
Medium Priority

Municipality

PLANO
SANDWICH

There are no Low Priority Detention Basin Retrofit Recommendations



AES Project #: 18-0105
Coordinate System:
NAD83 IL Stat Plane East
Data Sources:
DeKalb, Kendall County

6.2.2 Streambank & Riparian Area Restoration Recommendations

Applied Ecological Services, Inc. (AES) completed a general inventory of Lower Little Rock Creek and its tributaries in fall 2019. All streams and tributaries were assessed based on divisions into "Stream Reaches". Eleven (11) stream reaches were assessed accounting for 56,592 linear feet or 10.6 linear miles. Detailed notes were recorded for each stream reach related to potential Management Measure recommendations such as improving streambank and channel conditions, restoring riparian areas, and maintaining these reaches long term. The results of the stream inventory are summarized in Section 3.13; detailed field investigation datasheets can be found in Appendix C.

The condition of stream reaches in the watershed varies. According to the stream inventory, 72% (40,776 lf) of stream and tributary length is naturally meandering; approximately 11% (5,982 lf) is moderately channelized; 17% (9,834 lf) is highly channelized. Approximately 53% (29,796 lf) of the total stream and tributary length exhibits no or low bank erosion while moderate erosion is occurring along 47% (26,797 lf) of streambanks. There were no highly eroded streambanks within the watershed. On the other hand, approximately 29% (along 16,453 linear feet of streams) of the riparian areas are "Poor" quality. Of the remaining reaches, 16,611 linear feet or 29% of riparian areas are in "Moderate" condition and 42% (23,528 linear feet) are in good condition.

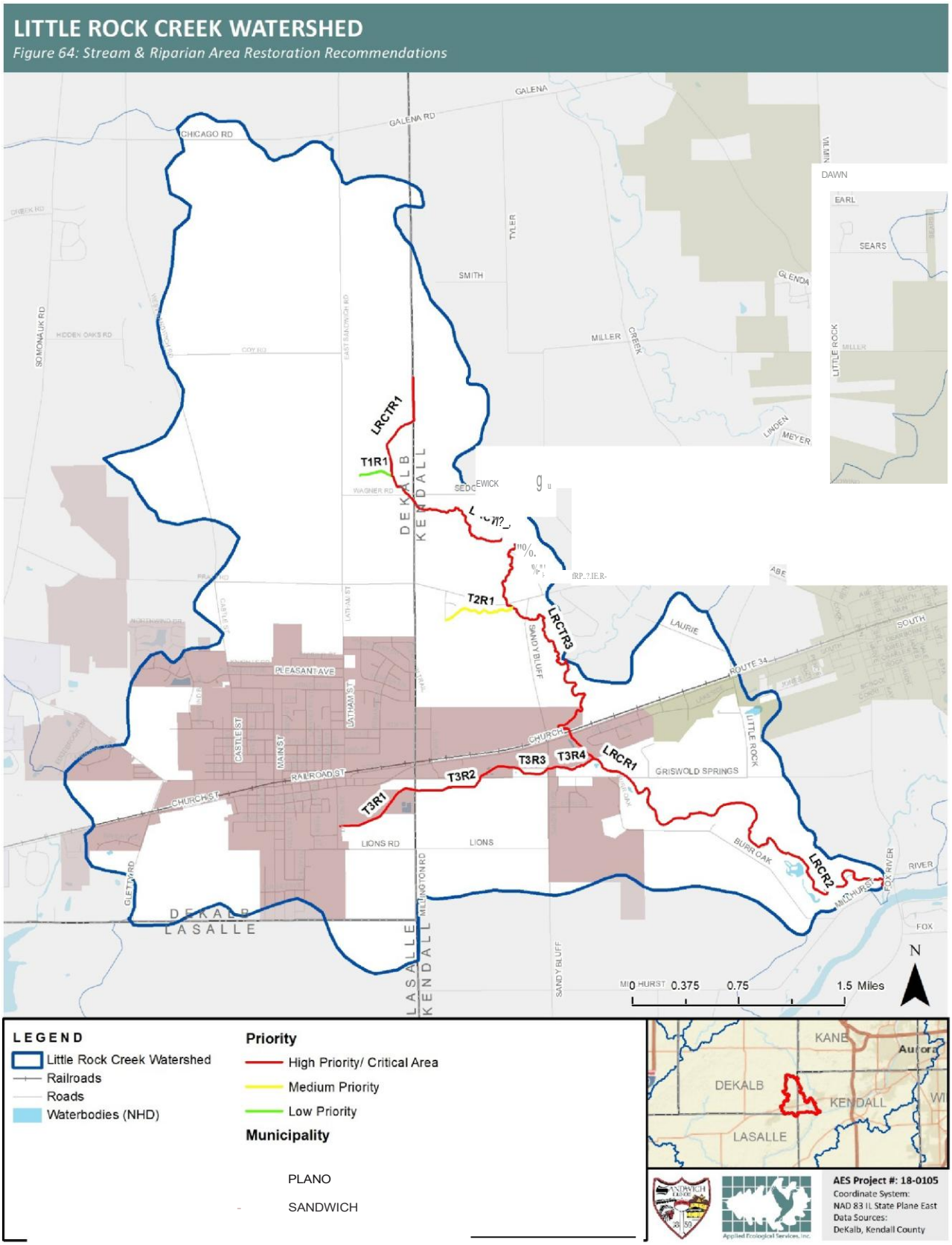
Stream and riparian area recommendations for this watershed plan generally focus on restoring and improving the riparian corridor, with some spot stabilization of banks recommended where appropriate.

Example AES stream restoration in Barrington Illinois.

Most stream restoration projects include at least one of the following three water quality and habitat improvement components; 1) removal of existing invasive vegetation including trees and shrubs from the banks and extending buffers where none currently exists followed by; 2) spot stabilization of banks using bioengineering, regrading of banks, and installation of native vegetation where necessary; and 3) restored riffles/grade controls in the stream channel to simulate conditions found in naturally meandering streams and to improve in-stream habitat. Short- and long-term maintenance then follows and is critically important in the development process and to maintain restored conditions.

Figure 64 shows the location of all potential streambank and riparian area restoration projects by reach ID# and priority while Table 44 lists project details about each recommendation within the appropriate jurisdictional boundary. Potential streambank and riparian area restoration projects on public land and reaches exhibiting severe problems on private land are generally assigned as higher priority for implementation. Medium or Low priority was generally assigned to stream reaches exhibiting less urgent problems. In total, 52,428 linear feet of stream are considered High Priority/

Critical Area projects.


LITTLE ROCK CREEK WATERSHED
Figure 64: Stream & Riparian Area Restoration Recommendations
GALENA
GALENA RD
CHICAGO RD
DAWN
EARL
SEARS
SMITH
TYLER
GLENDA
MILLER CREEK
LINDEN
MEYER
LITTLE ROCK
SONOMA LK RD
HIDDEN OAKS RD
COY RD
EAST SANDWICH RD
WAGNER RD
SEDG EWICK
LRCTR1
T1R1
T2R1
LRCTR3
SANDY BLUFF
LAURIE
ROUTE 34
SOUTH
ABE
PLEASANT AVE
LATHAM ST
CASTLE ST
MAIN ST
CHURCH ST
RAILROAD ST
T3R1
T3R2
T3R3
T3R4
LRCR1
GRISWOLD SPRINGS
LITTLE ROCK
LIONS RD
LIONS
BUR OAK
LRCR2
MILLINGTON RD
CLEETWYRD
DEKALB
LASALLE
KENDALL
FOX RIVER
FOX
RIVER
N
0 0.375 0.75 1.5 Miles
LEGEND
Little Rock Creek Watershed
Railroads
Roads
Waterbodies (NHD)
Priority
High Priority/ Critical Area
Medium Priority
Low Priority
Municipality
PLANO
SANDWICH
KANE
DEKALB
KENDALL
LASALLE
AES Project #: 18-0105
Coordinate System:
NAD 83 IL State Plane East
Data Sources:
DeKalb, Kendall County

6.2.3 Wetland Restoration Recommendations

Wetland restoration is the process of bringing back historic wetlands in areas where they have been drained. This section does not include enhancement and maintenance for existing wetlands. Restoration can be important for mitigation purposes or done simply to benefit basic environmental functions that historic wetlands once served. Improvement in water quality is the greatest benefit provided by wetland restoration. Other benefits include reducing flood volumes/rates and improved habitat to increase plant and wildlife biodiversity. The wetland restoration process is generally the same for all sites. First a study must be completed to determine if restoration at the site is actually feasible. If it is, a design plan is developed, permits obtained, then the project is implemented by breaking existing drain tiles and/or regrading soils to attain proper hydrology to support wetland vegetation. Planting with native wetland species is the next step followed by short- and long-term maintenance and monitoring to ensure establishment.

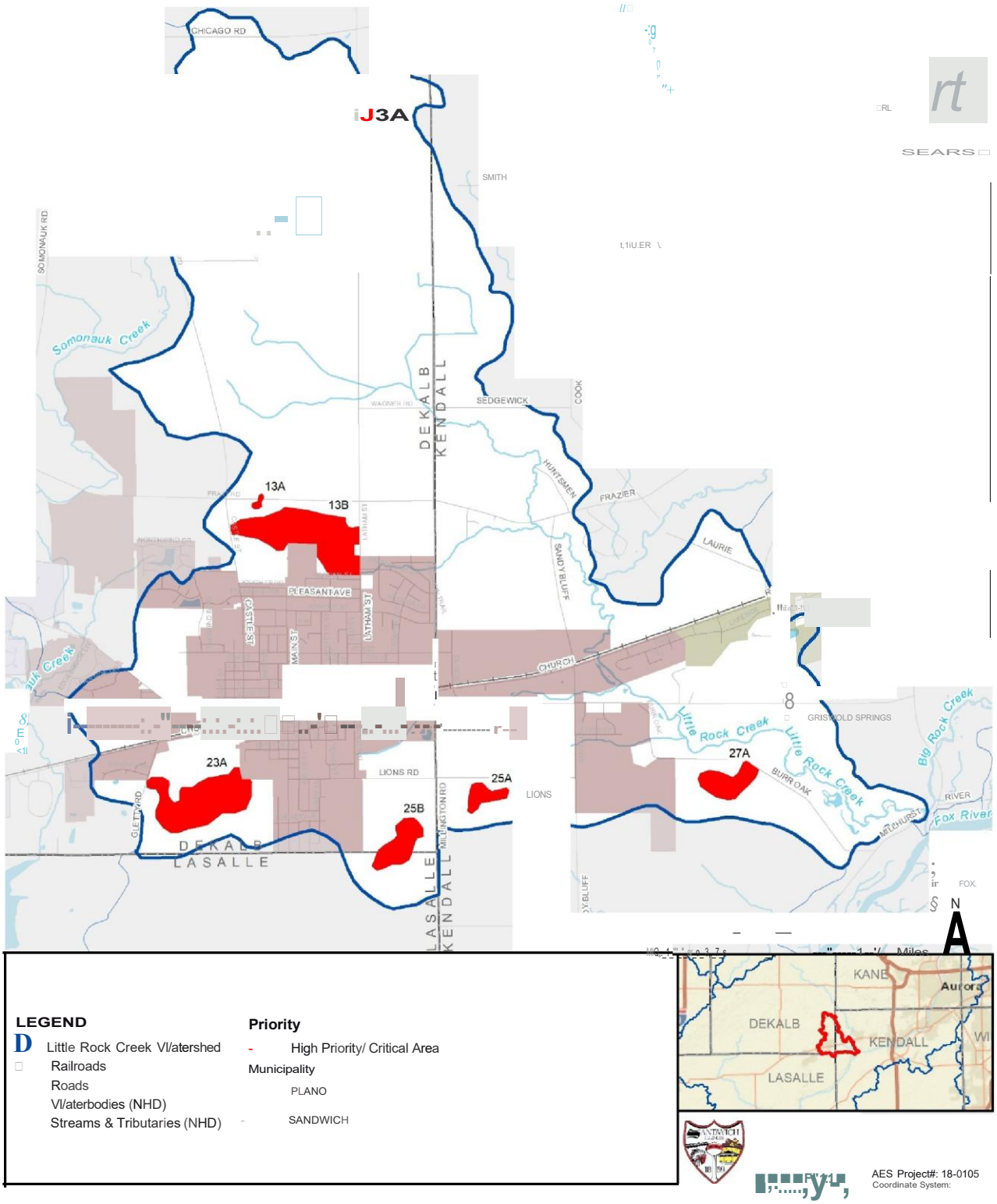
Wetland restoration sites were identified in Section 3.13.3 using a GIS exercise and then confirmed in the field to meet specific criteria determined to be essential for restoration of a functional and beneficial wetland. The analysis resulted in seven sites, totaling 355.1 acres, meeting the criteria and considered as potentially feasible wetland restoration sites. All seven sites were determined to be high priority/critical area restorations. There were no medium or low priority wetland restoration recommendations.

Example wetland restoration at AES wetland mitigation site

Figure 65 includes the location of all the potential wetland restoration sites by site priority and site ID#. The site ID#s match those used in Section 3.13.3. Details about each recommendation can be found in the Action Plan Table (Table 44) within the appropriate jurisdictional boundary.

LITTLE ROCK CREEK WATERSHED

Figure 65: Wetland Restoration Recommendations



There are no Medium or Low Priority

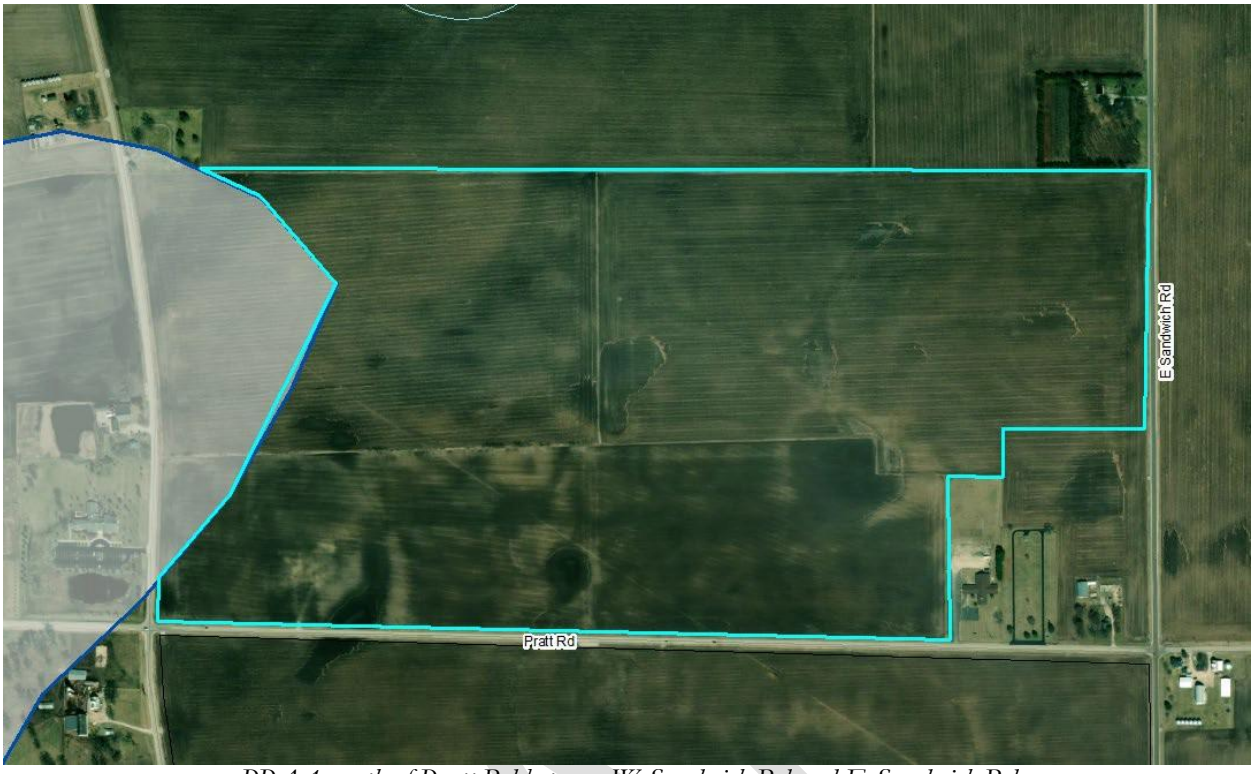
6.2.4 Priority Green Infrastructure Protection Area Recommendations

Priority Green Infrastructure Protection Areas are best described as large unprotected parcels of land that are currently undeveloped with no plans for future development or similar parcels where future development is planned. The significance is that these parcels are situated in environmentally sensitive or important green infrastructure areas. This assessment is by no means meant to prevent or deter future urbanization or land use change, but rather to determine which areas might be most in need of utilizing conservation design or low impact development when change does occur so as to protect remaining natural resources, and to identify existing developed lands that could be managed for maximum green infrastructure benefit, restoration, and preservation.

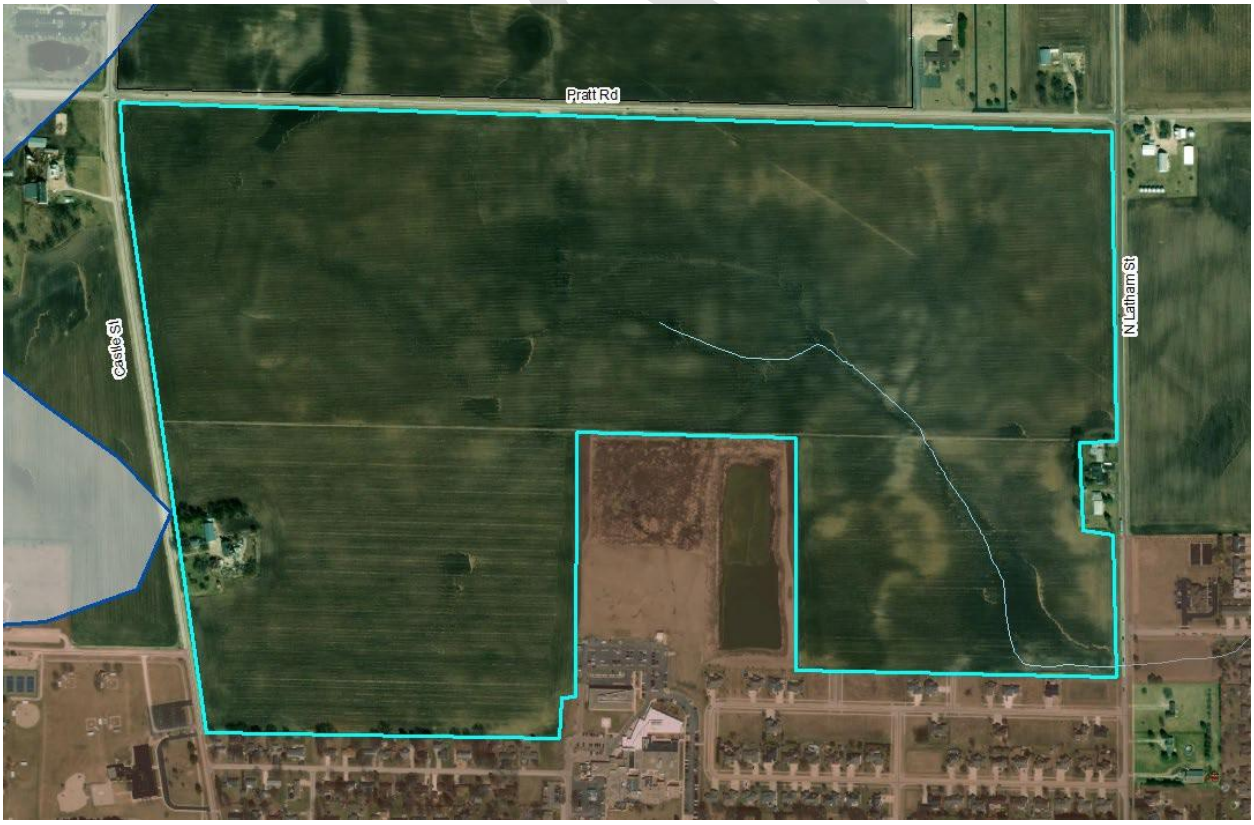
For the Lower Little Rock Creek watershed plan, two Priority Green Infrastructure Protection Areas were found, and both are lands that are currently in agricultural production and have the potential to be developed in the future. While these lands remain in agricultural production, it will be important to ensure that no-till farming is being utilized. If and when any of the areas are developed, development should follow Conservation Design or Low Impact Development standards and guidelines to help maintain and improve water quality and watershed conditions.

Two Priority Protection Areas (PPAs) totaling approximately 446 acres were identified in the watershed based on information obtained from observations during the field inventory, existing and predicted future land use data (Section 3.8), and green infrastructure (Section 3.11) sections of this report.

Figure 66 shows the location of the Priority Green Infrastructure Protection Areas by site ID# while Table 44 includes management measure recommendations for each. Both sites are considered "High Priority/Critical Areas". Cost estimates for implementing recommendations for these areas are not included due to varying individual landowner/site costs. In addition, pollutant reduction estimates cannot be determined for these areas.



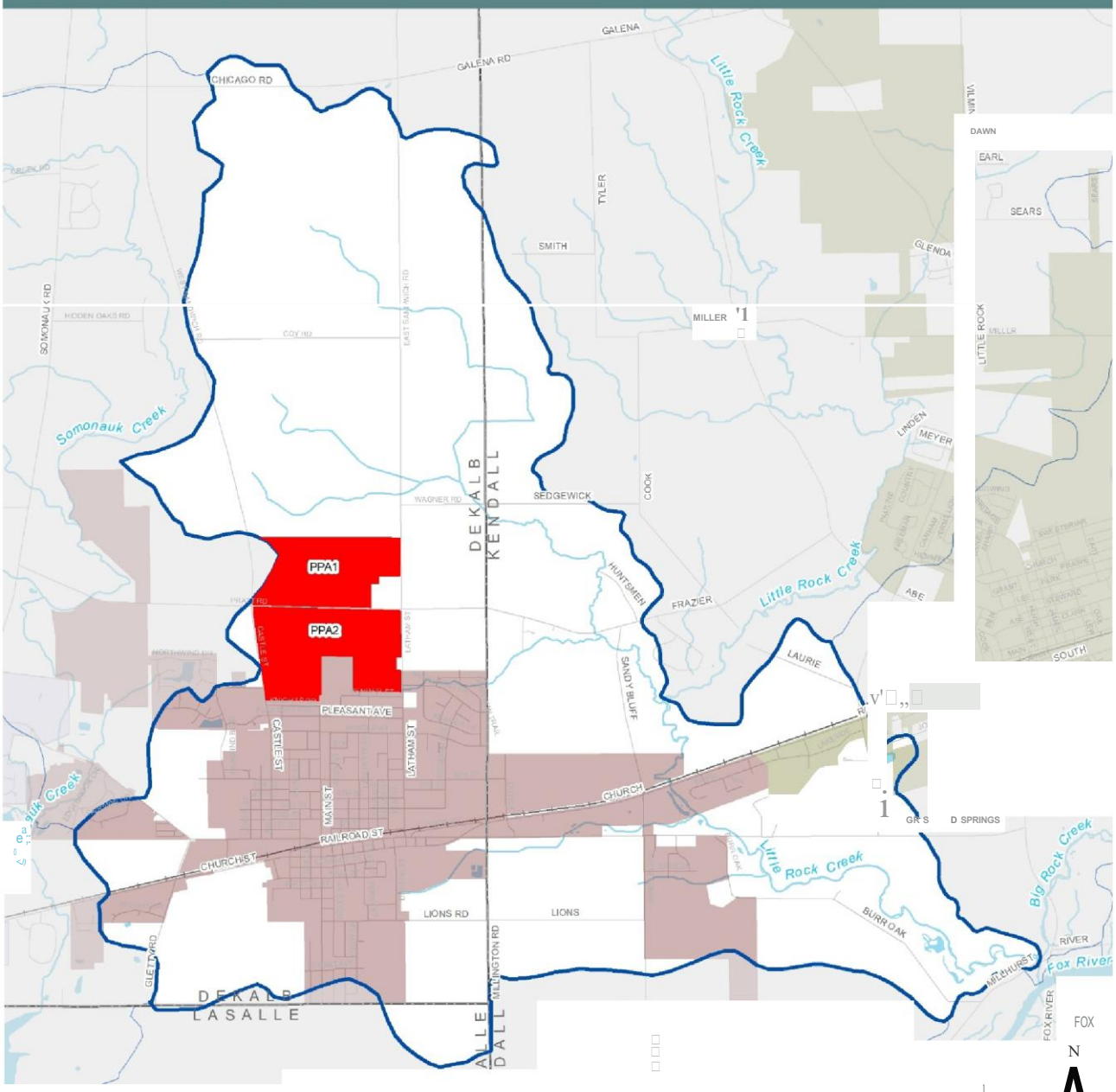
PPA 1 north of Pratt Rd between W Sandwich Rd and E Sandwich Rd



PPA 2 south of Pratt Rd between Castle St and N Latham St

LITTLE ROCK CREEK WATERSHED

Figure 66: Priority Green Infrastructure Protection Area Recommendations



LittleRock Creek Wat

Ra;l=ds **oohed**

Roads

Waterbodies (NHD)

Streams & T.nbutaries(NHD)

Municipality

PLANO

SANDWICH

There are no Med·

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lot_e_d_ io nA rea's

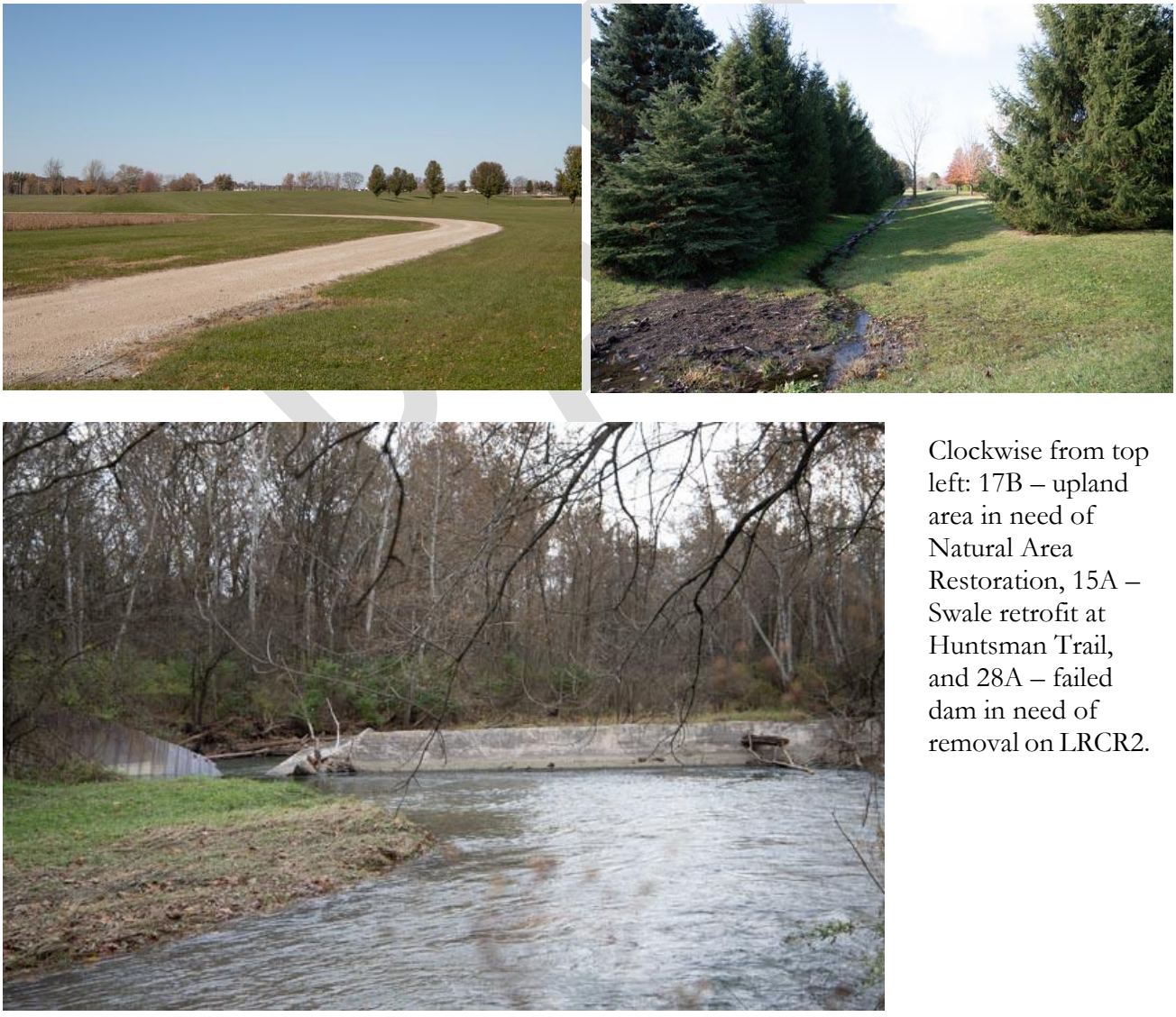
AES Project#: 18-010S
Coordinate system·
NAD 63 IL State Pla.ne East
Oa,ta,Sources:
DeKalb, K□ndall County

6.2.5 Other Management Measure Recommendations

While completing the general inventory of Lower Little Rock Creek watershed, Applied Ecological Services, Inc. (AES) noted potential Management Measure projects that fit under miscellaneous other categories. In total there were 6 projects that fell into the other management measures category. Detailed field investigation datasheets for these projects can be found in Appendix C. Figure 67 shows the location of all "Other Management Measure" recommendations by ID# while Table 44 lists details about each recommendation within the appropriate jurisdictional boundary.

Potential projects include:

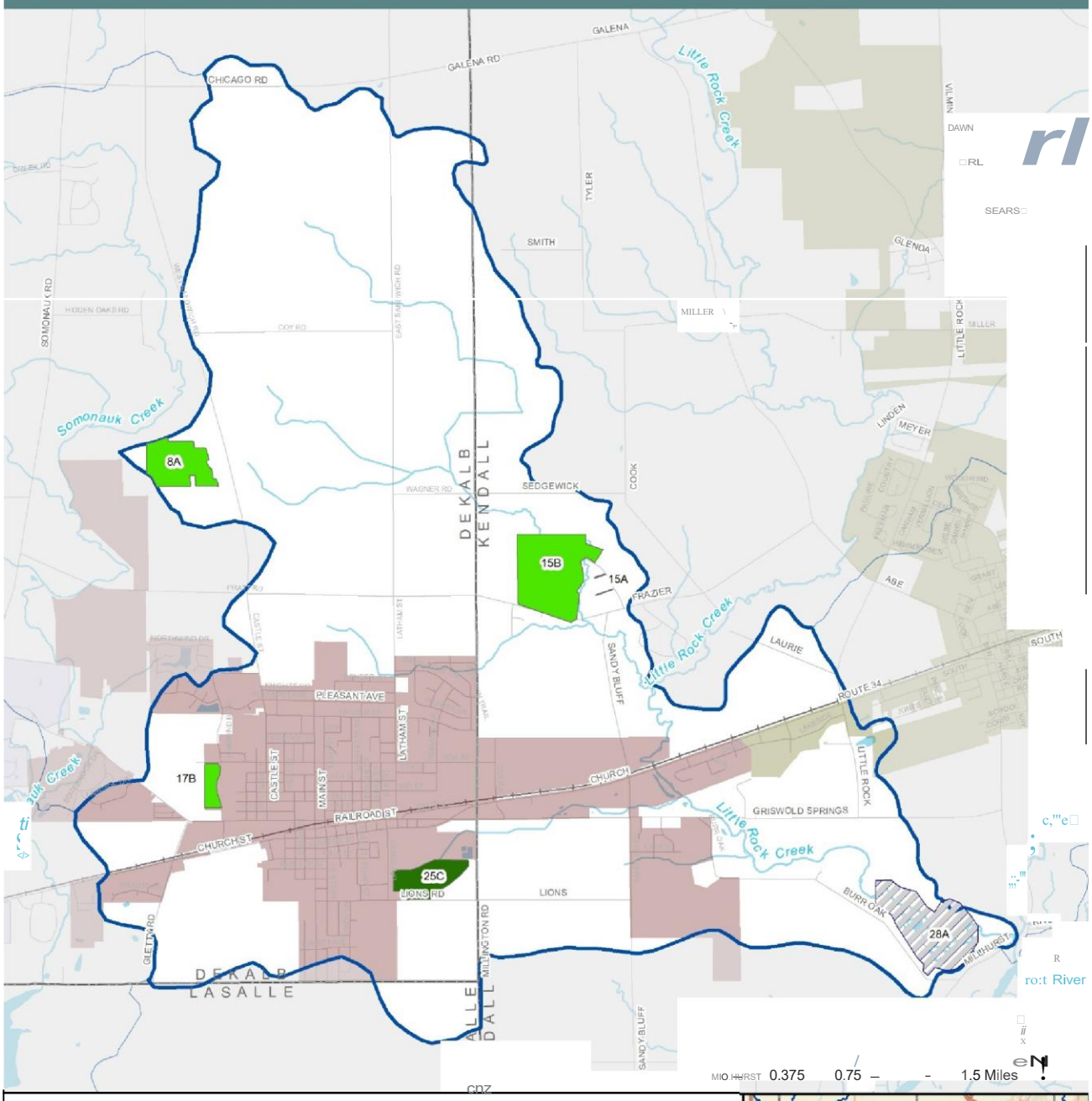
- 3 Natural area restorations
- 1 Natural area maintenance
- 1 Swale retrofit
- 1 Failed dam in need of removal



Clockwise from top left: 17B – upland area in need of Natural Area Restoration, 15A – Swale retrofit at Huntsman Trail, and 28A – failed dam in need of removal on LRCR2.

LITTLE ROCK CREEK WATERSHED

Figure 67: Other Management Measure Recommendations



LEGEND

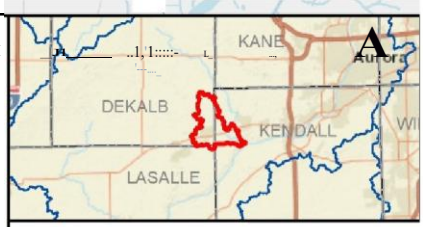
- Little Rock Creek Watershed
- Railroads
- Roads
- Waterbodies (NHD)
- Streams & Tributaries (NHD)

Municipality

- PLANO
- SANDWICH

Recommendation Type

- Natural Area Restoration
- Natural Area Maintenance
- Swale Naturalization
- Failed Dam Removal



AES Project#: 18-0105
Coordinate Svste-m:
NAD 83 IL State Plane East
Data Sources:
DeKalb, Kendall County

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6.2.6 Site-Specific Management Measures Action Plan Table

Table 44. Site-specific management measures action plan.

DEKALB COUNTY													
ID #	Location	Units (Acres or Linear Feet)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency			Priority	Owner & Responsible Entity	Sources of Technical Assistance	Cost Estimate		Implementation Schedule (Years)
					TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)				Design, Permit, Install	Annual Maintenance and/or 3 Yrs. to Establish	
OTHER MANAGEMENT MEASURES (SEE FIGURE 67). Technical and Financial Assistance Needs: Technical and financial assistance needed to implement these projects varies depending on complexity.													
8A	See Figure X for project location	64.8	Remnant dry-mesic oak woodland overgrown with invasive shrub and tree species	Conduct Natural Resource Inventory and develop management plan then implement management plan to restore oak woodland. Maintain for three years to establish/maintain.	7	10	121	High/ Critical Area	Private Owner	Ecological Consultant/ Contractor	$390,000	$90,000/3-yr	1-10 Years
25C	See Figure X for project location	47.4	Restored wetland complex and wet-mesic prairie at Harvey Creek Conservation Area. Important to maintain control of invasive species long term	Develop and implement maintenance plan to control invasive species and manage long term.	8	13	146	High/ Critical Area	Sandwich Park District	Ecological Consultant/ Contractor	n/a	$20,000/yr	1-10 Years
PRIORITY GREEN INFRASTRUCTURE PROTECTION AREAS (See Figure 66). Technical and Financial Assistance Needs: Technical assistance needed to implement no-till vary widely based on differences between individual farms but can be relatively low because NRCS can provide much of this information and matching funds. Implementing future conservation and/or low-density design development in Priority Protection Areas is mostly a matter of instituting policies and ordinances.													
PPA2 (13H)	See Figure X for project location	191.6	Existing row crop production that drains south to 13B/PPA1 and likely to be developed in the future (also 13H)	Utilize no-till farming and reduce stormwater flows to nearby Latham flood problem area as long as property is in production; utilize conservation design or low impact development if developed	NA	NA	NA	High/ Critical Area	Private Owner	NRCS, DCSWCD, DeKalb County	The cost for acquiring & protecting parcels cannot be determined		1-10 Years
STREAMBANK & RIPARIAN AREA RESTORATION RECOMMENDATIONS (See Figure 64). Technical and Financial Assistance Needs: Stream restorations are complex and require high technical and financial assistance needs to protect land, design, construct, monitor, and maintain the restoration. The project becomes more complex in areas that flow through several governing bodies or multiple private residences. Technical and financial assistance associated with stream maintenance is generally low for minor tasks such as removing debris.													
LRCTR1	See Figure X for project location	5,157.2	5,157 lf of stream exhibiting high levels of channelization, no erosion and poor overall riparian area condition	Design and implement a project to remove invasive species from riparian areas and restore with native vegetation then maintain for three years to ensure establishment	36	48	485	High/ Critical Area	Private Owner	Environmental Consultant/ Contractor, DeKalb County, DCSWCD	$100,000	$30,000/3-yer	1-10 Years
LRCTR2	See Figure X for project location	8,641.8	8,642 lf of stream exhibiting low levels of channelization, low levels of erosion and poor overall riparian area condition	Design and implement a project to remove invasive species from riparian areas and restore with native vegetation then maintain for three years to ensure establishment	114	122	569	High/ Critical Area	Private Owner	Environmental Consultant/ Contractor, Kendall County, KCSWCD	$400,000	$100,000/3-yr	1-10 Years

ID #	Location	Units (Acres or Linear Feet)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency			Priority	Owner & Responsible Entity	Sources of Technical Assistance	Cost Estimate		Implementation Schedule (Years)
					TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)				Design, Permit, Install	Annual Maintenance and/or 3 Yrs. to Establish	
T1R1	See Figure X for project location	1,282.2	1,282 lf of stream exhibiting high levels of channelization, no erosion and poor overall riparian area condition	Design and implement a project to remove invasive species and restore with native vegetation then maintain for three years to ensure establishment	4	11	52	Low	Private Owner	Environmental Consultant/ Contractor, DeKalb County, DCSWCD	$30,000	$12,000/3-yr	10-20+ Years
WETLAND RESTORATION RECOMMENDATIONS (See Figure 65). Technical and Financial Assistance Needs: Wetland restoration projects are typically complex and require high technical and financial assistance needs to protect land, design, construct, monitor, and maintain the restoration.													
3A	See Figure X for project location	14.0	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration site.	Design, permit, and construct a project to restore hydrology by breaking drain tiles if necessary, revegetating with native vegetation/seed, and maintaining for three years until established	10	16	203	High/ Critical Area	Private Owner	USACE, IEPA, DeKalb County, Environmental Consultant/ Contractor	$150,000	$50,000/3-yr	1-10 Years
13A	See Figure X for project location	2.5	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration site.	Design, permit, and construct a project to restore hydrology by breaking drain tiles if necessary, revegetating with native vegetation/seed, and maintaining for three years until established	7	13	137	High/ Critical Area	Private Owner	USACE, IEPA, DeKalb County, Environmental Consultant/ Contractor	$25,000	$12,000/3-yr	1-10 Years
23A	See Figure X for project location	112.6	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration and/or mitigation bank	Design, permit, and construct a project to restore hydrology by breaking drain tiles if necessary, revegetating with native vegetation/seed, and maintaining for three years until established	21	39	422	High/ Critical Area	Private Owner	USACE, IEPA, DeKalb County, Environmental Consultant/ Contractor	$560,000	$100,000/3-yr	1-10 Years
25B	See Figure X for project location	39.0	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration and/or mitigation bank	Design, permit, and construct a project to restore hydrology by breaking drain tiles if necessary, revegetating with native vegetation/seed, and maintaining for three years until established	21	39	422	High/ Critical Area	Private Owner	USACE, IEPA, DeKalb County, Environmental Consultant/ Contractor	$400,000	$80,000/3-yr	1-10 Years

KENDALL COUNTY

ID #	Location	Units (Acres or Linear Feet)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency			Priority	Owner & Responsible Entity	Sources of Technical Assistance	Cost Estimate		Implementation Schedule (Years)
					TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)				Design, Permit, Install	Annual Maintenance and/or 3 Yrs. to Establish	
OTHER MANAGEMENT MEASURES (SEE FIGURE 67). Technical and Financial Assistance Needs: Technical and financial assistance needed to implement these projects varies depending on complexity.													
15A	See Figure X for project location	0.7	Large residential lots with mowed turf swales between homes	Design and implement a project to covnert grass swales to native wetland-bottomed swales and maintain for three years to establish	2	4	11	Medium	Private Owners	Ecological Consultant/ Contractor	$25,000	$10,000/3-yr	10-20+ Years
15B	See Figure X for project location	130.3	Large old field area with overgrown dry-mesic oak woodland adjacent to stream	Conduct Natural Resource Inventory and develop management plan then implement management plan to restore oak woodland and old field areas. Maintain for three years to establish/maintain.	10	18	178	High/ Critical Area	Private Owner	Ecological Consultant/ Contractor	$260,000	$65,000/3-yr	1-10 Years
28A	See Figure X for project location	129.5	Failed concrete dam and old berm adjacent to and upstream creating artificial slough, with failed crossing just downstream, in Little Rock Creek Forest Preserve	Design, permit, and implement a project to remove dam, crossing, and berms around slough to restore floodplain function. Dam removal will equalize flow upstream and downstream and will allow fish and mussel passage. Project should be completed in conjunction with restoration of Reach LRCR2.	18	53	354	High/ Critical Area	Kendall County FPD	USACE, IDNR, Engineer, Environmental Consultant/ Contractor	$650,000	$130,000/3-yr	1-10 Years
STREAMBANK & RIPARIAN AREA RESTORATION RECOMMENDATIONS (See Figure 64). Technical and Financial Assistance Needs: Stream restorations are complex and require high technical and financial assistance needs to protect land, design, construct, monitor, and maintain the restoration. The project becomes more complex in areas that flow through several governing bodies or multiple private residences. Technical and financial assistance associated with stream maintenance is generally low for minor tasks such as removing debris.													
LRCR1	See Figure X for project location	14,070.7	14,071 lf of stream exhibiting no channelization, moderate levels of erosion and good overall riparian area condition	Design, permit, and implement a project to remove invasive species from riparian areas, spot stabilize eroding banks where necessary, and restore riparian buffer with native vegetation then maintain for three years to ensure establishment	640	589	1,943	High/ Critical Area	Private Owners/ Kendall County	USACE, IDNR, Engineer, Environmental Consultant/ Contractor	$950,000	$200,000/3-yr	1-10 Years
LRCR2	See Figure X for project location	9,457.5	9,458 lf of stream exhibiting no channelization, moderate levels of erosion and good overall riparian area condition	Design, permit, and implement a project to remove invasive species from riparian areas, spot stabilize eroding banks where necessary, and restore riparian buffer with native vegetation then maintain for three years to ensure establishment	509	433	866	High/ Critical Area	Kendall County FPD	USACE, IDNR, Engineer, Environmental Consultant/ Contractor	$750,000	$150,000/3-yr	1-10 Years
LRCTR2	See Figure X for project location	8,641.8	8,642 lf of stream exhibiting low levels of channelization, low levels of erosion and poor overall riparian area condition	Design and implement a project to remove invasive species from riparian areas and restore with native vegetation then maintain for three years to ensure establishment	114	122	569	High/ Critical Area	Private Owner	Environmental Consultant/ Contractor, Kendall County, KCSWCD	$400,000	$100,000/3-yr	1-10 Years

ID #	Location	Units (Acres or Linear Feet)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency			Priority	Owner & Responsible Entity	Sources of Technical Assistance	Cost Estimate		Implementation Schedule (Years)
					TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)				Design, Permit, Install	Annual Maintenance and/or 3 Yrs. to Establish	
LRCTR3	See Figure X for project location	4,351.2	4,351 lf of stream exhibiting no channelization, low levels of erosion and average overall riparian area condition	Design and implement a project to remove invasive species from riparian areas and restore with native vegetation then maintain for three years to ensure establishment	50	53	151	High/ Critical Area	Private Owners	Environmental Consultant/ Contractor, Kendall County, KCSWCD	$250,000	$70,000/3-yr	1-10 Years
T2R1	See Figure X for project location	2,882.8	2,883 lf of stream exhibiting low levels of channelization, low levels of erosion and average overall riparian area condition; horses have free access to lower quarter of stream	Design, permit, and implement a project to remove invasive species spot stabilize eroding banks, restore riparian buffer with native vegetation, and install fencing to control livestock access to stream then maintain for three years to ensure establishment	15	24	81	Medium	Private Owner	Environmental Consultant/ Contractor, Kendall County, KCSWCD	$40,000	$15,000/3-yr	10-20+ Years
T3R2	See Figure X for project location	4,085.6	4,086 lf of stream exhibiting moderate levels of channelization, low levels of erosion and average overall riparian area condition	Design and implement a project to remove invasive species and restore with native vegetation then maintain for three years to ensure establishment	97	106	848	High/ Critical Area	Private Owners	Environmental Consultant/ Contractor, Kendall County, KCSWCD	$50,000	$18,000/3-yr	1-10 Years
T3R3	See Figure X for project location	1,371.7	1,372 lf of stream exhibiting low levels of channelization, moderate levels of erosion and poor overall riparian area condition; cattle have free access to stream	Design, permit, and implement a project to remove invasive species, spot stabilize eroding banks, restore riparian buffer with native vegetation, install fencing to control livestock access to stream, and maintain for three years to ensure establishment	61	58	311	High/ Critical Area	Private Owners	Environmental Consultant/ Contractor, Kendall County, KCSWCD	$375,000	$40,000/3-yr	1-10 Years
T3R4	See Figure X for project location	1,896.7	1,897 lf of stream exhibiting moderate levels of channelization, moderate levels of erosion and average overall riparian area condition; culverts under Sandy Bluff Rd inhibit fish passage	Design, permit, and implement a project to remove invasive species, spot stabilize eroding banks, restore riparian buffer with native vegetation, restore fish passage, and maintain for three years to ensure establishment	86	80	256	High/ Critical Area	Private Owners	USACE, IDNR, Engineer, Environmental Consultant/ Contractor	$550,000	$50,000/3-yr	1-10 Years
WETLAND RESTORATION RECOMMENDATIONS (See Figure 65). Technical and Financial Assistance Needs: Wetland restoration projects are typically complex and require high technical and financial assistance needs to protect land, design, construct, monitor, and maintain the restoration.													
25A	See Figure X for project location	18.3	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration and/or mitigation bank	Design, permit, and construct a project to restore hydrology by breaking drain tiles if necessary, revegetating with native vegetation/seed, and maintaining for three years until established	13	24	256	High/ Critical Area	Private Owner	USACE, IEPA, Kendall County, Environmental Consultant/ Contractor	$200,000	$50,000/3-yr	1-10 Years

ID #	Location	Units (Acres or Linear Feet)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency			Priority	Owner & Responsible Entity	Sources of Technical Assistance	Cost Estimate		Implementation Schedule (Years)
					TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)				Design, Permit, Install	Annual Maintenance and/or 3 Yrs. to Establish	
25B	See Figure X for project location	39.0	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration and/or mitigation bank	Design, permit, and construct a project to restore hydrology by breaking drain tiles if necessary, revegetating with native vegetation/seed, and maintaining for three years until established	21	39	422	High/ Critical Area	Private Owner	USACE, IEPA, DeKalb County, Environmental Consultant/ Contractor	$400,000	$80,000/3-yr	1-10 Years
27A	See Figure X for project location	36.7	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration and/or mitigation bank	Design, permit, and construct a project to restore hydrology by breaking drain tiles if necessary, revegetating with native vegetation/seed, and maintaining for three years until established	15	28	304	High/ Critical Area	Private Owner	USACE, IEPA, Kendall County, Environmental Consultant/ Contractor	$380,000	$70,000/3-yr	1-10 Years

PLANO													
ID #	Location	Units (Acres or Linear Feet)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency			Priority	Owner & Responsible Entity	Sources of Technical Assistance	Cost Estimate		Implementation Schedule (Years)
					TSS (tons/yr)	TP (lbs/yr)	TN (lbs/ yr)				Design, Permit, Install	Annual Maintenance and/or 3 Yrs. to Establish	
DETENTION BASIN RETROFITS & MAINTENANCE (SEE FIGURE 63). Technical and Financial Assistance Needs: Technical assistance needed to implement detention basin retrofits is relatively low while financial assistance needs are moderate. Private landowners will need the greatest assistance.													
21A	See Figure X for project location	2.5	Dry detention basin with mowed turf bottom and slopes in poor ecological condition	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish	17	21	155	High/ Critical Area	Private Owner	Ecological Consultant/ Contractor	$45,000	$18,000/3-yr	1-10 Years

SANDWICH

ID #	Location	Units (Acres or Linear Feet)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency			Priority	Owner & Responsible Entity	Sources of Technical Assistance	Cost Estimate		Implementation Schedule (Years)
					TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)				Design, Permit, Install	Annual Maintenance and/or 3 Yrs. to Establish	
DETENTION BASIN RETROFITS & MAINTENANCE (SEE FIGURE 63). Technical and Financial Assistance Needs: Technical assistance needed to implement detention basin retrofits is relatively low while financial assistance needs are moderate. Private landowners will need the greatest assistance.													
12A	See Figure X for project location	6.0	Wet-bottomed detention basin with naturalized side slopes in average ecological condition	Maintain well-established naturalized basin	7	21	71	Medium	Private Owner	Ecological Consultant/ Contractor	n/a	$5,000/yr	10-20+ Years
13D	See Figure X for project location	0.9	Dry detention basin with mowed turf bottom and slopes in poor ecological condition	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish	5	14	46	Medium	Private Owner	Ecological Consultant/ Contractor	$18,000	$8,000/3-yr	10-20+ Years
13E	See Figure X for project location	0.9	Dry detention basin with mowed turf bottom and slopes in poor ecological condition	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish	7	9	31	Medium	Northwestern Medicine Valley West Hospital	Ecological Consultant/ Contractor	$18,000	$8,000/3-yr	10-20+ Years
13F	See Figure X for project location	9.1	Wet-bottomed detention basin with naturalized side slopes in average ecological condition	Maintain well-established naturalized basin	13	15	94	Medium	Private Owner	Ecological Consultant/ Contractor	n/a	$7,000/yr	10-20+ Years
13G	See Figure X for project location	0.7	Wet-bottomed detention basin with naturalized side slopes in average ecological condition	Maintain well-established naturalized basin	14	22	77	Medium	Private Owner	Ecological Consultant/ Contractor	n/a	$2,000/yr	10-20+ Years
14A	See Figure X for project location	3.2	Dry detention basin with mowed turf bottom and slopes in poor ecological condition	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish	12	37	125	High/ Critical Area	Private Owner	Ecological Consultant/ Contractor	$58,000	$20,000/3-yr	1-10 Years
14B	See Figure X for project location	0.8	Dry detention basin with mowed turf bottom and slopes in poor ecological condition	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish	1	2	9	Medium	Private Owner	Ecological Consultant/ Contractor	$17,000	$7,000/3-yr	10-20+ Years
14C	See Figure X for project location	2.0	Dry detention basin with mowed turf bottom and slopes in poor ecological condition	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish	5	7	30	High/ Critical Area	Sandwich	Ecological Consultant/ Contractor	$36,000	$15,000/3-yr	1-10 Years
17A	See Figure X for project location	11.6	Dry detention basin with mowed turf bottom and slopes in poor ecological condition	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish	57	29	246	High/ Critical Area	Sandwich Fair	Ecological Consultant/ Contractor	$140,000	$35,000/3-yr	1-10 Years
18A	See Figure X for project location	0.3	Dry detention basin with mowed turf bottom and slopes in poor ecological condition	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish	5	6	22	Medium	St. Paul the Apostle Church	Ecological Consultant/ Contractor	$10,000	$5,000/3-yr	10-20+ Years

ID #	Location	Units (Acres or Linear Feet)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency			Priority	Owner & Responsible Entity	Sources of Technical Assistance	Cost Estimate		Implementation Schedule (Years)
					TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)				Design, Permit, Install	Annual Maintenance and/or 3 Yrs. to Establish	
18B	See Figure X for project location	5.9	Dry detention basin with mowed turf bottom and slopes in poor ecological condition	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish	2	3	18	High/ Critical Area	Private Owner	Ecological Consultant/ Contractor	$90,000	$30,000/3-yr	1-10 Years
19A	See Figure X for project location	1.1	Dry detention basin with mowed turf bottom and slopes in poor ecological condition	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish	13	15	55	Medium	Private Owner	Ecological Consultant/ Contractor	$20,000	$9,000/3-yr	10-20+ Years
19B	See Figure X for project location	0.4	Wet-bottomed detention basin with naturalized side slopes in average ecological condition	Maintain well-established naturalized basin	7	10	42	Medium	Private Owner	Ecological Consultant/ Contractor	n/a	$1,800/yr	10-20+ Years
19C	See Figure X for project location	4.2	Wet-bottomed detention basin with naturalized side slopes but in poor ecological condition	Design and implement a project to naturalize basin slopes and turf areas with natives and maintain for three years to establish	19	26	108	High/ Critical Area	Private Owner	Ecological Consultant/ Contractor	$76,000	$25,000/3-yr	1-10 Years
20A	See Figure X for project location	0.9	Dry detention basin with mowed turf bottom and slopes in poor ecological condition	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish	2	7	24	Medium	Private Owner	Ecological Consultant/ Contractor	$18,000	$8,000/3-yr	10-20+ Years
20B	See Figure X for project location	0.7	Dry detention basin with mowed turf bottom and slopes in poor ecological condition	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish	1	3	11	Medium	Private Owner	Ecological Consultant/ Contractor	$16,000	$7,000/3-yr	10-20+ Years
20C	See Figure X for project location	1.5	Dry detention basin with mowed turf bottom and slopes in poor ecological condition	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish	3	8	28	Medium	Private Owner	Ecological Consultant/ Contractor	$25,000	$11,000/3-yr	10-20+ Years
20D	See Figure X for project location	1.5	Wet-bottomed detention basin with naturalized side slopes but in poor ecological condition	Design and implement a project to naturalize basin slopes and turf areas with natives and maintain for three years to establish	11	14	48	Medium	Private Owner	Ecological Consultant/ Contractor	$25,000	$11,000/3-yr	10-20+ Years
24A	See Figure X for project location	0.8	Dry detention basin with mowed turf bottom and slopes in poor ecological condition	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish	9	28	95	Medium	Private Owner	Ecological Consultant/ Contractor	$18,000	$8,000/3-yr	10-20+ Years
OTHER MANAGEMENT MEASURES (SEE FIGURE 67). Technical and Financial Assistance Needs: Technical and financial assistance needed to implement these projects varies depending on complexity.													
17B	See Figure X for project location	15.4	Upland area mowed turf area where spoils from detention appear to be placed	Design and implement a project to convert turf to prairie and maintain for three years to establish	33	42	299	High/ Critical Area	Sandwich Fair	Ecological Consultant/ Contractor	$185,000	$50,000/3yr	1-10 Years

ID #	Location	Units (Acres or Linear Feet)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency			Priority	Owner & Responsible Entity	Sources of Technical Assistance	Cost Estimate		Implementation Schedule (Years)
					TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)				Design, Permit, Install	Annual Maintenance and/or 3 Yrs. to Establish	
25C	See Figure X for project location	47.4	Restored wetland complex and wet-mesic prairie at Harvey Creek Conservation Area. Important to maintain control of invasive species long term	Develop and implement maintenance plan to control invasive species and manage long term.	8	13	146	High/ Critical Area	Sandwich Park District	Ecological Consultant/ Contractor	n/a	$20,000/yr	1-10 Years
PRIORITY GREEN INFRASTRUCTURE PROTECTION AREAS (See Figure 66). Technical and Financial Assistance Needs: Technical assistance needed to implement no-till vary widely based on differences between individual farms but can be relatively low because NRCS can provide much of this information and matching funds. Implementing future conservation and/or low-density design development in Priority Protection Areas is mostly a matter of instituting policies and ordinances.													
PPA1 (13C)	See Figure X for project location	254.2	Existing row crop production likely to be developed in the future (also 13C). Includes 13B.	Utilize no-till farming as long as property is in production; utilize conservation design or low impact development if developed	NA	NA	NA	High/ Critical Area	Private Owner	NRCS, DCSWCD, DeKalb County	The cost for acquiring & protecting parcels cannot be determined		1-10 Years
STREAMBANK & RIPARIAN AREA RESTORATION RECOMMENDATIONS (See Figure 64). Technical and Financial Assistance Needs: Stream restorations are complex and require high technical and financial assistance needs to protect land, design, construct, monitor, and maintain the restoration. The project becomes more complex in areas that flow through several governing bodies or multiple private residences. Technical and financial assistance associated with stream maintenance is generally low for minor tasks such as removing debris.													
LRCR1	See Figure X for project location	14,070.7	14,071 lf of stream exhibiting no channelization, moderate levels of erosion and good overall riparian area condition	Design, permit, and implement a project to remove invasive species from riparian areas, spot stabilize eroding banks where necessary, and restore riparian buffer with native vegetation then maintain for three years to ensure establishment	640	589	1,943	High/ Critical Area	Private Owners/ Kendall County	USACE, IDNR, Engineer, Environmental Consultant/ Contractor	$950,000	$200,000/3-yr	1-10 Years
T3R1	See Figure X for project location	3,395.3	3,395 lf of stream exhibiting high levels of channelization, low levels of erosion and average overall riparian area condition	Design and implement a project to remove invasive species and restore with native vegetation then maintain for three years to ensure establishment	95	105	785	High/ Critical Area	Private Owners	Environmental Consultant/ Contractor, DeKalb County, DCSWCD	$48,000	$17,000/3-yr	1-10 Years
T3R2	See Figure X for project location	4,085.6	4,086 lf of stream exhibiting moderate levels of channelization, low levels of erosion and average overall riparian area condition	Design and implement a project to remove invasive species and restore with native vegetation then maintain for three years to ensure establishment	97	106	848	High/ Critical Area	Private Owners	Environmental Consultant/ Contractor, Kendall County, KCSWCD	$50,000	$18,000/3-yr	1-10 Years
T3R4	See Figure X for project location	1,896.7	1,897 lf of stream exhibiting moderate levels of channelization, moderate levels of erosion and average overall riparian area condition; culverts under Sandy Bluff Rd inhibit fish passage	Design, permit, and implement a project to remove invasive species, spot stabilize eroding banks, restore riparian buffer with native vegetation, restore fish passage, and maintain for three years to ensure establishment	86	80	256	High/ Critical Area	Private Owners	USACE, IDNR, Engineer, Environmental Consultant/ Contractor	$550,000	$50,000/3-yr	1-10 Years

ID #	Location	Units (Acres or Linear Feet)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency			Priority	Owner & Responsible Entity	Sources of Technical Assistance	Cost Estimate		Implementation Schedule (Years)
					TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)				Design, Permit, Install	Annual Maintenance and/or 3 Yrs. to Establish	
WETLAND RESTORATION RECOMMENDATIONS (See Figure 65). Technical and Financial Assistance Needs: Wetland restoration projects are typically complex and require high technical and financial assistance needs to protect land, design, construct, monitor, and maintain the restoration.													
13B	See Figure X for project location	132.0	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration and/or mitigation bank.	Design, permit, and construct a project to create wetland storage in farmed area by restoring hydrology via breaking drain tiles if necessary, excavating and installing water control structures for additional water storage, and revegetate with native vegetation.	70	130	1,397	High/ Critical Area	Private Owner	USACE, IEPA, DeKalb County, Environmental Consultant/ Contractor	$675,000	$135,000/3-yr	1-10 Years

7.0 INFORMATION & EDUCATION PLAN

While the health of the Lower Little Rock Creek watershed is currently in relatively good condition, it faces challenges and threats from land use changes, poor land management practices, a lack of natural habitat, invasive species, and flooding. Since a significant portion of the Lower Little Rock Creek watershed is held as private property, any efforts to improve water quality must include significant education and outreach efforts to those landowners and key stakeholders.

This Information & Education Plan (I&E Plan) recommends campaigns that are designed to enhance understanding of the issues, problems, and opportunities within the Lower Little Rock Creek watershed. The intention is to promote general acceptance and stakeholder participation in selecting, designing, and implementing recommended Management Measures to improve watershed conditions. The first step in understanding the issues, problems, and opportunities within Lower Little Rock Creek watershed is to gain a better perspective on how the watershed evolved over time into what exists today.

The goal of the I&E Plan is to equip municipal staff, elected officials, and other key stakeholders with the tools necessary to establish watershed-based practices and engrain these tools into their respective activities and procedures. If this I&E plan is successfully implemented, developers will follow guidelines that consider watershed health and residents of the Lower Little Rock Creek watershed will be actively involved in protecting and restoring the river and its tributaries. They will become aware of the factors that threaten surface waters of the watershed and adopt specific behaviors that contribute to improving overall conditions. Through these changes in behaviors, the threats and challenges to the watersheds will decrease, water quality will improve, and the overall health of the watersheds will improve.

Due to the current conditions of water quality within the watershed, it is imperative that the Management Measure recommendations are closely linked with watershed information and education programs. Thorough public information and stakeholder education efforts will ultimately inspire local residents and community members to adopt recommended implementation actions. The cumulative actions of individuals and communities' watershed-wide can accomplish the goals of the watershed plan. Watershed health is of primary importance for the people of Lower Little Rock Creek watershed. When people begin to understand the issues related to water quality and natural resource protection, they begin to change their actions and activities, thereby improving the overall health of the watershed.

Many of the stakeholders in the watershed have been active in the creation and leadership of the Lower Little Rock Creek Watershed-Based Plan. Key stakeholders include the DeKalb County Community Foundation, DeKalb and Kendall County Soil & Water Conservation Districts, the Cities of Sandwich and Plano, DeKalb and Kendall Counties, DeKalb and Kendall County Forest Preserve Districts, the Sandwich Park District, Illinois Environmental Protection Agency, Illinois Department of Natural Resources, and many private residents and landowners. These groups, led by the City of Sandwich and the DeKalb County Community Foundation, look forward to engaging the public in watershed activities such as: educational seminars, Regenerative Agriculture workshops, educational programming centered around flood problem areas, and other public education programs and outreach events. The watershed planning process for the watershed formally began in 2019, but many of the local outreach programs have been underway for much longer. The planning

process has allowed watershed partnerships to form that will help with implementing the watershed plan and initiating projects.

Recommended Information & Education Campaigns

A successful I&E Plan first raises awareness among stakeholders of watershed issues, problems, and opportunities. The second step is to provide stakeholders with information on alternatives to implement to address the issues, problems, and opportunities. This I&E Plan includes the following components as referenced in USEPA's *"Handbook for Developing Watershed Plans to Restore and Protect Our Waters"* (USEPA 2008):

- Define I&E goals and objectives.
- Identify and analyze the target audiences.
- Create the messages for each audience.
- Package the message to various audiences.
- Distribute the message.
- Evaluate the I&E program.

Goals and Objectives

Development of an effective I&E Plan begins by defining goals and objectives. Goals were established for the Lower Little Rock Creek watershed based on facilitated stakeholder engagement, voting, and responses during the February 17, 2021 stakeholder Goals workshop. The goals and objectives were then refined during the planning process. Objectives assigned to each goal are intended to be measurable where appropriate so that future progress can be assessed. The following goals refer to education and communication goals and objectives only (*objectives unrelated to communications have been left out of this section*).

Goal 1: ***Protect, manage, and restore natural components of the Green Infrastructure Network and improve fish and wildlife habitat.***

Objectives:

2) Encourage private landowners with parcels within the Green Infrastructure Network to manage their land for ecological and water quality benefits.

Goal 2: ***Encourage agricultural techniques and soil conservation practices that will protect and conserve topsoil, improve soil health, and protect our water resources.***

Objectives:

1) Educate and inform landowners about federal and state cost-share programs, which provide incentives for landowners to enroll in conservation programs and implement conservation practices.
2) Encourage landowners to utilize existing programs and agencies such as the Natural Resource Conservation Service, the DeKalb and Kendall County Soil and Water Conservation Districts and the Farm Service Agency to install conservation practices that protect soil loss and water quality.
4) Encourage landowners and farmers to follow the principles of soil health and/or regenerative agriculture on their land.
6) Encourage landowners and farmers to support the Illinois Nutrient Loss Reduction Strategy by implementing practices that reduce annual loading of nitrate-nitrogen and total Phosphorus to the Lower Little Rock Creek by at least 15 percent and 25 percent respectfully by 2025.

Goal 5: ***Build stakeholder awareness of watershed issues through education and stewardship while increasing communication and coordination among stakeholders.***

Objectives:

1) Implement the Lower Little Rock Creek Watershed-Based Plan Information & Education Campaign.
2) Increase environmental stewardship opportunities and encourage stakeholders to participate in watershed plan implementation and restoration campaigns to increase activism in the watershed.
3) Inform public officials of the benefits of conservation design and low impact development and the importance of ordinance language changes that promote these developments.
4) Leverage targeted educational information developed by DCSWCD for agricultural landowners.
5) Provide educational information to residents on flooding issues, the City's adaptive management of stormwater over time, and the City's work to address flooding where there are recurring flooding issues.
6) Provide homeowner and business associations with the knowledge needed to maintain naturalized detention basins.

Goal 6: ***Assess and improve policies and regulations to protect and support our natural resources.***

Objectives:

4) Encourage local governments to incorporate Conservation Design or Low Impact Development standards where new development is planned on Priority Green Infrastructure Protection Areas and/or within the Green Infrastructure Network identified in this Plan (see Sections 3.11 and 6.2.4).
5) Encourage developers to protect sensitive natural areas, restore degraded natural areas and streams as part of the development process. Encourage donation of highly sensitive natural areas such as high-quality habitat, to a public agency or conservation organization for long term management with dedicated funding such as impact fees, Special Service Areas (SSA's) or a one-time donation.

Target Audiences

The recommended target audience for each education campaign is selected based on the ability to attain objectives. The target audience is a group of people with a common denominator who are intended to be reached by a particular message. The target audience of the watershed includes people of all demographics, locations, occupations, and watershed roles. There can be multiple target audiences depending on which topic is being presented. The overall umbrella target audiences selected to meet watershed goals and objectives include residential and agricultural landowners, homeowners, general public, local government, elected officials, businesses, schools, and stakeholders/residents. Once the target audience is identified for a specific education campaign, existing local programs and communication vehicles should be leveraged to help distribute the message.

Public Input

Creating and distributing a message for each audience is done via campaigns that address education goal objectives. The I&E Plan objectives for the Lower Little Rock Creek watershed were determined by the Steering Committee with feedback from stakeholder meetings. An I&E Plan matrix (Table 45) was developed as a tool to help implement the I&E Plan. Not only does the matrix include recommended education campaigns, it also includes columns for 1) Target Audience,

2) Communications Vehicles, 3) Priority/Schedule, 4) Lead & Supporting Organizations, 5) Outcomes/ Change in Action, and 6) Estimated Cost.

Evaluation

The I&E Plan should be evaluated regularly to provide feedback regarding the effectiveness of the outreach campaigns. Evaluation conducted early on in the effort will help determine campaigns that are successful and those that are not. Based on the evaluation, information, money, and time can be saved by focusing on the campaigns that work. Those that do not work should be ended and/or refined. Section 9.2 of this plan contains a "Report Card" with milestones related to watershed education that can be used to evaluate I&E Plan implementation efforts.

The plan will be made available electronically on the City of Sandwich website upon IEPA approval at http://www.sandwich.il.us/document-list.html.

Table 45. Information and Education Plan Matrix.

Education Action of Campaign	Target Audience	Communication Vehicles	Priority/ Schedule	Lead (Supporting) Organization	Outcomes, Change in Action	Estimated Cost
Regenerative Agriculture Workshop	Farmers and Ag Industry	Social Media, Websites, local publications	Critical/ Fall/ Winter 2022/2023; Every other year	SWCD (NRCS)	Understanding of the Nutrient Loss Reduction Strategy, improved water quality and soil health.	$500
Provide educational information on flooding issues, the City's adaptive management of stormwater over time, and work to address flooding where there are recurring flooding issues	Property owners with flooding	Conduct City Council meetings or similar	At least yearly	Sandwich (Steering Committee, Eco Consultants)	Educate landowners about flood mitigation projects and prevention and to reduce future issues	$3,000/yr
Provide homeowner and business associations with the knowledge needed to maintain naturalized detention basins.	Business and Homeowner Associations	Online workshops or website for businesses and homeowner associations that own naturalized detention basins. Should stress maintenance of existing naturalized basins and retrofits to improve poorly functioning or poorly designed basins	Ongoing	Sandwich (Steering Committee, Eco Consultants)	Increase awareness of implementation projects and how management of detention basins can improve water quality	$2,000

Education Action of Campaign	Target Audience	Communication Vehicles	Priority/ Schedule	Lead (Supporting) Organization	Outcomes, Change in Action	Estimated Cost
Nitrate reduction (strip testing) program	Agricultural Landowners and Farmers	Mailings and Social Media	Medium/Spring of 2021	SWCD (Sandwich)	Establish baseline for nitrate loss, encourage timing of nitrogen application to achieve minimal loss	$500
Educate Elected Officials about the completed plan to 1) encourage them to adopt the Lower Little Rock Creek Watershed-Based Plan 2) encourage amendments of municipal comprehensive plans, codes and ordinances to include watershed plan goals/objectives	Elected Officials, Community Leaders	Meetings with boards, special presentations with community leaders	Critical/ Immediately following completion of the plan	Sandwich, Plano, DeKalb County, Kendall County (SWCD, DCCF)	All communities within the watershed adopt the plan and encourage implementation of identified watershed issues within their jurisdiction	N/A
Urban Educational Seminars: Examples Rain Gardens, Rain Barrel, Lawn to River Webinar, and Managing Yard Waste	Stakeholders	Newspaper, Social Media, Websites	Critical/ Ongoing	The Conservation Foundation (Sandwich, Park District)	Encourage Homeowners to install BMPs to control runoff and implement water quality improvements	$500
Inform and support farmland owners and renters about the plan and recommended actions within the plan	Agricultural landowners and farmers	Meetings of farmland owners and operators	Critical/ Ongoing	SWCD, NRCS, (Steering Committee)	Encourage implementation of identified watershed projects and discuss funding mechanisms to install BMPs	$100

8.0 PLAN IMPLEMENTATION

8.1 Plan Implementation Roles and Coordination/Responsibilities

Identification of responsible entities for implementation of Management Measure recommendations was first mentioned in the Action Plan section of this report. These entities are key stakeholders that will be responsible in some way for sharing the responsibility required to implement the Watershed-Based Plan. However, no single stakeholder has the financial or technical resources to implement the plan alone. Rather, it will require working together and using the strengths of individual stakeholders to successfully implement this plan. Key stakeholders are listed in Table 46.

There are several important first steps that the Lower Little Rock Creek Watershed Steering Committee partners will need to accomplish prior to beginning plan implementation.

1) Watershed partners are encouraged to adopt and/or support (via a resolution) the Lower Little Rock Creek Watershed-Based Plan.
2) The partners will need to extend the Steering Committee or recruit "champions" within each municipality and other stakeholder groups to form a Watershed Implementation Committee that actively implements the Watershed-Based Plan and conducts progress evaluations.
3) The watershed partners may also need to hire and fund a Watershed Implementation Coordinator or find an employee internally to follow through on plan implementation.

Table 46. Key Lower Little Rock Creek watershed stakeholders/partners.

Key Watershed Stakeholder/Partner	Abbreviation
City of Plano	Plano
City of Sandwich	Sandwich
DeKalb County	DeKalb Co.
DeKalb County Community Foundation	DCCF
DeKalb County Soil and Water Conservation District	DCSWCD
Illinois Department of Natural Resources	IDNR
Illinois Environmental Protection Agency	IEPA
Kendall County	Kendall Co.
Kendall County Forest Preserve District	KCFPD
LaSalle County	LaSalle Co.
Sandwich Park District	SPD
Sandwich Stormwater Treatment Plan	SSTP
The Conservation Foundation	TCF
United States Army Corps of Engineers	USACE
United States Fish & Wildlife Service	USFWS

Early on in the plan implementation process, the Steering Committee should assign or hire a Watershed Implementation Coordinator to call meetings and update the committee on plan implementation progress by way of the Report Cards (detailed in Section 9.2). If needed, adaptive management should be implemented accordingly by referencing the adaptive management recommendations on each Report Card then developing a strategy to either change the milestone(s) or decide how to implement projects or actions to achieve the milestone(s).

Report Cards can be evaluated at any time. However, it is recommended that they be evaluated *at least* every five years to determine if sufficient progress is being made toward achieving milestones or if adaptive management is needed.

8.2 Implementation Schedule

The Watershed Steering Committee should meet at least quarterly each year to guide the implementation of the Lower Little Rock Creek Watershed-Based Plan. The development of an implementation schedule is important in the watershed planning process because it provides a timeline for when each recommended Management Measure should be implemented in relation to others. High Priority Critical Area projects, for example, are generally scheduled for implementation in the short term. A schedule also helps organize project implementation evenly over a given time period, allowing reasonable time availability for developing funding sources and opportunities.

For this plan, each "Site-Specific Management Measure" recommendation located in the Management Measures Action Plan Table (see Section 6.2.6, Table 44) contains a column with a recommended "Implementation Schedule" based on the short term (1-10 years) for High Priority Critical Areas and 10-20+ years for medium and low priority project recommendations. Other recommendations such as maintenance activities have ongoing or as needed schedules. Some projects that are high priority could be recommended for long term implementation based on selected practices, available funds, technical assistance needs, and time frame. In addition, the "Information & Education" plan (see Section 7.0) and the "Monitoring Plan" (see Section 9.0) are designed to be conducted annually and evaluated at least every five years to determine if progress is being made toward achieving plan goals and objectives.

8.3 Funding Sources

Opportunities to secure funds for watershed improvement projects are widespread due to the variety and diversity of Management Measure recommendations found in the Action Plan. Public and private organizations that administer various conservation and environmental programs are often eager to form partnerships and leverage funds for land preservation, restoration, and environmental education. In this way, funds invested by partners in Lower Little Rock Creek watershed can be doubled or tripled, although actual dollar amounts are difficult to measure. A list of potential funding programs and opportunities is included in Appendix E. The list was developed by Applied Ecological Services, Inc. (AES) through involvement in other watershed and ecological studies.

Funds generally fall into two relatively distinct categories. The first includes existing grant programs, funded by a public agency or by other sources. These funds are typically awarded following a competitive application process. The IEPA Nonpoint Source Management Program (Section 319 Grants) is an example: an applicant will submit a grant application to the program, and, if the proposed project meets the required criteria and if the funds appropriated have not been exhausted, a grant may be awarded.

The second category, one that can provide greater leverage, might be called "money to be found." The key to this money is to recognize that any given project may have multiple benefits. It is important to note and explore all of the potential project benefits from the perspective of potential partners and to then engage those partners. Partners may wish to become involved because they

believe the project will achieve their objectives, even if they have little interest in the specific objectives of the Watershed-Based Plan.

It is not uncommon for an exciting and innovative project to attract funds that can be allocated at the discretion of project partners. When representatives of interested organizations gather to talk about a proposed project, they are often willing to commit discretionary funds simply because the proposed project is attractive, is a priority, is a networking opportunity, or will help the agency achieve its mission. In this way, a new partnership is assembled.

Leveraging and Partnerships

It is critically important to recognize that no one program has been identified that will simply match the overall investment of the Lower Little Rock Creek watershed partners in implementing the Watershed-Based Plan. Rather, partnerships are most likely to be developed in the context of individual and specific land preservation, restoration, or education projects that are recommended in the Plan or may unfold over time during the planning process. Partners attracted to one recommendation may not have an interest in another located elsewhere for jurisdictional, programmatic, or fiscal reasons.

Almost any land or water quality improvement project ultimately requires the support of those who live nearby if it is to be successful over the long term. Local environmental groups, neighborhood associations, homeowner associations, and similar groups interested in protecting water resources, open space, preventing development, or protecting wildlife habitat and scenic vistas, make the best partners for specific projects. Those organizations ought to be contacted in the context of specific individual projects.

It is equally important to note that the development of partnerships that will leverage funding or goodwill can be, and typically is, a time-consuming process. In many cases, it takes more time and effort to develop partnerships that will leverage support for a project than it does to negotiate with the landowners for use or acquisition of the property. Each protection or restoration project will be different; each will raise different ecological, political and financial issues, and each will in all likelihood attract different partners. It is also likely that the process will not be fully replicable. That is, each jurisdiction or partner will have a different process and different requirements.

In short, a key task in leveraging additional funds is to assign responsibility to specific staff or for developing relationships with individual agencies and organizations, recognizing that the funding opportunities might not be readily apparent. With some exceptions, it will not be adequate simply to write a proposal or submit an application; more often, funding will follow a concerted effort to seek out and engage specific partners for specific projects, fitting those projects to the interests of the agencies and organizations. Successful partnerships are almost always the result of one or two enthusiastic individuals or "champions" who believe that engagement in this process is in the interests of their agency. There is an old adage in private fundraising: people give to other people, not to causes. The same thing is true with partnerships using public funds.

Partnerships are also possible, and probably necessary, that will leverage assets other than money. By entering into partnerships with some agencies, organizations, or even neighborhood groups, a stakeholder will leverage valuable goodwill, and relationships that have the potential to lead to funds and other support, including political support, from secondary sources.

8.4 Additional Investigations

Over the course of the planning process a number of instances were identified that were beyond the scope of the initial planning process where additional research or discovery in the future might further plan goals and implementation. Additional potential watershed investigations that the Steering Committee could pursue in the future include, but are not limited to, the following:

- More detailed inventory or existing septic systems and their condition,
- Feasibility studies related to wetland restoration projects,
- Demand analysis and/or feasibility study into creating a wetland restoration bank,
- Biological water quality monitoring,
- Use of satellite imagery to calculate and track a minimum Normalized Difference Tillage Index (NDTI).

These additional investigations are considered High Priority/Critical Areas for future funding should the Steering Committee decide to pursue them in the future.

8.5 Plan Amendments

Data, research, and methodologies are continuously updating and evolving. In order to accommodate new and updated information, the Steering Committee may decide to update the plan by way of Amendment as often as yearly, if necessary. The process for updating the plan will be led by the Steering Committee and include amendments as agreed to and documented by the Steering Committee and attached to the final watershed-based plan as an Amendment. Amendments should be written as stand-alone documents that reference the plan and appropriate plan sections. The process is outlined as follows:

- Steering Committee research and documents Amendment,
- Steering Committee approves Amendment,
- Steering Committee sends Amendment to IEPA for review and approval,
- IEPA and Steering Committee agree to and make edits as necessary,
- Steering Committee publishes Amendment.

Amendments might include additional projects that were not identified during the planning process; new practices, methodologies, or programs that will improve implementation our watershed outcomes; the results or outcomes of any additional investigations (as identified in Section 8.4); NRCS updates or updates to the Illinois Urban Manual; or any similar findings that the Steering Committee and IEPA agree to.

The City of Sandwich will house a link to the approved watershed-based plan and any approved amendments on its website, currently available at http://www.sandwich.il.us/document-list.html.

9.0 MEASURING PLAN PROGRESS & SUCCESS

It is essential to have a monitoring plan and evaluation component as part of any watershed plan to evaluate plan implementation progress and success over time. This watershed plan includes two monitoring/evaluation components:

1) The **"Water Quality Monitoring Plan"** includes methods and locations where monitoring should occur and a set of criteria (indicators & targets) used to determine whether impairment reduction targets and other watershed improvement objectives are being achieved over time.

2) **"Report Cards"** for each plan goal were developed that include interim, measurable milestones linked to evaluation criteria that can be evaluated by the planning committee over time.

9.1 Water Quality Monitoring Plan & Evaluation Criteria

Background Information

This subsection provides a monitoring plan that can be implemented to measure changes in watershed impairments related primarily to water quality. Water quality monitoring is performed by first collecting physical, chemical, biological, and/or social indicator data. This data is then compared to criteria (indicators & targets) related to established water quality objectives.

Available water quality data collected within the Lower Little Rock Creek watershed is summarized in Section 4.1. The most recent chemical water quality data was collected in 2020 by Applied Ecological Services, Inc. (AES), as part of this planning effort and by IEPA in 2017. AES also analyzed historical water quality for the Lower Little Rock Creek available via EPA's WQX/Storet water quality database for the last ten years (2010 through 2019). According to Illinois EPA's most recent 2018 *Integrated Water Quality Report and Section 303(d) List*, Little Rock Creek (IEPA Segment Code: IL_DTCA-01) is "Fully Supporting" for *Aquatic Life* and for *Aesthetic Quality*; Little Rock Creek was not assessed for *Fish Consumption* or *Primary Contact Recreation.* Analyzing all of the data suggests that there is likely moderate impairment to the Lower Little Rock Creek due to elevated total phosphorus and total nitrogen levels.

The water quality monitoring plan is designed to: 1) capture snapshots of water quality within the Lower Little Rock Creek watershed over time; 2) assess changes in water quality following implementation of Management Measures, and 3) assess the public's social behavior related to water quality issues. It is crucial that representative water quality samples be carefully collected using method appropriate handling procedures. Unrepresentative samples or samples contaminated during collection or handling can prove useless. It is important that future monitoring be completed using protocol and methods used by the EPA for QAQC purposes**.** EPA Quality Assurance Project Plans (QAPPs) and Standard Operating Procedures (SOPs) can be found at https://www.epa.gov/sites/production/files/2015-06/documents/vol_qapp.pdf.

Physical, chemical, and biological water quality indicators in streams are typically measured during base flow and after significant (≥ 1.5 inches) storm events. Chemical parameters typically include nutrients (nitrogen and phosphorous) and total suspended solids. All samples should be analyzed by certified labs to ensure accurate results. Physical parameters, such as temperature, dissolved oxygen, pH, and water clarity (turbidity) should be collected in the field using properly maintained and calibrated field equipment. It is also important to obtain stream discharge calculations as a

determination of potential pollutant loading. These calculations are easily obtained by measuring the stream width, average depth, and flow rate at the monitoring location. Biological (fish and macroinvertebrate) and habitat assessments may also be performed, site assessment criteria dependent.

When management measures are implemented, monitoring should ideally take place both before and after implementation to track the effectiveness of those projects. Management Measure implementation sampling locations should include points of water ingress and egress, such as the inflow and outflow points on a retrofitted detention basin as an example. To achieve the best results with respect to performance, Management Measure implementation monitoring should occur during or shortly after large rain events (≥ 1.5 inches). Biological and/or habitat assessments should also be included on any habitat improvement project, such as a stream restoration. Because funding for post implementation monitoring is typically limited, money should be built into the initial Management Measures project budget.

Monitoring Plan Implementation

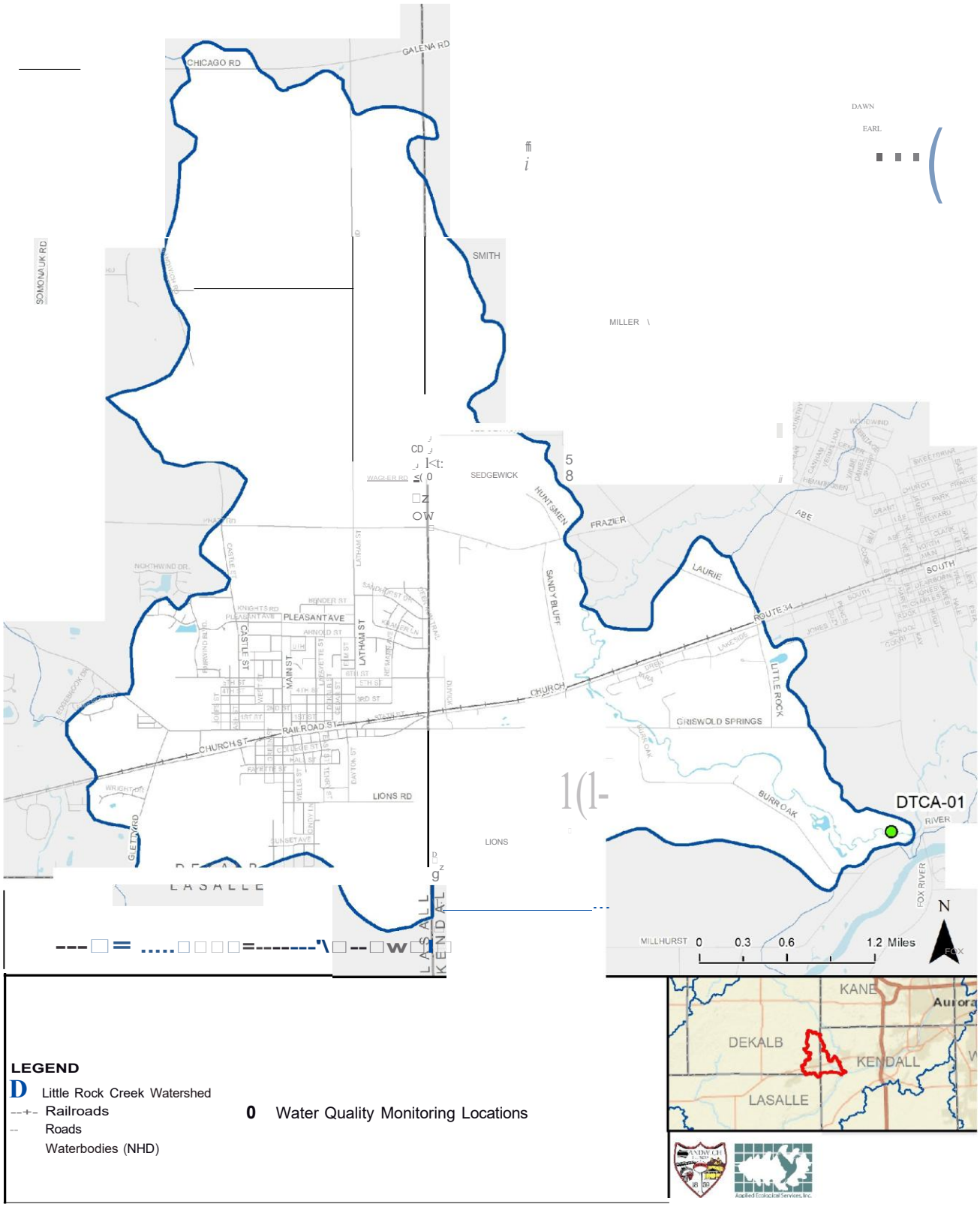
Existing and recommended water quality monitoring regimes, including recommended monitoring entity, monitoring locations, schedule/monitoring frequency, type of parameters sampled, and expected costs, are outlined in Table 47. Existing monitoring will yield data over time that will help track changes in watershed water quality over time. All existing monitoring should continue and in addition, AES recommends that additional monitoring occur before and after each project is implemented to determine the effectiveness of individual management measures. Figure 68 includes the location of all recommended monitoring locations. Note: monitoring locations related to individual Management Measures are not described or mapped as this monitoring will come later when projects are implemented.

Table 47. Recommended water quality monitoring programs/locations.

Monitoring Entity/Program	Monitoring Location (See Figure 74)	Schedule/ Monitoring Frequency	Parameters Sampled	Cost to Implement
Existing Monitoring Programs				
Illinois EPA Intensive Basin and Special Study	DTCA-01	Every 5 years	Physical; Chemical	Not Applicable
RiverWatch/INHS	DTCA-01	Every 10 years	Mussel & macro-invertebrate	Not Applicable
IDNR	DTCA-01	Every 5 years	Fish survey (fIBI)	Not Applicable
New Monitoring Programs				
Project lead or landowner	Varies: Specific to each management measure	Pre and post implementation	Physical, Chemical	$5,000 for each project

LITTLE ROCK CREEK WATERSHED

Figure 68: Future Water Quality Momtoring Locat,ons



AES Project#: 18-0105

Coordinate System:
NAD 83 IL State Plane East
Data Sources: DeKalb County,
Kendall County, City of Sandwich

Physical and Chemical Monitoring Methods & Recommendations

Physical and chemical monitoring of water can be time consuming and expensive depending on the complexity of the monitoring program. Usually the budget and/or personnel available for monitoring limit the amount of data that can be collected. Therefore, the monitoring program should be developed to maximize the usable data given the available funding and personnel. Any monitoring program should be flexible and subject to change to collect additional information or use newer equipment or technology when available while maintaining a link to past data.

Future physical/chemical monitoring should continue according to the existing schedule/frequency, averaged annually for each parameter, and then compared to target water quality values. Many different parameters can be included in physical monitoring of water quality in streams. Measurements of temperature, pH, conductivity, dissolved oxygen, and turbidity should be collected in the field for any monitoring done on Lower Little Rock Creek using portable instruments. The measurements can then be recorded on data sheets in the field or the units can be taken back to the lab and the data downloaded. Chemical parameters should generally include total phosphorus, total nitrogen, total suspended solids, and chloride at a minimum, all of which are already be monitored by IEPA. Unlike physical monitoring, chemical monitoring requires grab samples be collected and taken to certified labs for analysis and collection needs to follow handling procedures for samples as outlined in Table 48. Unrepresentative samples or samples contaminated during collection or handling are often useless. The collected samples should be submitted for analysis to a laboratory certified by the National Environmental Laboratory Accreditation Conference (NELAC). Alternatively, the Steering Committee partners could work with City of Sandwich STP to save on sampling costs. Generally, the laboratory will work closely with the monitoring entity to assure that the samples are collected in the proper containers with preservatives for the parameter of interest.

Table 48. Physical & chemical stream monitoring parameters, collection, and handling procedures.

Parameter	Statistical, Numerical, or General Use Guideline	Container	Volume	Preservative	Max. Hold Time
Physical Parameters Measured in Field					
pH	>6.5 or <9.0	These parameters are measured in the field			
Conductivity	<1,667 µmhos/cm				
Dissolved Oxygen	>5.0 mg/l				
Temperature	<90 F				
Turbidity	<14 NTU				
Chemical & Physical Parameters Analyzed in Lab					
Total Suspended Solids	<19 mg/l	Plastic	32 oz	Cool 4 °C	7 days
Biochemical Oxygen Demand	<5.0 mg/l	Plastic	32 oz	Cool 4 °C	48 hours
Ammonia Nitrogen, Nitrate-Nitrite, & Total Kjeldahl Nitrogen	Total Nitrogen (mg/L) *calculated* <2.461 mg/l	Plastic	32 oz	Cool 4 °C 20% Sulfuric Acid	28 days
Total Phosphorus	<0.0725 mg/l (streams)	Plastic	4 oz	Cool 4 °C	28 days
Chloride	<500 mg/l	Plastic	32 oz	Cool 4 °C	28 days

Biological Monitoring Methods and Recommendations

The Illinois EPA uses biological data for determining "*Aquatic Life*" Use Attainment in streams because fish and macroinvertebrates are relatively easy to sample/identify and reflect specific and predictable responses to human induced changes to the landscape, stream habitat, and water quality.

Two indices have been developed that measure water quality using fish and macroinvertebrates - fish Index of Biotic Integrity (fIBI) and Macroinvertebrate Biotic Index (MBI). These indices are best applied prior to a project such as a stream restoration to obtain baseline data and again following restoration to measure the success of the project. Or, they can be conducted simply to assess resource quality in a stream or tributary reach.

Fish Index of Biotic Integrity (fIBI)

The fIBI is designed to assess water quality and biological health directly through several attributes of fish communities in streams. After the fish have been collected using electrofishing equipment and identified, the data is used to evaluate 12 metrics and a rating is assigned to each metric based on whether it deviates strongly from, somewhat from, or closely approximates the expected values found in a high quality reference stream reach. The sum of these ratings gives a total IBI score for the site. The best possible IBI score is 60. The Illinois EPA has determined that a score less than 41 indicates a stream is not fully supporting for "*Aquatic Life"* (Table 49). A manual for calculating IBI scores for streams in Illinois is available from Illinois DNR.

Macroinvertebrate Biotic Index (MBI)

The MBI is designed to rate water quality using aquatic macroinvertebrate taxa tolerance to degree and extent of organic pollution in streams. The MBI is calculated by taking an average of tolerance ratings weighted by the number of individuals in the sample. The Illinois EPA has determined that an MBI score greater than 5.9 indicates a stream is not fully supporting "*Aquatic Life*" (Table 49). A manual for collecting and calculating MBI scores for streams is available from Illinois EPA.

All biological monitoring, as currently being conducted by RiverWatch, Illinois Natural History Survey, and Illinois Department of Natural Resources should all continue in the future to track changes in biological water quality within Lower Little Rock Creek.

Biologists collecting fish in stream

Table 49. Illinois EPA indicators of aquatic life impairment using MBI and fIBI scores.

Biological Indicator	MBI and fIBI Scores		
MBI	> 8.9	5.9 < MBI < 8.9	≤ 5.9
fIBI	≤ 20	20 < IBI< 41	≥ 41
Impairment Status - Use Support - Resource Quality			
Impairment Status	Severe Impairment	Moderate Impairment	No Impairment
Designated Use Support	Not Supporting	Not Supporting	Fully Supporting
Resource Quality	Poor	Fair	Good

Source: Integrated Water Quality Report (2010).

Habitat Monitoring Methods and Recommendations

Stream habitat assessments comprise a major component of physical water quality monitoring. Many habitat assessment methods are available for assessing streams such as those developed by Illinois DNR and Ohio EPA. The Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA is a quick, accurate, and straightforward analysis with dependable and repeatable results found to correlate well with biological integrity of streams in the Midwest. The QHEI is also used by the Illinois EPA to assess "*Aquatic Life"* Use Attainment in streams. It is composed of six criteria that are scored individually then summed to provide the total QHEI score. The best possible score is 100. QHEI scores from hundreds of stream segments indicate that habitat values greater than 60 generally support average quality warm-water fauna. Scores greater than 80 typify pristine habitat conditions that have the ability to support exceptional warm-water fauna (Ohio EPA 1999). Areas with habitat scores lower than 60 may support warm-water fauna but usually exhibit significant degradation. Table 50 summarizes QHEI score classifications. Stream restoration projects should strive to create conditions that produce QHEI scores of at least 60.

Table 50. QHEI score classes and characteristics.

QHEI	Class	Usual Characteristics
80-100	Excellent	Comparable to pristine conditions; exceptional assemblage of habitat types; sufficient riparian zone
60-79	Good	Impacts to riparian zone
30-59	Fair	Impacts to riparian zone; channelization; most in-stream habitat gone
0-29	Poor	All aspects of habitat in degraded state

The index should be used on any stream reach and for stream restoration projects to document improvements. Prior to stream restoration, a QHEI evaluation should be completed by the project watershed coordinator, ecologist, or engineer. A follow-up QHEI for comparison purposes should be conducted by the same individual at least 2-4 years following project implementation after plant material grows and in-stream structures have had time to perform. QHEI forms and a narrative explaining how to use the index can be located on the web at http://rock.geo.csuohio.edu/norp/qhei.htm.

Tillage Practices and Residue Management

Changes in agricultural management practice implementation, such as tillage conditions within watersheds can be difficult to assess and track over time. NRCS currently conducts transect surveys to estimate tillage practices across the county. Recently, analysis of satellite imagery has been used to track these changes in conservation practices at the watershed scale as an alternative method of

collecting the same data. Since tillage takes place at different times, a series of satellite images can be analyzed in spring and fall months to calculate a minimum Normalized Difference Tillage Index (NDTI) for the Lower Little Rock Creek watershed. The NDTI estimates crop residue levels based on shortwave infrared wavelengths. This analysis of imagery can also be used to track implementation of cropping practices in a watershed as more years of imagery is collected, since satellites are always updating aerial imagery (Meyer, 2018).

For more information, a webinar produced by Elliot Meyer of WI Land+Water+Media called "Satellite Imagery Used in Conservation" as well as a document on how to calculate vegetation indices using ArcMap and Earth Explorer can be found online at http://wislandwatermedia.org/2018/05/02/webinar-satellite-imagery-used-in-conservation/.

Social Indicators of Water Quality

Quantifying social indicators of success in a watershed planning initiative is difficult. It is subjective to a large degree and complaints about poor conditions are often heard rather than compliments on improvements. The Great Lakes Regional Water Program (GLRWP), a leading organization that addresses water quality research, education, and outreach in Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin, defines social indicators as standards of comparison that describe the context, capacity, skills, knowledge, values, beliefs, and behaviors of individuals, households, organizations, and communities at various geographic scales. The GLRWP suggests that social indicators used in water quality management plans and outreach efforts are effective for several reasons including:

- Help watershed committee evaluate projects related to education and outreach;
- Help support improvement of water quality projects by identifying why certain groups install Management Measures while other groups do not;
- Measure changes that take place within grant and project timelines;
- Help watershed committee with information on policy, demographics, and other social factors that may impact water quality;
- Measure outcomes of water quality programs not currently examined.

GLRWP has developed a Social Indicators Data Management and Analysis Tool (SIDMA) to assist watershed stakeholders with consistent measures of social change by organizing, analyzing, and visualizing social indicators related to non-point source (NPS) management efforts. Detailed information about GLRWP's social indicator tool can be found at: http://35.8.121.111/si/Home.aspx.

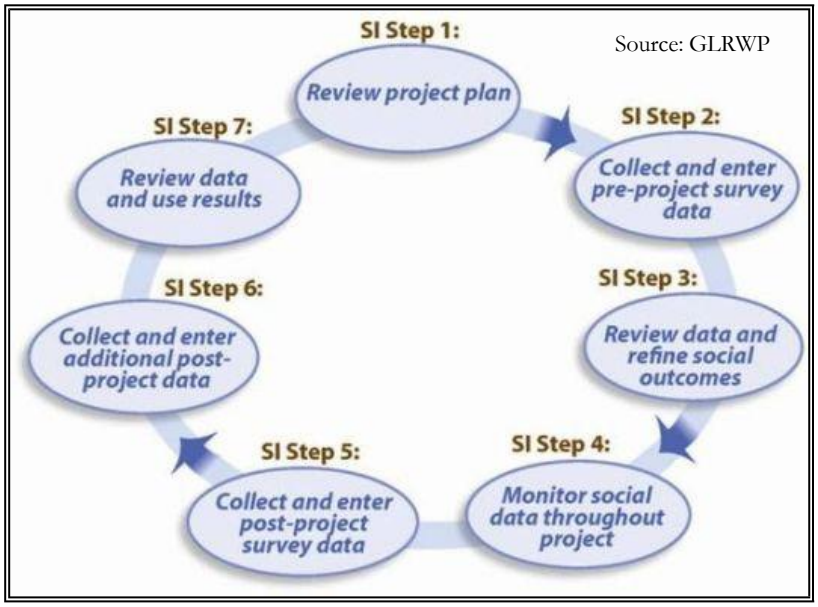


Figure 69. Steps to measure social indicators.

To summarize, the SIDMA tool uses a seven-step process to measure social indicators as shown in Figure 69.

Several potential social indicators could be evaluated by the Steering Committee using different strategies to assess changes in water quality. For example, surveys, public meetings, and establishment of interest groups can give an indication of the public feelings about the water quality in the watershed. It is important to involve the public in the water quality improvement process at an early stage through public meetings delineating the plans for improvement and how it is going to be monitored. Table 51 includes a list of potential social indicators and measures that can be used by the watershed committee to evaluate the social changes related to water quality issues.

Table 51. Social indicators and measures to understand behavior toward watershed issues.

Social Indicator	Measure
Media Coverage	• # of radio broadcasts related to watershed protection • # of newspaper articles related to watershed protection • # of press releases relate to watershed protection • # of social media posts related to watershed protection
Resident Awareness	• # of residents who are aware a watershed plan exists • # of informational flyers distributed per given time period • % of citizens who are able to identify where pollution is originating from • % change in volunteer participation to protect water quality • % change in attendance at water quality workshops and "Volunteer Days"
Watershed Management Activities	• # of schools helping implement the watershed monitoring plan • # of residents that perform ecological restoration on their properties • # of stream miles cleaned up per year • # of linear feet or miles of trails created or maintained each year • # of watershed partners who adopt the watershed management plan • # of watershed groups implementing plan recommendations

Monitoring social indicators in the watershed should be the responsibility of Lower Little Rock Creek Watershed Steering Committee. On-line internet surveys are among the most popular method to gauge social behavior toward water quality. Demographic information on a county basis can be obtained from the U.S. Census Bureau but will need to be modified based on the watershed boundary. This information is then used to select a random sample of individuals in the watershed. Next, a survey is developed that identifies citizens' perceptions of water quality problems and protections strategies. Citizens that respond to the survey are given a chance to donate a small amount of money ($1 for example) to a not for profit environmental group, then sent thank you letters, while those that did not respond should be sent a second survey. The results of the survey can be used to develop appropriate media, citizen awareness, and watershed management activities to support social behavior that will improve the watershed.

Water Quality Evaluation Criteria

Water quality criteria (expressed as measurable indicators & targets) have been developed so that water quality objectives can be evaluated over time. The criteria are designed to be compared against data gathered from the Monitoring Plan and other data then analyzed to determine the success of the watershed plan in terms of protecting and improving water quality. These criteria also support an

adaptive management approach by providing ways to reevaluate the implementation process if adequate progress is not being made toward achieving water quality objectives.

Section 2 of this plan includes a water quality goal (Goal 4) with seven objectives. Criteria are selected for each water quality objective to determine whether components of the water quality goal are being met (Table 52). Criteria are based on Illinois EPA water quality criteria, data analysis, reference conditions, literature values, and/or expert examination. Criteria are also designed to address potential or known sources of water quality impairment identified in Section 5. Future evaluation of the criteria will allow the Steering Committee to gage plan implementation success or determine if there is a need for adaptive management. Note: evaluation criteria are included for the water quality goal only; criteria for other plan goals are examined within the appropriate progress evaluation "Report Cards" in Section 9.2.

Table 52. Set of criteria related to the water quality goal and objectives.

GOAL 3: Improve Surface Water Quality to Meet Applicable Standards.	
Water Quality Objective	**Criteria: Indicators and Targets**
1) Continue existing water quality monitoring programs and implement the Water Quality Monitoring Plan outlined within the plan.	• *Number of Monitoring Programs that continue:* All existing monitoring continue. • *Number of implementation projects that include monitoring:* All implementation projects conduct monitoring before and after installation.
2) Restore 29.4 acres of High Priority/Critical Area detention basin retrofit opportunities.	• *Acres of High Priority/Critical Area detention basin retrofit opportunities implemented:* All 29.4 acres of detention basin retrofit opportunities identified in plan are implemented. • *Social Indicator:* >50% of surveyed residents understand the importance of detention basin retrofit restoration projects.
3) Restore 47,270 linear feet of stream and riparian area restoration along all High Priority/Critical Area stream reaches.	• *Linear Feet of Restored Stream Reaches:* All 47,270 linear feet of stream and riparian area restoration along all High Priority/Critical Area stream reaches implemented. • *Chemical & Physical Water Quality Standards:* <19 mg/l TSS, <0.0725 mg/l TP, and <2.461 mg/l TN in stream water quality samples. • *Biotic Indexes:* Macroinvertebrate and fish communities achieve at least "Fair" resource quality based on MBI and fIBI scores, respectively. • *Social Indicator:* >50% of surveyed residents know that stream and riparian area conditions are a problem in the watershed and support stream restoration efforts.
4) Implement 355 acres of High Priority/Critical Area wetland restoration recommendations.	• *Acres of wetland restoration recommendations implemented:* All 355 acres of High Priority/Critical Area wetland restoration recommendations identified in plan are implemented. • *Social Indicator:* >50% of surveyed residents understand the importance of wetland restoration projects.
5) Implement 397 acres of High Priority/Critical Area other management measures recommendations.	• *Acres of Other Management Measures implemented:* All 397 acres of High Priority/Critical Area other management measure identified in plan are implemented. • *Social Indicator:* >50% of surveyed residents understand the importance of other management measure restoration projects.
6) Implement an additional 19% (1,357 acres) of more intensive Conservation Tillage practices (leaving at least 60% residue) on agricultural land identified in the plan.	• *Number of Landowners Increasing Residue:* an additional 19% (1,357 acres) or more of existing cropland landowners implement more intensive Conservation Tillage practices (leaving at least 60% residue) on their lands. • *Social Indicator:* >75% of farmers understand the importance of Conservation Tillage for reducing pollutants to Lower Little Rock Creek.
7) Track changes in water quality over time and make adaptive management changes to the plan as necessary to ensure water quality improvements toward meeting identified pollutant load reductions.	• *Monitor changes in TP, TN, and TSS:* Track changes in TP and TN over time. • *Chemical & Physical Water Quality Standards:* <0.0725 mg/l TP and <2.461 mg/l TN in stream water quality samples. • *Number of Adaptive Management Changes Needed:* Track any additional adaptive management changes needed as goal milestone report cards are completed over time.

9.2 Goal Milestones/Implementation & Progress Evaluation Report Cards

Milestones are essential when determining if Management Measures are being implemented and how effective they are at achieving plan goals over given time periods. Tracking milestones allows for adaptive management whereby periodic plan updates and changes can be made if milestones are not being met.

Watersheds are complex systems with varying degrees of interaction and interconnection between physical, chemical, biological, hydrological, habitat, and social characteristics. Criteria that reflect these characteristics may be used as a measure of watershed health. Goals and objectives in the watershed plan determine which criteria should be monitored to evaluate the success of the watershed plan.

A successful watershed plan involves stakeholder participation to get projects completed and must include a feedback mechanism to measure progress toward meeting goals. Watershed "Report Cards," developed specifically for each goal in this plan, provide this information. Each Report Card provides:

1) Summaries of current conditions for each goal to set the stage for what efforts are needed
2) Most important performance criteria related to goal objectives (see Section 2.0)
3) Milestones to be met for various time frames
4) Monitoring needs and efforts required to evaluate milestones
5) Remedial actions to take if milestones are not met
6) Notes section

Report Cards were developed for each of the six plan goals and are located at the end of this section. The milestones are generally based on "Short Term" (1-10 years) and "Long Term" (10-20 years) objectives. Grades for each milestone term should be calculated using the following scale: 80%-100% of milestones met = A; 60%-79% of milestones met = B; 40%-59% of milestones met = C; and < 40% of milestones met = failed.

Report Cards should be used to identify and track plan implementation to ensure that progress is being made towards achieving the plan goals and to make corrections as necessary. Lack of progress could be demonstrated in factors such as monitoring that shows no improvement, new environmental problems, lack of technical assistance, or lack of funds. In these cases, the Report Card user should explain why other factors resulted in milestones not being met in the notes section of the Report Card.

Early on in the plan implementation process, the Steering Committee should assign or hire a Watershed Implementation Coordinator to call meetings and update the committee on plan implementation progress by way of the Report Cards. If needed, adaptive management should be implemented accordingly by referencing the adaptive management recommendations on each Report Card then developing a strategy to either change the milestone(s) or decide how to implement projects or actions to achieve the milestone(s).

Report Cards can be evaluated at any time. However, it is recommended that they be evaluated *at least* every five years to determine if sufficient progress is being made toward achieving milestones or if adaptive management is needed.

Goal 1 Report Card

Protect, manage, and restore natural components of the Green Infrastructure Network and improve fish and wildlife habitat.

Current Condition:

- Ecological communities were balanced ecosystems with clean water and diverse with plant and wildlife populations among prairies, woodlands, and wetlands prior to European settlement in the 1830s.
- Following European settlement, fires rarely occurred, prairies were tilled for farmland or developed, wetlands were drained, woodland corridors were harvested for timber, and several streams were channelized.
- Important Natural Areas in the watershed include Little Rock Creek Forest Preserve, Harvey Creek Conservation Area, and a portion of LRC Reach 2, among others.
- Three Natural Area Restoration sites were identified in the Action Plan.

Criteria/Targets to Meet Goal Objectives:

- All local governments include the Green Infrastructure Network (GIN), conservation design, and low impact development standards in comprehensive plans and development review maps.
- Degraded streams are restored along 47,270 linear feet of high priority/critical area stream reaches and enhanced for wildlife habitat, pollutant filtration, and floodplain storage/reconnection purposes.
- Detailed ecological management plans are developed for all 3 Natural Area Restoration sites.
- >50% of landowners within the GIN take steps to manage land for green infrastructure benefits.

Goal Milestones:	**Grade**
1-10 Yrs: 1) At least half of local governments include the GIN, conservation design, and LID in comprehensive plans and development review maps. *(Short)* 2) At least 20,000 linear feet of stream and riparian areas along priority reaches are enhanced. 3) Detailed ecological management plans are developed for 1 Natural Area Restoration sites. 4) At least 25% of landowners within GIN manage their land for green infrastructure benefits.	
10-20 Yrs: 1) All local governments include the GIN, conservation design, and LID in comprehensive plans and development review maps. *(Long)* 2) All 47,270 linear feet of stream and riparian areas along priority reaches are enhanced. 3) Detailed ecological management plans are developed for all 3 Natural Area Restoration sites. 4) At least 50% of landowners within GIN manage their land for green infrastructure benefits.	

Monitoring Needs/Efforts:

- Track number of local governments adopting GIN, conservation design and LID standards.
- Track number of stream & riparian area projects implemented each year that include ecological benefits.
- Track management plan status and implementation progress at Natural Area Restoration sites.
- Track landowner management practices within the GIN.

Remedial Actions:

- Work with IEPA, DeKalb & Kendall County SWCDs, and others identified in Appendix E to find funding for stream and riparian area restoration projects.
- Appropriate entities prepare budgets for creating and implementing ecological management plans.
- Hold additional meeting with landowners to educate them on need for managing their land as part of the green infrastructure network.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

Goal 2 Report Card

Encourage agricultural techniques and soil conservation practices that will protect and conserve topsoil, improve soil health, and protect our water resources.

Current Condition:

- Agricultural land comprises virtually 70% of the watershed at 7,140 acres and as such can affect the most wide-spread improvements in watershed health.
- Watershed health faces challenges and threats from agricultural land and the pollutant loading model suggests that cropland areas are the leading cause of nutrient and sediment loading in the watershed. Since a significant amount of the watershed is held as private agricultural property, any efforts to improve water quality will need to include significant education, outreach, and funding efforts targeting the agricultural community.

Criteria/Targets to Meet Goal Objectives:

- At least one agricultural related workshop dedicated to the topics of cost-share programs, regenerative agriculture and/or the principles of soil health, and the importance of buffers held annually.
- At least one workshop dedicated to implementation of additional conservation practices is held annually.
- Additional 19% (1,357 acres) of more intensive Conservation Tillage practices (leaving at least 60% residue) on agricultural land.
- Number of landowners utilizing NRCS cost share programs and supporting the IL NLRS increases over time.

Goal/Objective Milestones:	**Grade**
1-10 Yrs: 1) Ten agricultural related workshops dedicated to cost-share programs, regenerative agriculture and/or the principles of soil health, and the importance of buffers are held. *(Short)* 2) Ten workshops dedicated to implementation of additional conservation practices are held. 3) At least 10% (or 714 acres) of agricultural lands utilize more intensive Conservation Tillage practices (leaving at least 60% residue). 4) Number of landowners utilizing NRCS programs and supporting IL NLRS increases by 10%.	
10-20 Yrs: 1) Ten agricultural related workshops dedicated to cost-share programs, regenerative agriculture and/or the principles of soil health, and the importance of buffers are held. *(Long)* 2) Ten workshops dedicated to implementation of additional conservation practices are held. 3) At least 19% (1,357 acres) of agricultural lands in the watershed utilize more intensive Conservation Tillage practices (leaving at least 60% residue). 5) Number of landowners utilizing NRCS programs and supporting IL NLRS increases by 20%.	

Monitoring Needs/Efforts:

- Track number of conservation practice workshops held every 10 years.
- Track number of cost-share programs, regenerative agriculture and/or the principles of soil health, and buffers workshops held every 10 years.
- Track number of agricultural landowners participating in NRCS cost-share programs.
- Track number of agricultural landowners/acres where recommended agricultural management practices or increased tillage residue are implemented.

Remedial Actions:

- Counties work with NRCS/SWCD to raise funds for and/or sponsor agricultural related workshops.
- Counties work with NRCS/SWCD to increase participation in existing programs.
- NRCS/SWCD approach individual landowners to offer assistance with implementing management practices.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

Goal 3 Report Card

Manage and mitigate for existing and future structural flood problems.

Current Condition:

- Subwatershed Management Units 2, 4, 5, 8, 9, and 10 identified as "Highly Vulnerable" to future development changes and associated impervious cover.
- FEMA's 100-year floodplain occupies 380 acres or 4% of the watershed along the Lower Little Rock Creek.
- 11 documented Flood Problem Areas (FPAs) were identified.
- According to existing wetland inventories, about 309 acres or 17% of the pre-European settlement wetlands remain.

Criteria/Targets to Meet Goal Objectives:

- Stormwater Treatment Train, Conservation Design, or LID practices are used in all new and redevelopment within Highly Vulnerable SMU's 2, 4, 5, 8, 9, and 10.
- Limited or no development is allowed within FEMA's 100-year floodplain.
- All 11 (100%) Flood Problem Areas (FPAs) are addressed.
- All 7 (100%) critical wetland restoration recommendations implemented.

Goal/Objective Milestones:	**Grade**
1-10 Yrs: 1) Stormwater Treatment Train, Conservation Design, or LID practices are used in at least half of new and redevelopment within Highly Vulnerable SMU's. *(Short)* 2) Limited or no development is allowed within FEMA's 100-year floodplain. 3) At least 5 of 11 Flood Problem Areas are addressed. 4) At least 4 (57%) critical wetland restoration recommendations implemented.	
10-20 Yrs: 1) Stormwater Treatment Train, Conservation Design, or LID practices are used in at all new and redevelopment within Highly Vulnerable SMU's. *(Long)* 2) Limited or no development is allowed within FEMA's 100-year floodplain. 3) All 11 (100%) Flood Problem Areas (FPAs) are addressed. 4) All 7 (100%) critical wetland restoration recommendations implemented.	

Monitoring Needs/Efforts:

- Track number of Stormwater Treatment Train, Conservation Design, or LID practices are used in new and redevelopment within Highly Vulnerable SMU's 2, 4, 5, 8, 9, and 10.
- Track number of developments that are allowed within FEMA's 100-year floodplain.
- Track number of Flood Problem Areas addressed.
- Track number of critical wetland restoration recommendations implemented.

Remedial Actions:

- Meet with local governments that do not encourage Stormwater Treatment Train, Conservation Design, or LID practices in Highly Vulnerable SMU's 2, 4, 5, 8, 9, and 10.
- Meet with local governments that allow development within FEMA's 100-year floodplain.
- Conduct follow-up visits to Flood Problem Area sites during flood events to determine if additional remedial work is needed.
- Meet with critical wetland restoration landowners to encourage implementation and assist with funding if needed.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

Goal 4 Report Card

Improve surface water quality to meet applicable water quality standards.

Current Conditions:

- According to IEPA's most recent 2018 Integrated Water Quality Report and Section 303(d) List, Lower Little Rock Creek is "Fully Supporting" for Aquatic Life and for Aesthetic Quality; Little Rock Creek was not assessed for Fish Consumption or Primary Contact Recreation. Analyzing all of the data suggests that there is moderate impairment to the Lower Little Rock Creek due to elevated phosphorus and nitrogen levels.
- The majority of non-point source pollutants are originating from agricultural sources and upstream portions of Little Rock Creek beyond the Lower Little Rock Creek watershed boundary.

Criteria/Targets to Meet Goal Objectives:

- All 29.4 acres of High Priority/Critical Area detention basins retrofitted.
- All 47,270 linear feet of stream and riparian area restoration along all High Priority/Critical Area stream reaches restored.
- All 355 acres of High Priority/Critical Area wetlands restored.
- All 397 acres of High Priority/Critical Area other management measures recommendations implemented.
- Additional 19% (1,357 acres) of more intensive Conservation Tillage practices (leaving at least 60% residue) on agricultural land.

Goal/Objective Milestones:	**Grade**
1-10 Yrs: *(Short)* 1) At least 15 acres of "High Priority-Critical Area" detention basins retrofitted. 2) At least 23,635 linear feet of stream and riparian area restoration along all High Priority/Critical Area stream reaches restored. 3 At least 178 acres of High Priority/Critical Area wetlands restored. 4) At least 200 acres of High Priority/Critical Area other management measures recommendations implemented. 5) At least 10% (or 714 acres) of agricultural lands utilize more intensive Conservation Tillage practices (leaving at least 60% residue).	
10-20 Yrs: *(Long)* 1) All 29.4 acres of High Priority/Critical Area detention basins retrofitted. 2) All 47,270 linear feet of stream and riparian area restoration along all High Priority/Critical Area stream reaches restored. 3) All 355 acres of High Priority/Critical Area wetlands restored. 4) All 397 acres of High Priority/Critical Area other management measures recommendations implemented. 5) Additional 19% (1,357 acres) of more intensive Conservation Tillage practices (leaving at least 60% residue) on agricultural land.	

Monitoring Needs/Efforts:

- Track changes in water quality over time and make adaptive management changes to the plan as necessary to ensure water quality improvements toward meeting identified pollutant load reductions.
- Track implementation of restoration projects (detention basin, stream, wetland, other management measures.
- Track implementation of conservation tillage practices and amount of residue on existing cropland by acre.

Remedial Actions:

- Locate and track grants that are being submitted for recommended stream, wetland, detention basin, and other management measure projects and determine success rate.
- NRCS/SWCD contact farmers to determine barriers to implementing higher residue tillage practices.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

Goal 5 Report Card

Build stakeholder awareness of watershed issues through education and stewardship while increasing communication and coordination among stakeholders.

Current Condition:

Many of the stakeholders in the watershed have been active in the creation and leadership of the Lower Little Rock Creek Watershed-Based Plan. Key stakeholders include the DeKalb County Community Foundation, DeKalb County Soil & Water Conservation District, the Cities of Sandwich and Plano, DeKalb, Kendall and LaSalle Counties, Kendall County Forest Preserve District, the Sandwich Park District, Illinois Environmental Protection Agency, Illinois Department of Natural Resources, and many private residents and landowners. These groups, led by the City of Sandwich and the DeKalb County Community Foundation, are actively engaging the public in watershed activities such as: educational seminars, Regenerative Agriculture workshops, educational programming centered around flood problem areas, and other public education programs and outreach events. The watershed planning process for the watershed formally began in 2019, but many of the local outreach programs have been underway for much longer. The planning process has allowed watershed partnerships to form that will help with implementing the watershed plan and initiating projects.

Criteria/Targets to Meet Goal Objectives:

- Number of Education Actions completed from Information & Education Campaign.
- Number of public officials that support conservation design and low impact development ordinance language changes.
- Number of agricultural landowners that are informed about healthy land management.
- Number of residents that are informed about flooding issues, the City's adaptive management of stormwater over time, and the City's work to address flooding where there are recurring flooding issues.
- Number of homeowner and business associations informed about how to maintain naturalized detention basins.

Goal /Objective Milestones:	**Grade**
1-10 Yrs: *(Short)* 1) At least half of Education Actions completed from Information & Education Campaign. 2) At least one local government adopts conservation design and LID within their ordinances. 3) At least 25% of agricultural landowners are educated about healthy land management. 4) At least 25% of residents informed about flooding issues, the City's adaptive management of stormwater, and work to address flooding where there are recurring flooding issues. 5) At least 25% of homeowner and business associations informed about how to maintain naturalized detention basins.	
10-20 Yrs: *(Long)* 1) All Education Actions completed from Information & Education Campaign. 2) All local government adopt conservation design, LID within their ordinances. 3) At least 50% of agricultural landowners are educated about healthy land management. 4) At least 50% of residents informed about flooding issues, the City's adaptive management of stormwater, and work to address flooding where there are recurring flooding issues. 5) At least 50% of homeowner and business associations informed about how to maintain naturalized detention basins.	

Monitoring Needs/Efforts:

- Track number of Education Actions completed from Information & Education Campaign
- Track number of public officials with each local government that support conservation design and low impact development.
- Track amount of information targeted to agricultural landowners.
- Track number of educational and outreach opportunities are targeted at City's flood reduction efforts.
- Track number of educational and outreach opportunities are targeted at maintaining naturalized detention basins.

Remedial Actions:

- Ask partners for funding to implement the watershed plan and Information & Education Campaign.
- Meet with public officials to discuss the importance of conservation design and LID ordinance changes.
- Actively recruit public to attend watershed education campaigns.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

Goal 6 Report Card

Assess and improve policies and regulations to protect and support our natural resources.

Current Condition:

Protection of natural resources and green infrastructure during future urban growth will be important for the future health of Lower Little Rock Creek watershed. Watershed partners completed Center for Watershed Protection Ordinance Review worksheets to assess their individual ordinances and determine where improvements might be made in protecting water quality and natural resources. Two Priority Protection Areas were also found in the watershed where additional guidance and ordinances will be crucial in the future. If and when any of the areas are developed, development should follow Conservation Design or Low Impact Development (LID) standards and guidelines to help maintain and improve water quality and watershed conditions

Criteria/Targets to Meet Goal Objectives:

- Number of local governments support and adopt the Lower Little Rock Creek Watershed-Based Plan.
- Number of local governments that include the Green Infrastructure Network in comp. plans and development review maps.
- Number of local governments that incorporate Conservation Design or LID standards for all green infrastructure parcels where new development is planned on Priority Protection Areas.
- Number of local governments that institute Watershed Protection Fees, Development Impact Fees, or Special Service Area taxes for all new development to fund management of the Green Infrastructure Network.

Goal /Objective Milestones:	**Grade**
1-10 Yrs: *(Short)* 1) All local governments adopt the Lower Little Rock Creek Watershed-Based Plan. 2) At least half of local governments include Priority Green Infrastructure Protection Areas and Critical Area GIN in comp. plans and development review maps. 3) At least half of local governments adopt conservation design or LID where new development is planned on Priority Green Infrastructure Protection Areas. 4) At least half of developers protect sensitive natural areas, restore degraded natural areas and streams as part of the development process and donate them with dedicated funding for management.	
10-20 Yrs: *(Long)* 1) All least half of local governments include Priority Green Infrastructure Protection Areas and Critical Area GIN in comp. plans and development review maps. 2) All local governments adopt conservation design or LID where new development is planned on Priority Green Infrastructure Protection Areas. 3) At least 75% of developers protect sensitive natural areas, restore degraded natural areas and streams as part of the development process and donate them with dedicated funding for management.	

Monitoring Needs/Efforts:

- Track number of local governments support and adopt the Lower Little Rock Creek Watershed-Based Plan.
- Track number of local governments that include Priority Green Infrastructure Protection Areas and Critical Area GIN in comp. plans and development review maps.
- Track number of local governments that incorporate Conservation Design or LID standards for all green infrastructure parcels where new development is planned on Priority Protection Areas.
- Track number of sensitive natural areas protected, restored, and managed as part of new development standards.

Remedial Actions:

- Meet with public officials and municipal staff to discuss the importance of updating ordinances, conservation design, LID, and Watershed Protection Fees.
- Assess progress towards policy goals and target specific weak areas in education and outreach.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

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11.0 GLOSSARY OF TERMS

100-year floodplain: A 100-year flood is a flood that has a 1-percent chance of being equaled or exceeded in any given year. A base flood may also be referred to as a 100-year storm and the area inundated during the base flood is called the 100-year floodplain.

303(d) Impaired Waters: The Federal Clean Water Act requires states to submit a list of impaired waters to the USEPA for review and approval using water quality assessment data from the Section 305(b) Water Quality Report. States are then required to develop total maximum daily load analyses (TMDLs) for waterbodies on the 303(d) list.

305(b): The Illinois 305(b) report is a water quality assessment of the state's surface and groundwater resources that is compiled by the IEPA as a report to the USEPA as required under Section 305(b) of the Clean Water Act.

ADID wetlands: Wetlands that were identified through the Advanced Identification (ADID) process. Completed in 1992, the ADID process sought to identify wetlands that should be protected because of their high functional value. The three primary functions evaluated were:

1. Ecological value based on wildlife habitat quality and plant species diversity;
2. Hydrologic functions such as stormwater storage value and/or shoreline/bank stabilization value; and
3. Water quality values such as sediment/toxicant retention and/or nutrient removal/transformation function.

Applied Ecological Services Inc. (AES): A broad-based ecological consulting, contracting, and restoration firm that was founded in 1978. The company consists of consulting ecologists, engineers, landscape architects, planners, and contracting staff. The mission of AES is to bring wise ecological decisions to all land use activities.

Aquatic habitat: Structures such as stream substrate, woody debris, aquatic vegetation, and overhanging vegetation that is important to the survival of fish and macroinvertebrates.

Aquifer: A layer of permeable rock, sand, or gravel through which ground water flows, containing enough water to supply wells and springs.

Base flow: The flow that a perennially flowing stream reduces to during the dry season. It is often supported by groundwater seepage into the channel.

Bedrock: The solid rock that underlies loose material, such as soil, sand, clay, or gravel.

Best Management Practices (BMPs): See **Management Measures**

Biodiversity: The variety of organisms (plants, animals and other life forms) that includes the totality of genes, species and ecosystems in a region.

Bioengineering (or Soil Bioengineering): Techniques for stabilizing eroding or slumping stream banks that rely on the use of plants and plant materials such as live willow posts, brush layering,

coconut logs and other "greener" or "softer" techniques. This is in contrast to techniques that rely on creating "hard" edges with riprap, concrete and sheet piling (metal and plastic).

Bio-infiltration: Excavated depressional areas where stormwater runoff is directed and allowed to infiltrate back into groundwater rather than allowing to runoff. Infiltration areas are planted with appropriate vegetation.

Center for Watershed Protection (CWP): Non-profit 501(c)3 corporation founded in 1992 that provides local governments, activists, and watershed organizations around the country with the technical tools for protecting some of the nation's most precious natural resources such as streams, lakes and rivers.

Certified Municipalities: A municipality that is certified to enforce the provisions of local stormwater ordinances. The municipality's designated Enforcement Officer enforces the provisions in the Ordinance.

Channelized stream: A stream that has been artificially straightened, deepened, or widened to accommodate increased stormwater flows, to increase the amount of adjacent land that can be developed or used for urban development, agriculture or for navigation purposes

Conservation development: A development designed to protect open space and natural resources for people and wildlife while at the same time allowing building to continue. Conservation design developments sometimes designate half or more of the buildable land area as undivided permanent open space.

Conservation easement: The transfer of land use rights without the transfer of land ownership. Conservation easements can be attractive to property owners who do not want to sell their land now but would support perpetual protection from further development. Conservation easements can be donated or purchased.

Clean Water Act (CWA): The CWA is the basic framework for federal water pollution control and has been amended in subsequent years to focus on controlling toxics and improving water quality in areas where compliance with nationwide minimum discharge standards is insufficient to meet the CWA's water quality goals.

Debris jam: Natural and man-made debris in a stream channel including leaves, logs, lumber, trash and sediment.

Designated Use: Appropriate uses are identified by taking into consideration the use and value of the water body for public water supply, for protection of fish, shellfish, and wildlife, and for recreational, agricultural, industrial, and navigational purposes. In designating uses for a water body, States and Tribes examine the suitability of a water body for the uses based on the physical, chemical, and biological characteristics of the water body, its geographical setting and scenic qualities, and economic considerations

Detention basin: A man-made structure for the temporary storage of stormwater runoff with controlled release during or immediately following a storm.

Digital Elevation Model (DEM): Regularly spaced grid of elevation points used to produce elevation maps.

Discharge (streamflow): The volume of water passing through a channel during a given time, usually measured in cubic feet per second.

Dissolved oxygen (DO): The amount of oxygen in water, usually measured in milligrams/liter.

Downcutting: The action of a stream to deepen itself, often as a result of channelization.

Downspout disconnection: The process of disconnecting the downspout from a pipe or the paved area. Water is then redirected to flow into a rain barrel or to a lawn or garden where it can soak into the ground.

Ecology: The scientific study between living organisms and their interactions with their natural or developed environment, other organisms, and their abiotic environment.

Ecosystem: An ecological community together with its environment, functioning as a unit.

Erosion: Displacement of soil particles on the land surface due to water or wind action.

European settlement: A period in the early 1800s when European settlers moved across the United States in search of better lives. During this movement, much of the historical communities were altered for farming and other types of development.

Eutrophic: A waterbody having a high level of biological productivity. A typical eutrophic waterbody either has many aquatic plants and is clear or has few plants and is less clear. Both situations have potential to support many fish and wildlife.

Federal Emergency Management Agency (FEMA): Government agency within the Department of Homeland Security that responds to, plans for, recovers from, and mitigates against disasters/emergencies, both natural and man-made.

Fee-in-lieu: Defined by the USACE and EPA as a payment "to a natural resource management entity for implementation of either specific or general wetland or other aquatic resource development projects" for projects that "do not typically provide compensatory mitigation in advance of project impacts."

Fen: Peat-forming wetlands that receive nutrients from sources other than precipitation: usually from upslope sources through drainage from surrounding mineral soils and from groundwater movement. Fens are characterized by their water chemistry which is neutral or alkaline with relatively high dissolved mineral levels.

Filamentous algae: Simple one-celled or multi-celled organisms (usually aquatic) capable of photosynthesis that are an indicator of high nutrient levels in the water column.

Filter strip: A long narrow portion of vegetation used to retard water flow and collect sediment for the protection of watercourses, reservoirs or adjacent properties.

Flash hydrology/flooding: A quickly rising and falling overflow of water in stream channels that is usually the result of increased amounts of impervious surface in the watershed.

Flood problem area (FPA): One or more buildings, roads or other infrastructure in one location that are repeatedly damaged by flooding.

Flow Regime: The pattern of flow variability for a particular river or region.

Floodplain (100-year): Land adjoining the channel of a river, stream, watercourse, lake or wetland that has been or may be inundated by floodwater during periods of high water that exceed normal bank-full elevations. The 100-year floodplain has a probability of 1% chance per year of being flooded.

Floodproofing: Any combination of structural and non-structural additions, changes or adjustments to structures or property which reduce or eliminate flood damage to real estate or improved real property, water and sanitary facilities, structures and contents.

Floodway: The floodway is the portion of the stream or river channel that includes the adjacent land areas that must be reserved to discharge the 100-year flood without increasing the water surface.

Geographic Information System (GIS): A computer-based approach to interpreting maps and images and applying them to problem-solving.

Geology: The scientific study of the structure of the Earth or another planet, especially its rocks, soil, and minerals, and its history and origins.

Global Positioning System (GPS): Satellite mapping system that enables locators and mapping to be created via satellite.

Grasscycling: Grasscycling is a method of handling grass clippings by leaving them to decompose on the lawn when mowing.

Green infrastructure network: An interconnected network of waterways, wetlands, woodlands, wildlife habitats, and other natural areas; greenways, parks and other conservation lands, farms, and forests of conservation value; and wilderness and other open spaces that support native species, maintain natural ecological processes, sustain air and water resources and contribute to the health and quality of life.

Greenways: A protected linear open space area that is either landscaped or left in its natural condition. It may follow a natural feature of the landscape such as a river or stream, or it may occur along an unused railway line or some other right of way. Greenways also provide wildlife corridors and recreational trails.

Groundwater recharge: Primary mechanism for aquifer replenishment which ensures future sources of groundwater for commercial and residential use.

Headwaters: Upper reaches of streams and tributaries in a watershed.

HUC Code: A hydrologic unit code (HUC) that refers to the division and subdivision of U.S. watersheds. The hydrologic units are arranged or nested within each other, from the largest geographic area (regions) to the smallest geographic area (cataloging units).

Hydraulic and Hydrologic modeling: Engineering analysis that predicts expected flood flows and flood elevations based on land characteristics and rainfall events.

Hydraulic structures: Low head dams, weirs, bridges, levees, and any other structures along the course of the river.

Hydric soil: Soil units that are wet frequently enough to periodically produce anaerobic conditions, thereby influencing the species composition or growth, or both, of plants on those soils.

Hydrologic Soil Groups (HSG): Soils are classified by the Natural Resource Conservation Service into four Hydrologic Soil Groups based on the soil's runoff potential. The four Hydrologic Soils Groups are A, B, C and D. A's generally have the smallest runoff potential and D's the greatest.

Hydrology: The scientific study of the properties, distribution, and effects of water on the earth's surface, in the soil and underlying rocks, and in the atmosphere.

Hydrophytic vegetation: Plant life growing in water, soil or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content; one of the indicators of a wetland.

Illinois Department of Natural Resources (IDNR): A government agency established to manage, protect and sustain Illinois' natural and cultural resources; provide resource-compatible recreational opportunities and to promote natural resource-related issues for the public's safety and education.

Illinois Department of Transportation (IDOT): The Illinois Department of Transportation focuses primarily on the state's policies, goals and objectives for Illinois' transportation system and provides an overview of the department's direction for the future.

Illinois Environmental Protection Agency (IEPA): Government agency established to safeguard environmental quality, consistent with the social and economic needs of the State, so as to protect health, welfare, property and the quality of life.

Illinois Natural Areas Inventory (INAI): A survey conducted by the Illinois Department of Natural Resources to catalogue high quality natural areas, threatened and endangered species and unique plant, animal and geologic communities for the purpose of maintaining biodiversity.

Illinois Nature Preserves: State-protected areas that are provided the highest level of legal protection and have management plans in place.

Illinois Pollution Control Board (IPCB): An independent agency created in 1970 by the Environmental Protection Act. The Board is responsible for adopting Illinois' environmental regulations and deciding contested environmental cases.

Impervious Cover Model: Simple urban stream classification model based on impervious cover and stream quality. The classification system contains three stream categories, based on the percentage of impervious cover that predicts the existing and future quality of streams based on the measurable change in impervious cover. The three categories include sensitive, impacted, and non-supporting.

Impervious cover/surface: An area covered with solid material or that is compacted to the point where water cannot infiltrate underlying soils (e.g. parking lots, roads, houses, patios, swimming pools, tennis courts, etc.). Stormwater runoff velocity and volume can increase in areas covered by impervious surfaces.

Incised channel: A stream that has degraded and cut its bed into the valley bottom; indicates accelerated and often destructive erosion.

Index of Biotic Integrity (IBI): An index used to evaluate the heath of a stream based on the fish community present.

Infiltration: Portion of rainfall or surface runoff that moves downward into the subsurface soil.

Integrated Report: A bi-annual report combining the **303(d) Impaired Waters** and **305(b)** reports.

Invasive vegetation/plant: Plant species that are not native to an area and tend to out-compete native species and dominate an area (e.g. European buckthorn or garlic mustard).

Low Impact Development: Comprehensive land planning and engineering design approach with a goal of maintaining and enhancing the pre-development hydrologic regime of urban and developing watersheds.

Macroinvertebrate (aquatic): Invertebrates that can be seen by the unaided eye (macro). Most benthic invertebrates in flowing water are aquatic insects or the aquatic stage of insects, such as stonefly nymphs, mayfly nymphs, caddisfly larvae, dragonfly nymphs and midge larvae. They also include such things as clams and worms. The presence of benthic macroinvertebrates that are intolerant of pollutants is a good indicator of good water quality.

Macroinvertebrate Biotic Index (MBI): Method used to rate water quality using macroinvertebrate taxa tolerance to organic pollution in streams.

Management Measures: Also known as Best Management Practices (BMPs) are non-structural practices such as site planning and design aimed to reduce stormwater runoff and avoid adverse development impacts - or structural practices that are designed to store or treat stormwater runoff to mitigate flood damage and reduce pollution. Some BMPs used in urban areas may include stormwater detention ponds, restored wetlands, vegetative filter strips, porous pavement, silt fences and biotechnical streambank stabilization.

Marsh: An area of soft, wet, low-lying land, characterized by grassy vegetation and often forming a transition zone between water and land.

Meander (stream): A sinuous channel form in flatter river grades formed by the erosion on one side of the channel (pools) and deposition on the other (point bars).

Mitigation: Measures taken to eliminate or minimize damage from development activities, such as construction in wetlands or Regulatory Floodplain filling, by replacement of the resource.

Moraine (terminal): A ridge-like accumulation of till and other types of drift that was produced at the outer margin or farthest advance, of a retracting glacier.

Municipal Separate Stormwater Systems (MS4's): A system that transports or holds stormwater, such as catch basins, curbs, gutters, ditches, man-made channels, pipes, tunnels, and or/storm drains before discharging into local waterbodies.

National Pollutant Discharge Elimination System (NPDES Phase II): Clean Water Act law requiring smaller communities and public entities that own and operate a Municipal Separate Storm Sewer System (MS4) to apply and obtain an NPDES permit for stormwater discharges. Permittees at a minimum must develop, implement, and enforce a stormwater program designed to reduce the discharge of pollutants from the MS4 to the maximum extent practicable. The stormwater management program must include these six minimum control measures:

1. Public education and outreach on stormwater impacts
2. Public involvement/participation
3. Illicit discharge detection and elimination
4. Construction site stormwater runoff control
5. Post-construction stormwater management in new development and redevelopment
6. Pollution prevention/good housekeeping for municipal operations

National Wetland Inventory (NWI): U.S. Fish and Wildlife Service study that provides information on the characteristics, extent, and status of U.S. wetlands and deepwater habitats and other wildlife habitats.

Native Landscaping: A landscape that contains plants or plant communities that are indigenous to a particular region.

Native vegetation/plants: Plant species that have historically been found in an area.

Nitrogen: A colorless, odorless unreactive gas that forms about 78% of the earth's atmosphere. The availability of nitrogen in soil is important for ecosystem processes.

Natural community/area: an assemblage of plants and animals interacting with one another in a particular ecosystem.

No-net-loss: A policy for wetland protection to stem the tide of continued wetland losses. The policy has generated requirements for wetland mitigation so that permitted losses due to filling and other alterations are replaced and the net quality wetland acreage remains the same.

Nonpoint source pollution (NPS pollution): Refers to pollutants that accumulate in waterbodies from a variety of sources including runoff from the land, impervious surfaces, the drainage system and deposition of air pollutants.

Nutrients: Substances needed for the growth of aquatic plants and animals such as phosphorous and nitrogen. The addition of too many nutrients (such as from sewage dumping and over fertilization) will cause problems in the aquatic ecosystem through excess algae growth and other nuisance vegetation.

Open space parcel: Any parcel of land that is not developed and is often set aside for conservation or recreation purposes

Partially open parcel: Parcels that have been developed to some extent, but still offer some opportunities for open space and Best Management Practice (BMP) implementation.

Phosphorus: A nonmetallic element that occurs widely in many combined forms especially as inorganic phosphates in minerals, soils, natural waters, bones, and teeth and as organic phosphates in all living cells.

Point source pollution: Refers to discharges from a single source such as an outfall pipe conveying wastewater from an industrial plant or wastewater treatment facility.

Policy: A high-level overall plan embracing the general goals and acceptable procedures especially of a governmental body.

Pollutant load: The amount of any pollutant deposited into waterbodies from point source discharges, combined sewer overflows, and/or stormwater runoff.

Pool: A location in an active stream channel usually located on the outside bends of meanders, where the water is deepest and has reduced current velocities.

Prairie: A type of grassland characterized by low annual moisture and rich black soil characteristics.

Preventative measures: Actions that reduce the likelihood that new watershed problems such as flooding or pollution will arise, or that those existing problems will worsen. Preventative techniques generally target new development in the watershed and are geared toward protecting existing resources and preventing degradation.

Principles of Soil Health: The soil health foundation consists of five principles: 1) Soil armor; 2) minimizing soil disturbance; 3) plant diversity; 4) continual live plant/foot; and 5) livestock integration. These principles are intended to be applied in a systems approach, maximizing the soil building impact.

Programmatic Action: A series of steps to be carried out or goals to be accomplished.

Protection Area: Chicago Metropolitan Agency for Planning (CMAP) defines a "Protection Area" as an area that represents subsections of a watershed that have valuable characteristics; valuable either in the sense that (1) they contain resources and characteristics that may need to be

protected and/or (2) property ownership or land use characteristics make the subsection a strong candidate for action (CMAP 2007).

Rain gage station: Point along a stream where the amount of water flowing in an open channel is measured. The USGS makes most streamflow measurements by current meter. A current meter is an instrument used to measure the velocity of flowing water. By placing a current meter at a point in a stream and counting the number of revolutions of the rotor during a measured interval of time, the velocity of water at that point is determined.

Rainwater Harvesting: The accumulation and storing of rainwater for reuse before it reaches an aquifer.

Recovering stream: A stream that is naturally regaining streambank equilibrium according to the Stream Evolution Model, wherein the stream naturally cycles through widening, deposition, and stabilization of its banks.

Regenerative agriculture: Farming and grazing practices that, among other benefits, reverse climate change by rebuilding soil organic matter and restoring degraded soil biodiversity – resulting in both carbon drawdown and improving the water cycle.

Regulatory floodplain: Regulatory Floodplains may be either riverine or non-riverine depressional areas. Projecting the base flood elevation onto the best available topography delineates floodplain boundaries. A floodprone area is Regulatory Floodplain if it meets any of the following descriptions:

1. Any riverine area inundated by the base flood where there is at least 640 acres of tributary drainage area.
2. Any non-riverine area with a storage volume of 0.75 acre-foot or more when inundated by the base flood.
3. Any area indicated as a Special Flood Hazard Area on the FEMA Flood Insurance Rate Map expected to be inundated by the base flood located using best available topography.

Regulatory floodway: The channel, including on-stream lakes, and that portion of the Regulatory Floodplain adjacent to a stream or channel as designated by the Illinois Department of Natural Resources-Office of Water Resources, which is needed to store and convey the existing and anticipated future 100-year frequency flood discharge with no more that a 0.1 foot increase in stage due to the loss of flood conveyance or storage, and no more than a 10% increase in velocities. Where interpretation is needed to determine the exact location of the Regulatory Floodway boundary, the IDNR-OWR should be contacted for the interpretation.

Remnant: a small fragmented portion of the former dominant vegetation or landscape which once covered the area before being cleared for human land use.

Retrofit: Refers to modification to improve problems with existing stormwater control structures such as detention basins and conveyance systems such as ditches and stormsewers. These structures were originally designed to improve drainage and reduce flood risk, but they can also be retrofitted to improve water quality.

Ridge: A line connecting the highest points along a landscape and separating drainage basins or small-scale drainage systems from one another.

Riffle: Shallow rapids, usually located at the crossover in a meander of the active channel.

Riparian: Referring to the riverside or riverine environment next to the stream channel, e.g., riparian, or streamside, vegetation.

Runoff: The portion of rain or snow that does not percolate into the ground and is discharged into streams by flowing over the ground instead.

Savanna: A type of woodland characterized by open spacing between its trees and by intervening grassland.

Sediment: Soil particles that have been transported from their natural location by wind or water action.

Sedimentation: The process that deposits soils, debris and other materials either on other ground surfaces or in bodies of water or watercourses.

Seep: A moist or wet place where groundwater reaches the earth's surface from an underground aquifer.

Socioeconomics: Field of study that examines social and economic factors to better understand how the combination of both influences something.

Special Service Area (SSA) Tax: Special taxing districts in municipalities that are established by ordinance, often at the request of developers of new housing subdivisions, in order to pass on the costs of the streets, landscaping, water lines, and sewer systems to homeowners who reside within.

Stakeholders: Individuals, organizations, or enterprises that have an interest or a share in a project. (see also Watershed Stakeholders).

Stormsewershed: An area of land whose stormwater drains into a common storm sewer system.

Stormwater management: A set of actions taken to control stormwater runoff with the objectives of providing controlled surface drainage, flood control and pollutant reduction in runoff.

Stormwater Treatment Train: An alternative approach to managing stormwater that uses a series of natural Best Management Practices (BMPs) that are sized, engineered, and ecologically designed for low maintenance. The STT mimics the natural hydrologic cycle by basically creating a landscape design that slowly moves water through natural features that infiltrate, evaporate, filter and clean stormwater. STT elements include rooftop treatments, vegetated swales, parking-lot treatments, landscaping that utilizes stormwater, and open space systems such as parks and rights-of-way.

Stream corridor: The area of land that runs parallel to a stream.

Stream monitoring: Chemical, biological and physical monitoring used to identify the causes and sources of pollution in the river and to determine the needs for reduction in pollutant loads, streambank stabilization, debris removal and habitat improvement.

Stream reach: A stream segment having homogenous hydraulic, geomorphic and riparian cover and land use characteristics (such as all ditched agriculture or all natural and wooded). Reaches generally should not exceed 2,000 feet in length.

Streambank stabilization: Techniques used for stabilizing eroding streambanks.

Substrate (stream): The composition of the bottom of a stream such as clay, silt or sand.

Subwatershed: Any drainage basin within a larger drainage basin or watershed.

Subwatershed Management Unit (SMU): Small unit of a watershed or subwatershed that is delineated and used in watershed planning efforts because the effects of impervious cover are easily measured, there is less chance for confounding pollutant sources, boundaries have fewer political jurisdictions, and monitoring/mapping assessments can be done in a relatively short amount of time.

Swale: A vegetated channel, ditch or low-lying or depressional tract of land that is periodically inundated by conveying stormwater from one point to another. Swales are often used in natural drainage systems instead of stormsewers.

Threatened and Endangered Species (T&E): An "endangered" species is one that is in danger of extinction throughout all or a significant portion of its range. A "threatened" species is one that is likely to become endangered in the foreseeable future.

Till: A heterogeneous mixture of clay, silt, sand, gravel, stones, and boulders deposited directly by and underneath a glacier without stratification.

Topography: The relative elevations of a landscape describing the configuration of its surface. Study and depiction (such as charts or maps) of the distribution, relative positions, and elevations of natural and man-made features of a particular landscape.

Total Maximum Daily Load (TMDL): A TMDL is the highest amount of a particular pollutant discharge a waterbody can handle safely per day.

Total suspended solids (TSS): The organic and inorganic material suspended in the water column and greater than 0.45 micron in size.

Treatment Train: Several Management Measures/Best Management Practices (BMPs) used together to improve water quality, infiltration and reduce sedimentation.

Trophic State Index (TSI): Trophic State is a measure of the degree of plant material in a body of water. It is usually measured using one of several indices (TSI) of algal weight (biomass): water transparency (Secchi Depth), algal chlorophyll, and total phosphorus.

Turbidity: Refers to the clarity of the water, which is a function of how much material including sediment is suspended in the water.

United States Army Corps of Engineers (USACE): Federal group of civilian and military engineers and scientists that provide services to the nation including planning, designing, building and operating water resources and other Civil Works projects. These also include navigation, flood control, environmental protection, and disaster response.

United States Environmental Protection Agency Section 319 (Section 319): Section 319 of the Clean Water Act encourages and funds nonpoint source pollution control projects (any indirect pollution, like runoff, stormwater discharge, road salt, sediment, etc.) or NPS reduction at the source.

United States Geological Survey (USGS): Government agency established in 1879 with the responsibility to serve the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.

Urban runoff: Water from rain or snow events that runs over surfaces such as streets, lawns, parking lots and directly into storm sewers before entering the river rather than infiltrating the land upon which it falls.

USDA TR55 Document: A single event rainfall-runoff hydrologic model designed for small watersheds and developed by the USDA, NRCS, and EPA.

Vegetated buffer: An area of vegetated land to be left open adjacent to drainageways, wetlands, lakes, ponds or other such surface waters for the purpose of eliminating or minimizing adverse impacts to such areas from adjacent land areas.

Vegetated swale: An open channel drainageway used along residential streets and highways to convey stormwater and filter pollutants in lieu of conventional storm sewers.

Velocity (of water in a stream): The distance that water can travel in a given direction during a period of time expressed in feet per second.

Wastewater Treatment: Process that modifies wastewater characteristics such as its biological oxygen demand (BOD), chemical oxygen demand (COD), pH, etc. in order to meet effluent or water discharge standards.

Water Chemistry: The nature of dissolved materials (e.g. chlorides or phosphates) in water.

Water Quality Trading: An option for compliance with a water quality-based effluent limitation (WQBEL) in an NPDES permit. EPA's 2003 WQT Policy and 2007 WQT Toolkit for Permit Writers provide guidance to states, interstate agencies, and tribes on how to facilitate trading consistent with the CWA and its implementing regulations.

Waters of the United States (WOUS): For the purpose of this Ordinance the term Waters of the United States refers to those water bodies and wetland areas that are under the U. S. Army Corps of Engineers jurisdiction.

Watershed: An area confined by topographic divides that drains to a given stream or river. The land area above a given point on a waterbody (river, stream, lake, wetland) that contributes runoff to that point is considered the watershed.

Watershed Based Plan: A document that provides assessment and management information for geographically defined watershed, including the analysis, actions, participants, and resources related to development and implementation of the plan.

Watershed partner(s): Key watershed stakeholders who take an active role in the watershed management planning process and implementing the watershed plan.

Watershed Vulnerability Analysis: Rapid planning tool for application to watersheds and subwatersheds that estimates future and impervious cover and provides guidance on factors that might alter the initial classification or diagnosis of a watershed or subwatershed.

Wet meadow/sedge meadow: A type of wetland away from stream or river influence with water made available by general drainage and consisting of non-woody vegetation growing in saturated or occasionally flooded soils.

Wetland: A wetland is considered a subset of the definition of the Waters of the United States. Wetlands are land that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support, under normal conditions, a prevalence of vegetation adapted for life in saturated soil conditions (known as hydrophytic vegetation). A wetland is identified based upon the three attributes: 1) hydrology, 2) hydric soils and 3) hydrophytic vegetation.