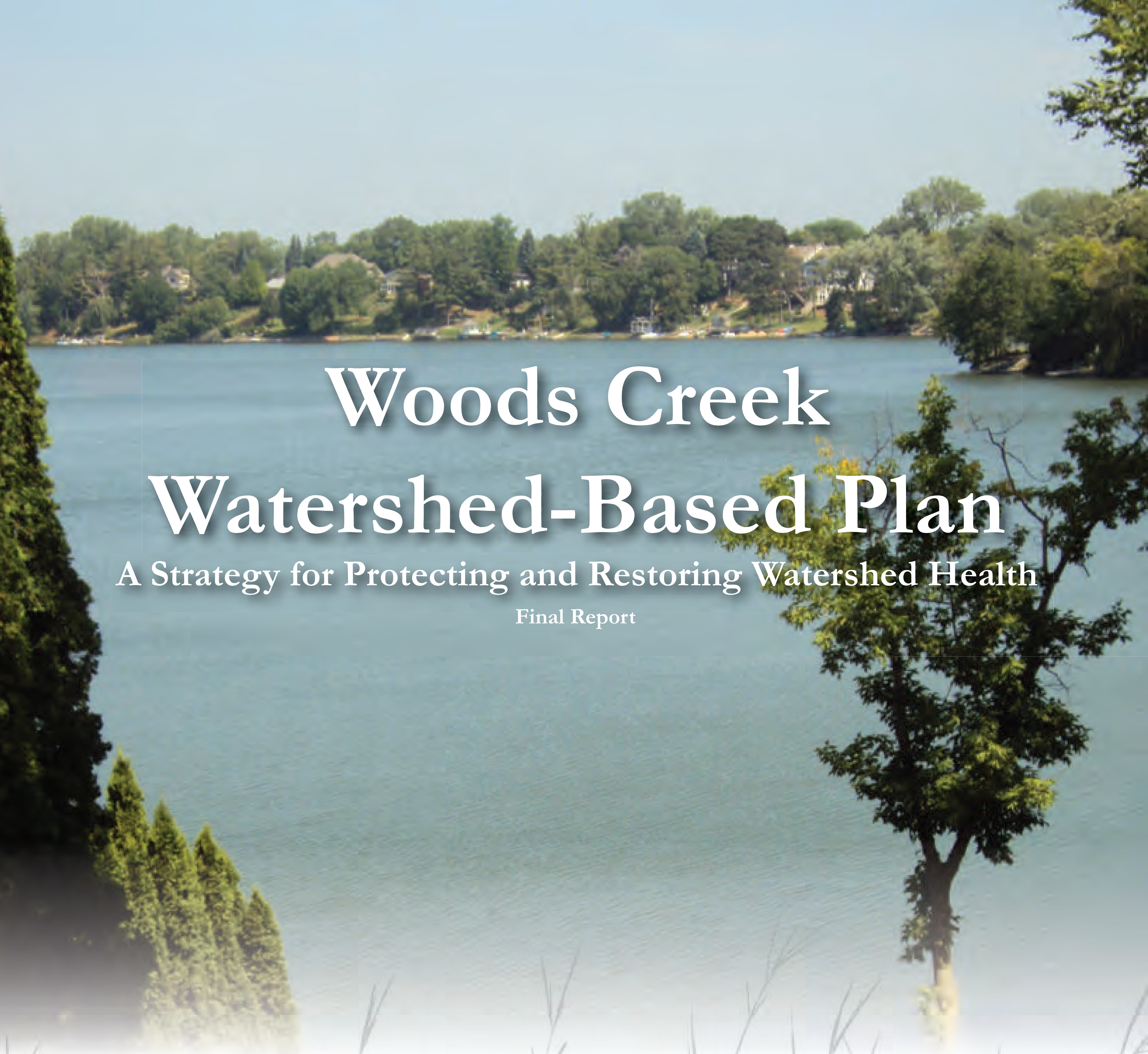


Woods Creek Watershed-Based Plan

A Strategy for Protecting and Restoring Watershed Health

Final Report

Prepared for Woods Creek Watershed Committee
By Applied Ecological Services, Inc.

January 2013

WOODS CREEK WATERSHED-BASED PLAN

McHenry and Kane Counties, Illinois

A Strategy for Protecting and Restoring Watershed Health

FINAL REPORT

January 2013
(AES #10-0524)

Prepared by:

Applied Ecological Services, Inc.
120 West Main Street
West Dundee, Illinois 60118
http://www.appliedeco.com
Phone: (847) 844-9385
Fax: (847) 844-8759

for

Woods Creek Watershed Committee Partners
with the Village of Algonquin as fiscal agent

Funding for this project provided, in part, by the Illinois Environmental Protection Agency through Section 319 of the Clean Water Act (#3191105).

ACKNOWLEDGEMENTS

Funding for the Woods Creek Watershed-Based Plan was provided, in part, by the Illinois Environmental Protection Agency (IEPA) through Section 319 of the Clean Water Act (#3191105). Additional funding was provided by the watershed partners: Village of Algonquin, Village of Lake in the Hills, City of Crystal Lake, and Crystal Lake Park District.

Christine Davis acted as project manager for IEPA's Bureau of Water while Katherine Parkhurst and Michele Zimmerman, representing the Village of Algonquin, acted as Watershed Coordinators for Woods Creek Watershed Committee (WCWC) and worked closely with IEPA and Applied Ecological Services, Inc. (AES) to produce the watershed planning document. Other duties performed by the coordinators included consultant contract administration, finance management, and WCWC meeting coordination.

Woods Creek Watershed Committee (WCWC) consisting of representatives from Algonquin, Lake in the Hills, Crystal Lake, Crystal Lake Park District, homeowner associations, Environmental Defenders of McHenry County, The Land Conservancy of McHenry County, McHenry County SWCD, Illinois DNR, McHenry County DOT, contractors, and residents played an important role in providing input on watershed goals & objectives, various planning approaches, and input on plan development.

Applied Ecological Services, Inc. (AES) conducted analysis, summarized results, and authored the Woods Creek Watershed-Based Plan.

The following people attended and provided input at WCWC meetings:

Abby Ridge Golf Course Woods Creek HOA: Julie Leffel, Lynda Potas
Bakley Construction Company: Ken Bakley
Cardo Entrix: Connor Kobeski; Jody Kubitz
CITP II: Kathy Casassa
City of Crystal Lake: Abby Wilgreen; Bill Peterhansen, Erik Morimoto
Crystal Lake Park District: Ann Viger, John Fiorina
Environmental Defenders of McHenry County: Cynthia Kanner
Greenview Villa Association: Donna Thomas
Illinois Department of Natural Resources: Nancy Williamson
Kings Gate West HOA: Tom Dennison
Lake in the Hills Lake Association: Ray Douglas
Lake in the Hills Sanitary District: Rick Forner
Land Conservancy of McHenry County: Lisa Haderlein
McHenry County DOT: Wynnyth Adair, Wally Dittrich
McHenry County Government: Cassandra McKinney
McHenry County SWCD: Tom Mattingly, Spring Duffey
Plote Homes, LLC: Ryan Trottier
Residents: Al Wilson, Bob Day, Ed Laumbacher, Rich Zacragni, Dave Roberts
Students: Emily Donaldson, Shane Laekoic
Trustee: Jerry Glogowski
Village of Algonquin: Michele Zimmerman, Katherine Parkhurst, Bob Mitchard, Russ Farnum
Village of Lake in the Hills: Rick Trudy Wakeman, Fred Mullard, Guy Fehrman

***All photos taken by AES unless otherwise noted**

TABLE OF CONTENTS

Section Page

LIST OF FIGURES

LIST OF APPENDICES

(Note: All appendices are included on attached CD)

Woods Creek Watershed-Based Plan

A Strategy for Protecting and Restoring Watershed Health

Prepared for Woods Creek Watershed Committee
By Applied Ecological Services, Inc.
January 2013

Executive Summary

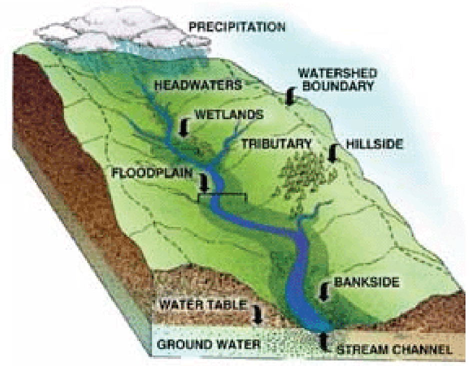
Spella Wetland at headwaters of Woods Creek

WHAT'S INSIDE THIS EXECUTIVE SUMMARY?

What is a watershed?

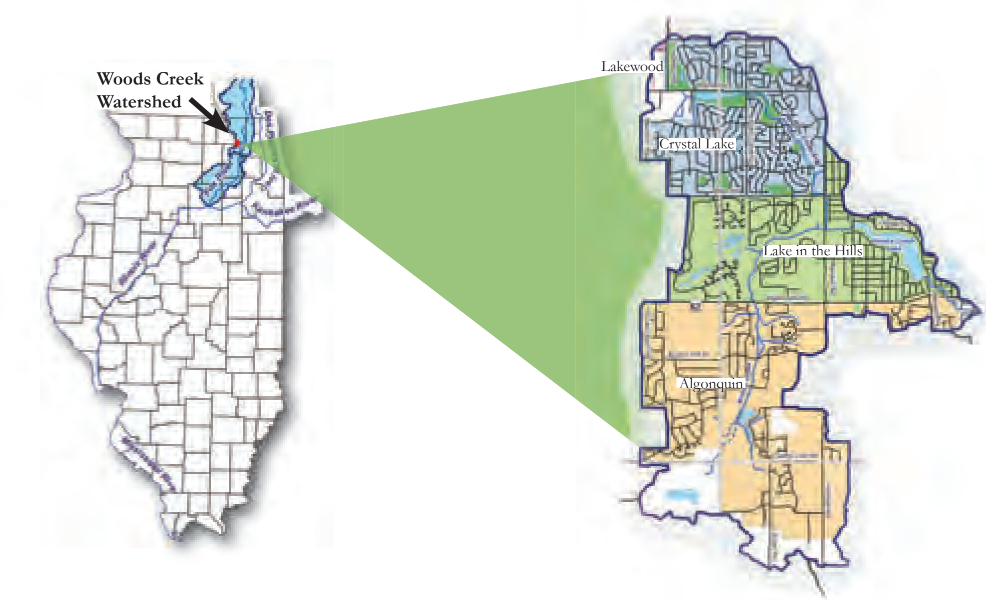
Each of us lives in a watershed or area of land that drains water to a stream or lake. Despite this relatively simple definition, a watershed is a complex interaction between natural elements such as climate, surface water, groundwater, vegetation, wildlife, and humans. Human influences can produce polluted stormwater runoff, increase impervious surfaces, alter stormwater flows, and increase erosion.

Image Source: City of Berkley, Department of Public Works



Where is Woods Creek watershed?

Woods Creek watershed is located in northeast Illinois in McHenry and Kane Counties (see map, below). Woods Creek and its numerous tributaries account for approximately 9.5 stream miles and drain approximately 8.6 square miles (5,508 acres) of land surface. Nearly the entire watershed drains east to Woods Creek Lake, the only true lake in the watershed, just prior to joining Crystal Creek watershed, a subwatershed to the Fox River. The Fox River Basin drains portions of five counties in southern Wisconsin before entering northeastern Illinois where it drains eleven counties. It then joins the Illinois River in Ottawa, Illinois. From there the Illinois River flows southwest through central Illinois prior to joining the Mississippi River north of St. Louis, Missouri.



The primary jurisdictions (map, left) in the watershed include the municipalities of Algonquin, Lake in the Hills, and Crystal Lake. The Crystal Lake Park District also has significant holdings within the watershed.

Why this watershed plan?

Farming practices followed by heavy residential and commercial development in the 1990s and 2000s drastically altered the natural landscape, and with landscape change came negative impacts to the environment. Streams began to suffer from streambank erosion causing sediment deposition and nutrient loading in Woods Creek Lake. Invasive species established in natural areas causing loss of habitat. The ability for water to infiltrate to groundwater aquifers also decreased. Beginning in 2004, Woods Creek Lake and Crystal Creek downstream appeared on the Illinois Environmental Protection Agency's 303(d) impaired waters list. A segment of the Fox River downstream is also impaired. A voluntary group of stakeholders including individual landowners, organizations, and governments came together in an effort to protect and restore the health of Woods Creek watershed. The Woods Creek Watershed-Based Plan can be downloaded at:

www.algonquin.org/eco

Purpose


Woods Creek Lake

In early 2011, the inter-governmental group of partners, consisting of Algonquin, Lake in the Hills, Crystal Lake, and Crystal Lake Park District applied for and received Illinois Environmental Protection Agency funding through Section 319 of the Clean Water Act to initiate a voluntary planning effort to produce a comprehensive "Watershed-Based Plan" for Woods Creek watershed. With this plan, identified projects become eligible for state and federal grants.

The primary purpose of this plan is to spark interest and give stakeholders a better understanding of the Woods Creek watershed to promote and initiate plan recommendations that will improve green infrastructure, improve water quality, conserve groundwater, restore habitat, and provide educational and recreational opportunities.


Spella Park Bridge

Mission

The Woods Creek Watershed Committee (WCWC) is comprised of watershed stakeholders dedicated to the preservation, protection, and improvement of Woods Creek watershed. The Woods Creek Watershed Committee's vision and mission is to:

Improve water quality through refined stormwater management, flood reduction, enriched natural area management, groundwater recharge protection, utilization of green infrastructure, and control of invasive species. The goal is to enhance ecosystem benefits within Woods Creek watershed and ultimately the Fox River through education and stewardship.

Goals

Identify, protect, and manage the *GREEN INFRASTRUCTURE NETWORK*.

Create *POLICY* **to protect watershed resources from the impacts of future development.**

Restore and manage aquatic and terrestrial *HABITAT*.

Provide watershed *EDUCATIONAL OPPORTUNITIES*.

Improve and monitor surface *WATER QUALITY*.

Improve *GROUNDWATER RECHARGE*.

Increase and/or improve *RECREATIONAL OPPORTUNITIES*.

Mitigate for existing structural *FLOOD PROBLEMS*.


Stakeholder Meeting

Depiction of pre-European settlement prairie landscape at nearby Lake in the Hills Fen Nature Preserve. Source: David Schwaegler.

The Past

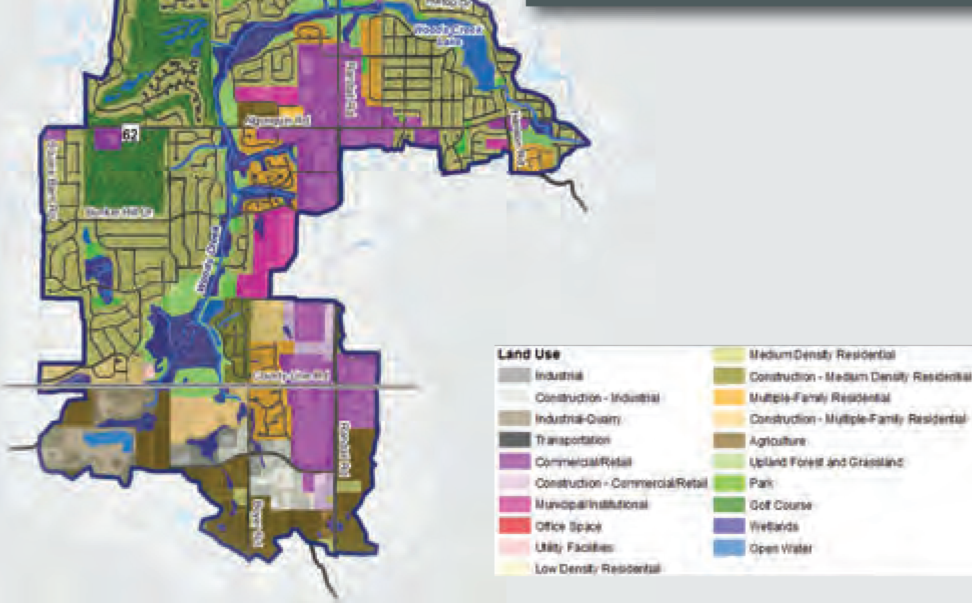
Glaciers that receded about 14,000 years ago formed the existing landscape in Woods Creek watershed. During this period the earth's temperature warmed and the ice slowly retreated leaving behind moraines, ridges, and other features. A tundra-like environment covered by spruce forest was the first ecosystem to colonize after glaciers retreated. As temperatures continued to rise, tundra was replaced by cool moist deciduous forests and eventually by oak-hickory forests, oak savannas, prairies, and wetlands.

Pre-European settlement ecological communities in Woods Creek watershed were undoubtedly balanced ecosystems with clean water and diverse with plant and wildlife populations. The first U.S. public land surveyors in the mid-1800s described nearly the entire Woods Creek watershed as "prairie." One island of "timber" was identified along Woods Creek on the far east side of the watershed in the area that is now Woods Creek Lake. This mixture of "prairie" and "timber," that is now referred to as savanna, was mentioned frequently in the mid 1800s as early settlers moved west out of the heavily forested eastern portion of the U.S. The prairie-savanna landscape was maintained and renewed by frequent lightning strike fires, fires ignited by Native Americans, and grazing by bison and elk. Running through the prairie-savanna landscape were meandering stream corridors and low wet depressions consisting of sedge meadow, marsh, wet praire and highly unique seeps, springs, and fen wetlands hydrated by alkaline rich groundwater discharge.

The Present

Ecological conditions in Woods Creek watershed changed drastically following European settlement in the mid 1800s. Large scale fires no longer occurred and bison and elk were extirpated. The majority of prairie was tilled under and drain tiles were installed throughout wet areas as farming became the primary land use by the early 1900s and continued through the 1980s. Residential and commercial development in the 1990s and 2000s followed, which led to additional alteration and fragmentation of the natural landscape. Today, Woods Creek watershed is home to thousands of people. Land uses within the watershed communities of Algonquin, Lake in the Hills, and Crystal Lake now include subdivisions of homes, commercial/industrial centers, retail along Randall Road, farmland, gravel mining operations, golf courses, recreational facilities, and preserved green infrastructure along Woods Creek and its tributaries (map, right).

Existing Land Use/Land Cover



Preserved riparian corridor in Crystal Lake

Challenges & Threats

Surface Water

Woods Creek and Tributaries
- 49% of stream length in the watershed is highly channelized.
- 62% of stream length exhibits moderate to highly eroded streambanks causing total suspended solids and total phosphorus loading downstream.

Woods Creek Lake
- High total phosphorus, total suspended solids/sediment deposition, and mercury have been documented.
- Invasive Eurasian watermilfoil is a dominant plant in the lake.

Detention Basins
- There are a total of 134 basins; 91 (68%) do not provide adequate ecological and/or water quality benefits.
- There is a general lack of management for naturalized basins.

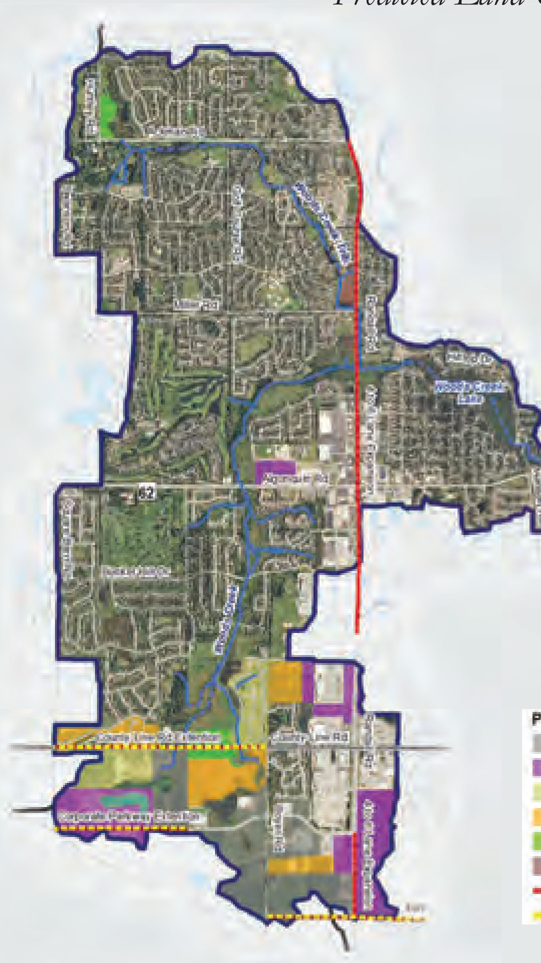

Severely eroded reach of Woods Creek


Poorly designed detention basin for ecological and water quality benefits

Groundwater

Aquifer Recharge
- Most moderate and highly sensitive aquifer recharge areas in the northern two thirds of the watershed are developed. Recharge areas in the southern third are slated for future development.
- Studies by Illinois State Water Survey show shallow bedrock aquifer drawdown from 5 feet to nearly 100 feet by 2050, ultimately affecting groundwater availability.

Predicted Land Use Changes




Common reed is a threat to most riparian areas

Land

- Chicago Metropolitan Agency for Planning predictions show a 14,500 (41%) population increase by 2040.
- There are 474 riparian acres comprised mostly of prairie, wet prairie, fen, and marsh; 57% is in poor ecological condition - managment is needed.
- Invasive and/or non-native plant species including common reed, purple loosestrife, reed canary grass, common buckthorn, sandbar willow, box elder, and eastern cottonwood are problematic in nearly all natural areas.
- The headwaters of Woods Creek is vulnerable to the impacts of proposed future commercial/retail, industrial, and residential development (map, left). Implementing policy to protect against impacts of future development will be a challenge.
- Educating the general public about watershed issues and actions will be challenging.

Special Natural Features

Natural Areas

McHenry and Kane County wetland studies note the location of several wetlands that have high quality habitat or functional value (see map, below). One of these wetlands is located at Crystal Lake Park District's "Willow's Edge Park." The largest of the wetlands extends along much of Woods Creek and Woods Creek Tributary between Woods Creek Lane in Algonquin and Ackman Road in Crystal Lake. Nearly the entire 240 acre area is protected and managed by Algonquin, Lake in the Hills, Crystal Lake Park District, and the Land Conservancy of McHenry County. The McHenry County Conservation District recognizes most of this wetland complex south of Miller Road as a Natural Area Inventory (MCNAI) Site called "Woods Creek Fen" which is made up primarily of remnant sedge meadow, marsh, wet prairie, and rare fen wetland communities.

High quality "Winding Creek Fen"

High quality reach of Woods Creek south of Algonquin Road on private land

Indian Trail Beach at Woods Creek Lake

The highest quality fen wetland in the watershed known as "Winding Creek Fen" is part of the larger "Woods Creek Fen," and is located along a small tributary to Woods Creek. Many uncommon and conservative plant species are found there including early fen sedge, bog lobelia, swamp thistle, narrow-leaved loosestrife, fen betony, yellow star grass, and bog valerian. The Village of Algonquin intensely manages this unique area.

Another MCNAI site is "Algonquin Hanging Fen", a 40 acre remnant graminoid fen intermixed with high quality sedge meadow and wet prairie located at the headwaters of Woods Creek. The site harbors uncommon and conservative plants such as bog lobelia, fen betony, and a variety of sedges. This area is currently being managed by the Village of Algonquin as a cohesive extension of Spella Park Wetland.

One additional natural area worth mentioning includes portions of two adjacent private parcels located just southeast of Woods Creek Lake and south of Algonquin Road. There, Woods Creek is high quality. To the south of Woods Creek is a steep northeast facing slope supporting the only remaining remnant woodland dominated by old growth (150+ year old) bur oak, red oak, and sugar maple.

Woods Creek Lake

This 52-acre public lake (see below) is the only lake in the watershed and provides recreation for local residents including fishing, boating, and swimming. The Village of Lake in the Hills currently has six public access points at Indian Trail Beach, Hilltop Beach, Nockels Park, Turtle Island Park, La Buy Park, and Echo Hill Park.

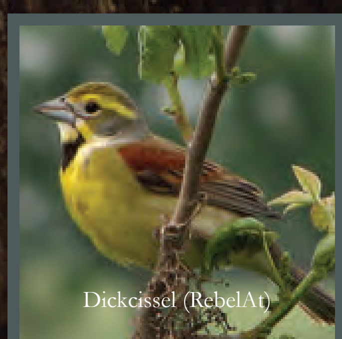
Spella Park Wetland

Spella Park Wetland is a wetland restoration project undertaken by the Village of Algonquin beginning in 2007. Approximately 60 acres of historic wetland and prairie was reestablished by breaking old farm drain tiles and planting with more than 50 native species. Several uncommon wetland and grassland birds currently use the site including marsh wren, sedge wren, dickcissel, and willow flycatcher. Spella Park Wetland is now a high quality wetland that expands and connects green infrastructure at the headwaters of Woods Creek. Algonquin manages the site primarily through controlled burns.

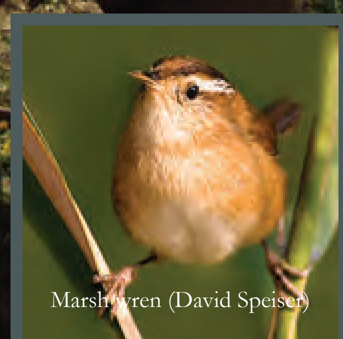
Controlled burn at Spella Park Wetland

Sedge wren (Terry Hartley)

Willow Flycatcher (AJ Hand)



Dickcissel (RebelAt)



Marsh wren (David Speiser)

Green Infrastructure

A "Green Infrastructure Network" 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. A well preserved Green Infrastructure Network with extensive interconnecting paths is currently in place along Woods Creek and its tributaries (see map, below). This network is comprised of over 2,000 acres or 38% of the watershed. Of this, approximately 35% is publically owned and protected primarily by Algonquin, Lake in the Hills, The Land Conservancy of McHenry County, and Crystal Lake Park District.

Watershed Improvement Projects

Watershed partners are taking the lead and moving forward with implementing a variety of watershed improvement projects. Projects include natural area restoration, stream/swale restoration, naturalized detention basins, rain gardens, and interconnected walking/bike trails.

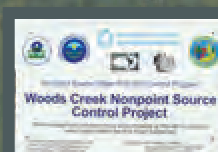
Rain garden at Nockels Park (Woods Creek Lake)
The Village of Lake in the Hills installed several water quality improvement projects within Village owned parks along Woods Creek Lake. This rain garden at Nockels Park captures and infiltrates water from the adjacent parking lot.

Winding Creek walking/bike path
This Crystal Lake Park District owned path along Woods Creek Tributary is one of many interconnecting paths located throughout the green infrastructure network in the watershed. These paths enable the public to experience nature and observe the many projects that are being implemented.

Swale stabilization behind Algonquin Area Public Library
The Village of Algonquin restored this swale by clearing invasive trees and shrubs then seeding the buffer with native prairie vegetation. Native wetland plant plugs were also installed in the swale to stabilize soils and filter stormwater.

Riparian corridor preservation and enhancement
The City of Crystal Lake preserved and enhanced this reach of Woods Creek Tributary south of Alexandra Blvd. to connect green infrastructure and Winding Creek walking/bike path.

Naturalized detention basin in Lake in the Hills
The Village of Lake in the Hills received a Section 319 Grant from the Illinois Environmental Protection Agency to naturalize this detention basin by replacing turf grass with native prairie vegetation. The basin now infiltrates and cleans stormwater while providing wildlife habitat within the Woods Creek riparian corridor.



Action Recommendations

The Woods Creek Watershed-Based Plan includes an "Action Plan" developed to provide stakeholders with recommendations to specifically address plan goals. The Action Plan includes two subsections: programmatic recommendations and site specific recommendations. Programmatic recommendations are general remedial, preventive, and regulatory watershed-wide actions. Site specific recommendations include actual locations where projects can be implemented to improve surface and groundwater quality, green infrastructure, and aquatic and terrestrial habitat.

Programmatic Recommendations

This section of the Action Plan provides stakeholders with general structural and non-structural, educational, policy, and project coordination/planning recommendations. The following recommendations are among the most important. A complete list of recommendations can be found in the full version of the watershed plan.

Example of stormwater treatmet train within Conservation Development.


Conceptual Conservation Design layout

Green Infrastructure

- Municipalities incorporate the identified Green Infrastructure Network into comprehensive plans and development review maps.
- Prepare and implement management plans for all publically owned green infrastructure.
- Leverage mitigation funds from proposed road extension/expansion projects to implement projects that benefit green infrastructure.

Policy

- Watershed Partners adopt the Woods Creek Watershed-Based Plan.
- Require Conservation Design standards based on the McHenry County Conservation Design Ordinance for development located within the Green Infrastructure Network.
- Require Development Impact Fees and/or Special Service Area taxes to help fund future management of green infrastructure.

Habitat

- Maintain naturalized detention basins per recommendations in the plan.
- Control non-native/invasive plant species.
- Apply ecologically sound practices to stream, wetland, shoreline, and other natural area restoration projects.

Education & Recreation

- Implement programs to educate stakeholders about watershed issues and projects.
- Incorporate green infrastructure amenities when creating or enhancing recreational areas.

Surface and Groundwater Quality

- Retrofit existing stormwater infrastructure to improve water quality.
- Apply lawn fertilizer in accordance with soil testing results and consider using no or low phosphorus fertilizer.
- Use best management practices when applying salt for snow and ice removal.
- Maintain open space in sensitive aquifer recharge areas.

Site Specific Project Recommendations

This portion of the Action Plan includes over 130 site specific project recommendations designed to improve watershed health. As part of the planning process, "Critical Areas" (see map, right) were identified where implementation of projects over the next five years could result in several pollutants being reduced to target levels. These areas are discussed below.

Streambank & Channel Restoration

Streambanks along critical reaches are highly eroded and are a major source of sediment and phosphorus that ends in downstream Woods Creek Lake. Water quality and habitat can be improved by restoring these areas using bioengineering techniques.

Lake Shoreline Restoration

Critical lake shorelines include those along Woods Creek Lake identified by the Village of Lake in the Hills. These areas contribute to sedimentation and turbidity in the lake. Shoreline restoration using bioengineering techniques is recommended.

Riparian Area Restoration & Maintenance

Critical riparian areas are select natural areas adjacent to stream reaches that are in poor ecological condition but have excellent ecological restoration and remediation potential to improve water quality and habitat conditions and reduce flooding downstream.

Wetland Restoration

Five critical area potential wetland restoration sites totaling 50 acres were identified. Wetland restoration projects improve water quality and wildlife habitat while acting as sponges to reduce stormwater runoff.

Detention Basin Retrofits

Many detention basins can be retrofitted by naturalizing with native vegetation. Naturalized basins improve water quality from developed areas, improve habitat, and require less maintenance. Twelve critical area detention basin retrofit projects were identified in the watershed.

Green Infrastructure Protection Areas

Six critical green infrastructure protection areas totaling over 400 acres were identified in the watershed. These sites are located in sensitive aquifer recharge areas, areas where Conservation Design standards are recommended if developed, or in areas where acquisition and protection is most beneficial.

Critical Area Project Locations

Woods Creek Lake detail showing eroded shorelines

Example of stream restoration project at nearby Dixie Creek

Properly designed wet bottom naturalized detention

Get Involved

Watershed planning and implementation is a voluntary effort. Active watershed stakeholders are needed to put this watershed plan into action. The Woods Creek Watershed Committee is in place to support plan implementation and future planning efforts. Contact the Village of Algonquin to learn how you can help.

Volunteer - you make a difference!

Residents & Businesses

- ☐ Use less fertilizer on lawns and consider using organic products.
- ☐ Use less salt on driveways, parking lots, and sidewalks during winter months.
- ☐ Use native landscaping to decrease watering needs and maintenance.
- ☐ Install rain gardens and use rain barrels to reduce stormwater runoff.
- ☐ Attend municipal and park district sponsored environmental education events.
- ☐ Become a natural area volunteer or steward.

Streamside and Lake Shoreline Owners

- ☐ Consult your local Natural Resources Conservation Service office regarding ways to establish, restore, and maintain natural buffers along stream channels and lake shorelines.

Municipalities & Park Districts

- ☐ Inform the public that a plan has been developed for Woods Creek watershed.
- ☐ Adopt the Woods Creek Watershed-Based Plan.
- ☐ Incorporate watershed plan goals and recommended actions into local comprehensive plans, zoning overlays, codes, and ordinances.
- ☐ Build "Demonstration Projects" in and around public facilities.
- ☐ Restore and manage publically owned Green Infrastructure Network natural areas.
- ☐ Prepare annual budgets for restoring & managing green infrastructure and providing education.
- ☐ Increase recreational opportunities throughout the Green Infrastructure Network.

Woods Creek Watershed Committee (WCWC) Stakeholders

- ☐ Identify "Champions" to participate at future WCWC meetings, pursue projects, and to discuss and evaluate watershed plan implementation progress.
- ☐ Build partnerships to leverage funding for implementing plan recommendations.

For more information contact:

The Village of Algonquin - Public Works
110 Meyer Drive
Algonquin, IL 60102
(847) 658-2754

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

Additional funding was provided by the Village of Algonquin, Village of Lake in the Hills, City of Crystal Lake, and Crystal Lake Park District.

Watershed Coordinators:
Michele Zimmerman
Katie Parkhurst

Executive Summary Produced by:
Applied Ecological Service, Inc.

All photos by AES unless otherwise noted.

Download the Woods Creek Watershed-Based Plan and list of planning participants at:
www.algonquin.org/eco

CRYSTAL LAKE PARK DISTRICT · ILLINOIS ENVIRONMENTAL PROTECTION AGENCY · VILLAGE OF ALGONQUIN · CITY OF CRYSTAL LAKE, IL · VILLAGE OF LAKE IN THE HILLS · APPLIED ECOLOGICAL SERVICES

1.0 INTRODUCTION

1.1 Woods Creek Watershed Setting

Each of us lives in a watershed or area of land drained by a river/stream system or body of water such as a lake (Figure 1). Despite this relatively simple definition, a watershed is a complex interaction between natural elements such as climate, surface water, groundwater, vegetation, and wildlife and human-created features such as agriculture and urban development that produce polluted stormwater runoff, increase impervious surfaces, alter stormwater flows, and increase erosion. Other common names given to watersheds, depending on size, include basins, sub-basins, subwatersheds, and Subwatershed Management Units (SMUs).

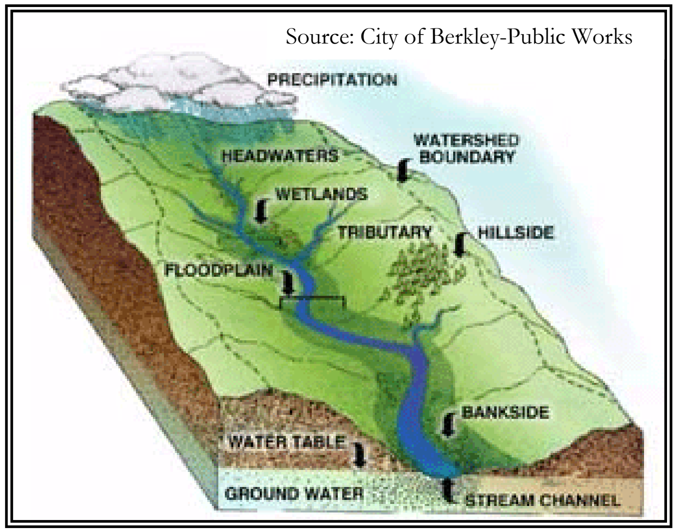


Figure 1. Hypothetical Watershed Setting.

Woods Creek watershed is located in northeast Illinois in McHenry and Kane Counties (Figure 2). Woods Creek and its numerous tributaries account for approximately 9.5 stream miles and drain approximately 8.6 square miles (5,508 acres) of land surface. Nearly the entire watershed drains east to Woods Creek Lake, the only true lake in the watershed, prior to joining Crystal Creek watershed, a subwatershed to the Upper Fox River Basin. The Upper Fox drains portions of Jefferson, Kenosha, Racine, Walworth, and Waukesha counties in Wisconsin and McHenry, Lake, Kane, and Cook Counties in Illinois. The Lower Fox River Basin extends south and west through DeKalb, DuPage, Grundy, Kendall, LaSalle, Lee, and Will Counties. The Fox River joins the Illinois River in Ottawa, Illinois. From there the Illinois River flows southwest across the heart of Illinois before joining the Mississippi River north of St. Louis, Missouri.

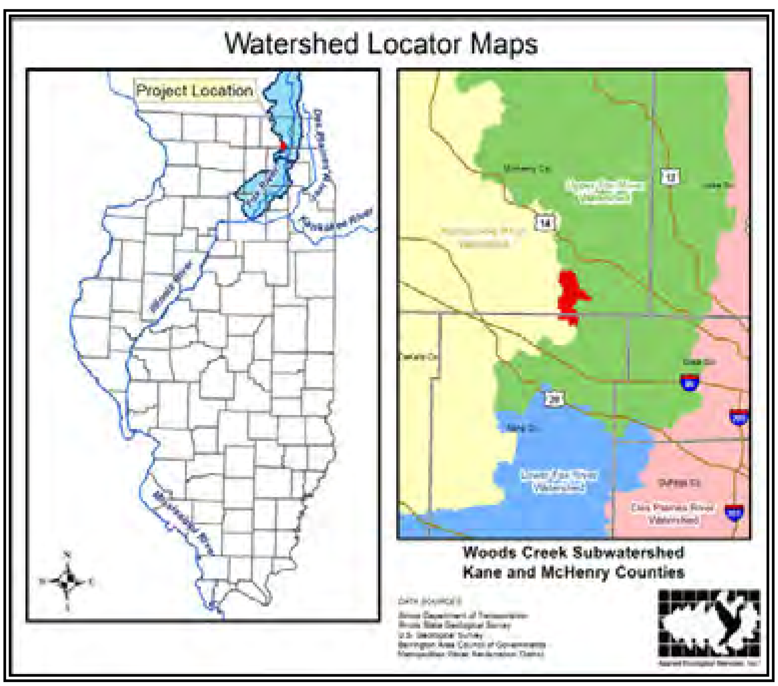


Figure 2. Watershed Locator Maps.

Pre-European settlement ecological communities in the Woods Creek watershed were undoubtedly balanced ecosystems with clean water and diverse with plant and wildlife populations. The mosaic of prairie, oak savanna, and 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 upland prairie and savanna communities and within the extensive wetlands that existed along stream corridors.

Ecological conditions changed drastically following European settlement in the mid 1800s. Large scale fires no longer occurred and bison and elk were extirpated. The majority of prairie and savanna was tilled under and drain tiles were installed throughout wet areas as farming became the primary land use by the early 1900s and continued through the 1980s. Heavy residential and commercial development in the 1990s and 2000s followed which led to additional alteration and fragmentation of the natural landscape and resulted in impervious surfaces that greatly reduce the ability of precipitation to infiltrate into the ground. Today, the Woods Creek watershed is dominated by a variety of land uses including subdivisions of homes, commercial/industrial centers, farmland, gravel mining operations, area schools, and recreational facilities within the jurisdictions of Algonquin, Lake in the Hills, Crystal Lake, and Crystal Lake Park District.

With landscape change came negative impacts to the environment. Streams and adjacent wetlands began to suffer from erosion causing sediment loading and deposition, invasive species establishment, loss of habitat, and nutrient inputs. In 2004, Woods Creek Lake and Crystal Creek (Crystal Lake Outlet) downstream appeared on the Illinois Environmental Protection Agency's (Illinois EPA) 303d impaired waters list. The segment of the Fox River at Crystal Creek's confluence is also impaired. Woods Creek Lake, Crystal Creek, and Fox River segment also appeared on 2006, 2008, 2010, and Draft 2012 303d lists. Impacts to Illinois EPA "Designated Uses" are primarily the result of phosphorus, total suspended solids, total dissolved solids, chloride, fecal coliform, mercury, and polychlorinated biphenyls originating from various municipal point sources, urban runoff/ stormsewers, atmospheric deposition, and other unknown sources.

The Villages of Algonquin, Lake in the Hills, Crystal Lake and Crystal Lake Park District are concerned for the health of the Woods Creek watershed since it began showing signs of degradation in the early 2000s. The Village of Algonquin reacted by creating "Woods Creek Watershed Protection Plan"(Algonquin 2001) in 2001 to help guide residential and commercial development. The jurisdictions also recognize that watershed issues are so complex and inter-related that it is essential for stakeholders including individual landowners, organizations, and governments to work together to protect and restore the health of the watershed. Watershed planning is entirely voluntary. The process of creating this Watershed-Based Plan for the Woods Creek unites volunteer stakeholders and helps them understand the watershed and initiate projects that improve water quality and enhance natural resources and open space.

Noteworthy- Illinois EPA Water Quality Monitoring

Illinois EPA does not monitor to the level of detail included in this plan. The local community conducted additional monitoring and developed a localized waterbody code system. Therefore, the codes used in this plan are not found in the Illinois EPA's *Illinois Integrated Water Quality Report and Section 303d List.*

1.2 Project Scope & Purpose

In early 2011, the inter-governmental group of partners, known as Woods Creek Watershed Committee (WCWC), consisting of Algonquin, Lake in the Hills, Crystal Lake, and Crystal Lake Park District applied for and received Illinois Environmental Protection Agency (Illinois EPA) funding through Section 319 of the Clean Water Act to produce a comprehensive "Watershed-Based Plan" for the Woods Creek watershed that meets requirements as defined by the United States Environmental Projection Agency (USEPA). Ultimately, the intent of 319 funding is to develop and implement Watershed-Based Plans designed to achieve water quality standards. The Village of Algonquin, acting as project Coordinator, hired Applied Ecological Services, Inc. (AES) in September 2011 to assist in developing the plan.

The watershed planning process is a voluntary exercise among stakeholders with the primary scope to develop an ecologically-based management plan for Woods Creek watershed that focuses on improving water quality by protecting green infrastructure, creating protection policies, implementing ecological restoration, and educating the public.

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

The Woods Creek Watershed Committee (WCWC) held regular, public meetings throughout 2011 and 2012 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 WCWC were addressed and incorporated into the Watershed-Based Plan. The plan acknowledges the importance of managing remaining open space to meet many of the goals and objectives in the plan and provides scientific and practical rational for protecting appropriate open space 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.

1.3 USEPA Watershed-Based Plan Requirements

In March 2008, the United States Environmental Protection Agency (USEPA) released watershed protection guidance entitled "Nonpoint 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 nonpoint 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) "Guidance for Developing Watershed Implementation Plans in Illinois" (CMAP 2007) to create this watershed plan. Having a Watershed-Based Plan will allow Woods 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. The nine Elements are as follows:

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 non-point source management measures that will need 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 implement the plan;

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 is designed to enhance public understanding and to change social behavior;

Element F: Plan implementation schedule;

Element G: Description of interim, measurable milestones;

Element H: Set of criteria that can be used to determine whether pollutant loading reductions are being achieved over time;

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

1.4 Planning Process

Watershed Stakeholder Planning Committee

The Woods Creek Watershed Committee (WCWC) partners met in September 2011 to initiate the watershed planning process. Next, relevant watershed stakeholders were invited to attend a kickoff meeting to become familiar with the watershed and steps in the planning process. Volunteer WCWC stakeholders met seven times throughout the planning process. The committee generally consisted of representatives from municipalities, park districts, land conservancies, residential/commercial developers, property specialists, non-profit organizations, and watershed residents.

WCWC meeting at Algonquin Village Hall

The WCWC 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 included in Table 1. Complete meeting minutes are included in Appendix A.

Table 1. Woods Creek Watershed Committee (WCWC) & Partner meeting schedule.

Date	Agenda	Topic(s)
Sept. 30, 2011	Watershed Planning Summary	AES summary to Partners describing items needed in USEPA approved watershed plan. Coordinator compiled a list of current and potential stakeholders.
Nov. 17, 2011	319 Grant; Watershed Planning Process; Watershed Boundary; BMP Inventory; Mission Statement	Coordinators summarized 319 Grant and gathered information from stakeholders to develop a mission statement. AES summarized the watershed plan process, defined the watershed boundary, and presented preliminary results of the BMP Inventory.
Jan. 25, 2012	Mission Statement; Watershed Inventory Recap; Baseline Water Quality Sampling Results; Stakeholder Topics; Preliminary Goals	Coordinators reviewed mission statement. AES presented a recap presentation of watershed conditions, BMP inventory, and results of baseline water quality sampling data. Stakeholders presented existing projects occurring in the watershed. Stakeholders voted on preliminary goals.
March 20, 2012	Mercury in Woods Creek Lake; Existing & Future Land Use; Identification of Impairments; Education Ideas	Jody Kubitz (Cardo Entrix) presented information about mercury in Woods Creek Lake. AES summarized existing & future land use and how impervious surfaces impact stream health. The stakeholder group then brainstormed potential and known impairments and potential education ideas.
May 22, 2012	Water Quality Update; Green Infrastructure Network; Ecologically Significant Areas; Sensitive Aquifer Recharge Areas; Goals/Objectives; Ecological Restoration	AES summarized the findings of the storm event water quality sampling and its implications. AES next summarized the results of several watershed characteristics findings with active discussion by stakeholders. Al Wilson (resident) gave a presentation about ecological restoration and its importance.
June 18, 2012	Watershed Tour	Watershed stakeholders visited nine sites in the watershed to see examples of watershed improvement projects, potential project sites, reaches of Woods Creek, and Woods Creek Lake.
August 22, 2012	Project Schedule Update Identification of Critical Areas Action Plan Executive Summary Fox River Ecosystem Partnership	AES went through the project schedule with stakeholders then showed maps identifying the Critical Areas and potential projects for those areas. Next, AES summarized the Action Plan section of the report and revealed the draft Executive Summary. Algonquin ended the meeting with a summary of the Fox River Ecosystem Partnership.

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. This section of the report summarizes what the user can expect to find in each major section of the Watershed-Based Plan.

Section 2.0: Mission, Goals, and Objectives
Section 2.0 of the report contains the Woods Creek Watershed Committee mission and goals/objectives identified by watershed stakeholders. Goal topics generally include protection of green infrastructure, watershed policy, ecological restoration, education and recreation, groundwater recharge, and flooding. In addition, "measurable objectives" were developed for each goal so that the progress toward meeting each goal can be measured in the future by evaluating information included in Section 8.0: Measuring Plan Progress & Success.

Section 3.0: Watershed Characteristics, Problems, & Opportunities
An inventory of the characteristics, problem, and opportunities in Woods Creek watershed is examined in Section 3.0. Resulting analysis of the inventory data led to recommended watershed actions that are included in Section 5: Management Measures Action Plan. Inventory results also helped identify causes and sources of watershed impairment as required under USEPA's *Element A*.

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

Inventory Topics Included in Plan

- 3.1 Geology, Climate, Soils	- 3.11 Drainage System
- 3.2 Pre-European Settlement Ecological Communities	- Streams & Riparian Areas
- 3.3 Topography, Watershed Boundary, Subwatersheds	- Detention Basins (Stormwater Management)
- 3.4 Jurisdictions	- Lakes
- 3.5 Demographics	- Wetlands &Wetland Restoration
- 3.6 Existing and Future Land Use/Land Cover	- Floodplain & Flood Problem Areas
- 3.7 Transportation Network	- 3.12 Groundwater Recharge/Public Water Supply
- 3.8 Impervious Cover	- 3.13 Water Quality
- 3.9 Open Space/Green Infrastructure	- 3.14 Pollutant Loading
- 3.10 Ecologically Significant Areas	

The following watershed inventory topics are not covered in this plan either because the item is not found in the watershed or because the information was not readily available to document the information.

Inventory Topics *Not* Included in Plan

- Levees	- Livestock
- Irrigation	- Combined Sewer System and Discharge Locations
- Drainage (Tiles and Ditches)	- Agricultural Practices
- Drainage Districts	- Air Quality
- Municipal/Industrial Point Sources	

Section 4.0: Causes & Sources of Watershed Impairment
This section of the plan includes a list of causes and sources of watershed impairment as identified in Section 3.0 and by watershed stakeholders that affect IEPA "Designated Uses". As required by USEPA, Section 4.0 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 recommended Management Measures identified in Section 5.0.

Section 5.0: Management Measures Action Plan
A "Management Measures Action Plan" is included in Section 5.0 to provide stakeholders with action items for watershed-wide improvements and direct stakeholders towards specific sites in the watershed where measures can be implemented resulting in the greatest watershed benefits.

The Action Plan is divided into a Programmatic Action Plan and a Site Specific Action Plan. Action recommendations are presented in table format with references to entities that would provide consulting, permitting, or other services needed to implement specific measures. The tables also outline project priority, implementation schedule, sources of technical and financial assistance, and cost estimates. The Programmatic Action Plan recommends action items with general applicability throughout the watershed whereas the Site Specific Action Plan identifies specific sites where recommended measures would improve water quality, expand and enhance natural resources/open space, and minimize flooding. This section addresses all or a portion of USEPA's *Elements C & D.*

Section 6.0: Information/Education Plan
This section addresses USEPA *Element E* by providing an Information/Education component to enhance public understanding and to encourage participation in selecting, designing, and implementing recommendations provided in the plan. This is accomplished by providing a matrix that outlines each recommended education action, target audience, package/vehicle for implementing the action, lead entitiy, and what the expected outcomes or behavior change will be.

Sections 7.0 & 8.0: Plan Implementation & Measuring Plan Progress & Success
A list of key stakeholders and discussion about forming watershed partnerships and implementing watershed improvement projects is in included in Section 7.0. Section 8.0 includes two monitoring components; 1) a "Water Quality Monitoring Plan" that includes specific locations and methods where future sampling should occur and a set of "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 7.0 and 8.0 address USEPA *Elements F, G, H, and I.*

Sections 9.0 & 10.0: Literature Cited and Glossary of Terms
Section 9.0 includes a list of literature that is cited throughout the report. The Glossary of Terms (Section 10.0) 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. It contains WCWC meeting minutes (Appendix A), results of the watershed inventory (Appendix B), raw data used to develop the pollutant loading and reduction models (Appendix C), a list of Woods Creek stakeholders & partners (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 Woods Creek watershed. Many 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 or restoration work is summarized below.

1. The Village of Lake in the Hills completed the "Clean Lakes Program Phase I Diagnostic-Feasibility Study of Woods Creek Lake" in August 2000 via cooperation with the Illinois Environmental Protection Agency. The study is a lake management plan for Woods Creek Lake that aims to restore and protect the lake's beneficial uses.

2. The Village of Algonquin completed the "Woods Creek Watershed Protection Plan" in 2001 to help guide development in the Algonquin portion of the watershed. The plan does not address the USEPA nine Elements.

3. Municipal comprehensive plans are available for the Village of Algonquin (2008), City of Crystal Lake (2001; currently being amended), and Village of Lake in the Hills (2002; last amended Sept. 22, 2009).

4. The McHenry and Kane County ADID wetland inventory (NIPC 1998, 2004) were developed in 1998 and 2004 respectively. These studies were conducted to identify the values of individual wetlands and identify wetlands of such high value that they merit special consideration for protection.

5. McHenry County Conservation District (MCCD) completed a Natural Area Sites Inventory (MCNAI) that was last updated in 2005. The inventory identifies two sites; ALG25 (Woods Creek Fen) & GRA01 (Algonquin Hanging Fen).

6. Illinois EPA collects water samples at two locations within Woods Creek Lake (sites ILRTZZ & ILRTZS). This data is included in biannual *Integrated Water Quality Reports*. These reports must describe how Illinois assessed water quality and whether assessed waters meet or do not meet water quality standards specific to each "Designated Use" of a waterbody.

7. Friends of the Fox River completed a stream assessment of Woods Creek at Randall Road (Site #30) in 2002, 2003, and 2005. Water chemistry, macroinvertebrates, plants, and stream dimensions were all examined.

8. Students at Jacobs High School collect basic water quality and macroinvertebrate data at Woods Creek near Bunker Hill Drive as part of the school's environmental science program. Unfortunately, the data is not available for analysis.

9. The Village of Algonquin restored a 60 acre wetland known as Spella Park Wetland located near the headwaters of Woods Creek in 2008. The Village currently maintains the site via weed control and by conducting controlled burns.

10. The Village of Algonquin currently manages 250+ natural area acres along the Woods Creek Corridor between Spella Park Wetland and Algonquin Road. Management consists of invasive shrub and tree removal, seeding with native prairie and wetland species, herbiciding invasive species, and controlled burns. This work is being completed following the "Woods Creek Riparian Corridor Natural Resource Inventory & Management Plan" prepared by Applied Ecological Services, Inc. in 2011.

11. The Village of Algonquin currently manages 15 natural area acres along Winding Creek a tributary to Woods Creek south and east of Algonquin Road. This site contains the highest quality fen wetlands in the watershed. Management consists of invasive shrub and tree removal, seeding with native prairie and wetland species, herbiciding invasive species, and controlled burns. This work is being completed following the "Winding Creek Riparian Corridor Natural Resource Inventory & Management Plan" prepared by Applied Ecological Services, Inc. in 2008.

12. The Village of Lake in the Hills currently manages the natural area corridor within Ken Carpenter Park along Woods Creek between Algonquin Road and Randall Road via controlled burns. It is also important to note that a 319 Grant was received in 2004 to implement ecological restoration work in this area.

13. The Village of Lake in the Hills has constructed several water quality improvement projects within the Village owned parks that abut Woods Creek Lake. Projects include rain gardens and stabilization with native plants.

14. The Crystal Lake Park District naturalized the large pond at Woodscreek Park and also owns and manages the Woods Creek Tributary headwater wetlands north of Ackman Road within Willow's Edge Park and the wetland corridor along Woods Creek Tributary between Golf Course Road and Village Road.

15. The Land Conservancy of McHenry County owns a 13 acre natural area along Woods Creek on the east side of Randall Road. This parcel is currently managed via spot herbicide treatments to invasive species and by removing invasive shrubs. Controlled burns are also conducted by the Conservancy.

16. Existing McHenry and Kane County Geographic Information System (GIS) data for Woods Creek watershed was obtained and used to analyze various data related to wetlands, soils, land use, and other relevant information.

17. The Illinois Department of Natural Resources: Division of Fisheries performed a fish population survey at Woods Creek Lake in September 2008. The study also includes basic water quality data, aquatic vegetation summary, and overall lake management recommendations.

2.0 MISSION, GOALS, AND OBJECTIVES

2.1 Woods Creek Watershed Committee Mission

The Woods Creek Watershed Committee (WCWC) is comprised of watershed stakeholders dedicated to the preservation, protection, and improvement of the Woods Creek watershed. The Woods Creek Watershed Committee's vision and mission is to:

"Improve water quality through refined stormwater management, flood reduction, enriched natural area management, groundwater recharge protection, utilization of green infrastructure, and control of invasive species. The goal is to enhance ecosystem benefits within Woods Creek watershed and ultimately the Fox River through education and stewardship."

2.2 Goals & Objectives

Watershed stakeholders were first presented with information about the character and quality of watershed resources prior to developing goals. Next, stakeholders listed a variety of issues, concerns, and opportunities that were sorted into eight general topics that should be addressed in the watershed plan. Stakeholders were then given the opportunity to vote on topics they felt were most important.

The voting process occurred following two separate watershed stakeholder meetings early on in the planning stages. Each stakeholder was given four votes. Each person was allowed to use up to two votes on a single topic if he/she felt strongly about it. The voting process helped focus on items that need to be adequately addressed in the planning process and within this watershed plan report. Tallied votes are as follows:

1) Identify, protect, and manage the Green Infrastructure Network – *18 votes*
2) Create policy to protect watershed resources from future development – *16 votes*
3) Restore and manage aquatic and terrestrial habitat – *12 votes*
4) Provide watershed educational opportunities – *12 votes*
5) Improve and monitor surface water quality – *11 votes*
6) Improve groundwater recharge – *5 votes*
7) Increase and/or improve recreational opportunities – *4 votes*
8) Mitigate for existing structural flood problems – *2 votes*

The eight topics were used as goals for Woods Creek watershed. Objectives for each goal were also formulated and are very specific where feasible and designed to be measurable so that future progress toward meeting goals can be assessed. Goals and objectives ultimately lead to the development of action items. 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 when measuring plan progress and success via milestones and "Report Cards" in Section 8.0.

Goal A: Identify, protect, and manage the Green Infrastructure Network.
Objectives:
1) Include all green infrastructure parcels in municipal comprehensive plans and on development review maps.
2) Incorporate Conservation Design standards for all green infrastructure parcels where new development or re-development is planned. At a minimum, standards included in the "McHenry County Subdivision Ordinance-Conservation and Design Standards and Procedures" adopted February 19, 2008 should apply.
3) Permanently protect all or portions of green infrastructure parcels harboring "Ecologically Significant Areas" or threatened and endangered species.
4) Implement appropriate land use management on all green infrastructure parcels.

Goal B: Create policy to protect watershed resources from the impacts of future development.
Objectives:
1) All key watershed stakeholders adopt the Woods Creek Watershed-Based Plan.
2) Amend municipal comprehensive plans and zoning ordinances to include a Woods Creek Watershed Protection Overlay that requires Conservation Design standards for all development located on green infrastructure parcels using the "McHenry County Subdivision Ordinance-Conservation and Design Standards and Procedures" adopted February 19, 2008 as a minimum standard.
3) Require developers to protect sensitive natural areas, restore degraded natural areas and streams, then donate all natural areas and naturalized stormwater management systems to a public agency or conservation organization for long term management with dedicated funding.
4) Require Watershed Protection Fees in the form of Development Impact Fees and/or Special Service Area (SSA) taxes for all new development to help fund management of the Green Infrastructure Network.
5) Require reduced or no phosphorus fertilizer use based on soil testing recommendations and Illinois Phosphorus Law.

Goal C: Restore and manage aquatic and terrestrial habitat.
Objectives:
1) Prepare and implement Natural Resource Inventory (NRI)/management plans for all publically owned natural areas within the Green Infrastructure Network.
2) Install appropriately spaced and designed artificial riffles throughout 24,160 linear feet of highly channelized stream.
3) Restore 269 acres of riparian area currently in poor ecological condition.
4) Manage 101 acres of riparian area currently in good ecological condition and 104 acres currently in average ecological condition.
5) Manage all detention basins that are currently in good or fair ecological condition.
6) Retrofit all "Critical Area" and "High Priority" detention basins with native vegetation.
7) Maintain overall aquatic plant (macrophyte) cover under 40% in Woods Creek Lake.

Goal D: Provide watershed educational opportunities.

Objectives:

1) Inform stakeholders and the general public that a Watershed-Based Plan has been developed for Woods Creek watershed then educate on the beneficial uses of the plan.
2) Implement the Information & Education Plan (I&E Plan) section of the Woods Creek Watershed-Based Plan. The following key education agendas and campaigns are included in the I&E Plan:
    - Target property owners to help them understand the link between their land management choices and its impact on the watershed resources.
    - Educate the general public about the benefits of ecological/natural area restoration and management.
    - Educate private land owners along Woods Creek Lake and miscellaneous stream/tributary corridors about the importance of proper land management to benefit the Green Infrastructure Network.
    - Role of the Green Infrastructure Network for public and school outdoor education.
    - Alternatives or management of phosphorus and road salt use.
    - Flood proofing structural flood problem areas.
    - Annual tour of watershed by elected officials and others that are interested to see the progress on restoration, areas that need improvement, or failed projects.
    - Offer outdoor "Volunteer Days" to get the general public to experience the watershed.
    - Student projects for high schools or college, boy scouts/girl scouts top service project, etc.
    - Implement demonstration projects, or highlight existing case studies within the watershed that promote the benefits of watershed protection and best management practices.

Goal E: Improve and monitor surface water quality.

Objectives:

1) Stabilize 8,960 linear feet of highly eroded streambank using bioengineering techniques.
2) Stabilize 1,000 linear feet of eroded shoreline at five Lake in the Hills owned parks along Woods Creek Lake using bioengineering techniques.
3) Restore 50 acres of wetland within "Critical Area" potential wetland restoration sites.
4) Install natural shoreline buffers along private residential lots around Woods Creek Lake.
5) Complete mercury analysis/management study for Woods Creek Lake.
6) Use best management practices when applying road salt during winter months.
7) Manage overuse of phosphorus based on soil testing recommendations and Illinois Phosphorus Law.
8) Retrofit all "Critical Area" and "High Priority" detention basins with native vegetation.
9) Implement the Water Quality Monitoring Plan section of the Woods Creek Watershed-Based Plan.

Goal F: Improve groundwater recharge.

Objectives:

1) Implement model policies included in county "Groundwater Protection Action Plans" for Sensitive Aquifer Recharge Areas (SARS) where development or re-development is planned.

Goal G: Increase and/or improve recreational opportunities.
Objectives:
1) Create bike path/trails connections between and within communities to increase public use thereby increasing people's understanding of the watershed and its features via information signage.
2) Locate and improve fishing access to Woods Creek and appropriate detention basins.
3) Use new recreational areas, or enhancement of existing recreational amenities, as a means to protect green infrastructure and facilitate other watershed protection goals.

Goal H: Mitigate for existing structural flood problems.
Objectives:
1) Continue to inspect the integrity of the dam at Woods Creek Lake annually.
2) Reconnect channelized stream reaches WCR2, WCR3, WCR5, WCR10, WCR11 and TRA1 to floodplain where feasible.
3) Implement impervious reduction stormwater measures as development occurs within Subwatershed Management Units 14, 16, and 17 that are ranked as "Highly Vulnerable" to future development and associated impervious cover.
4) Mitigate for identified structural flood problem areas on a case by case basis where feasible.

3.0 WATERSHED CHARACTERISTICS, PROBLEMS, AND OPPORTUNITIES

3.1 Geology, Climate, & Soils

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 Illinoian 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 event known as the Wisconsin 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 glaciers 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.

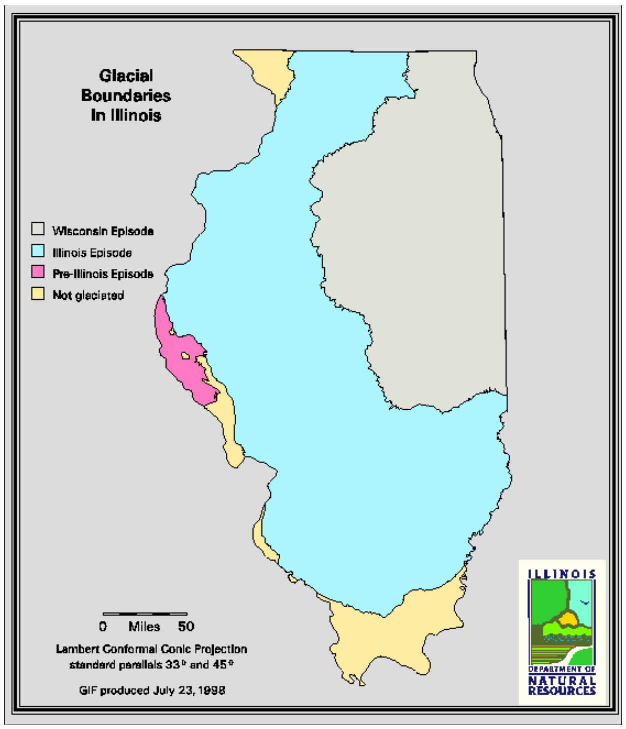


Figure 3. Glacial boundaries in Illinois.

The nearby Fox River was formed at the end of the Wisconsin glaciation as a stream at the edge of the Valparaiso Moraine system and an older moraine to the west. Woods Creek watershed is part of this Valparaiso Moraine system, which created the picturesque rolling hills and valleys found there today (Hansel 2005). The composition of the soil in Woods Creek watershed is also a remnant of that ancient ice movement. Above the bedrock lies a layer of deposits left behind from the glaciers, consisting of clay, silt, sand, and gravel (Hansel 2005).

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. Lake Michigan does influence the study area to some degree but not as much as areas immediately adjacent, south, and east of the lake where it reduces the heat of summer and buffers (warms) the cold of winter. 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 National Climatic Data Center (NCDC) provides an excellent summary of climate statistics including normals and extremes for sites in Illinois that were selected based on length of record and completeness of data. The NCDC has compiled average temperature and precipitation data from the past 30 years and daily extremes since 1923. Data collected in nearby Barrington, Illinois best represents the climate and weather patterns experienced in Woods Creek watershed. The winter months are cold, averaging 22° F, winter lows average 14° F. The coldest temperature on record is -16° F recorded on January 11, 1979. Summers are warm, averaging 70° F, summer highs average 80° F. The highest recorded temperature, 103° F occurred in July 2000.

Fairly typical for the Midwest, the current climate of Woods Creek watershed consists of an average rainfall of 36 inches and average snowfall of 33 inches. According to data collected in nearby Barrington, the most precipitation received in one month is 13.20 inches. This occurred in August 2007, breaking the previous record of 9.63 inches which occurred in September of 1986. The least amount of precipitation received in one month (0.0 inches) occurred in February of 1990. The one-day maximum precipitation (4.17 inches) occurred on September 23, 1986.

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 wetland, woodland, and prairie vegetation. The most up to date soils mapping provided by the USDA Natural Resources Conservation Service (NRCS) was used to summarize the extent of soil types, hydric soils, soil erodibility, and hydrologic soil groups within the Woods Creek watershed (Table 3; Figure 4).

Hydric Soils

Wetland or "Hydric Soils" 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 Woods 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. Where it was feasible wet areas were drained, streams channelized, and savanna and prairie cleared to farm the rich soils.

Historically there were approximately 1,479 acres of wetlands in the watershed. According to existing wetland inventories, 423.3 acres or 28.6% of the pre-European settlement wetlands remain. The location of hydric soils, existing wetlands, and wetland restoration opportunities in the watershed are discussed in detail in Section 3.11. Table 3 lists the various soil types in the watershed and includes columns summarizing hydric status and acreage in the watershed. Figure 4 maps the various soil types in the watershed.

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. Elevated TSS levels and sedimentation are problems in several stream reaches in the watershed (see Section 3.11).

Table 3 includes a list of the soil types in the watershed with a column indicating soil susceptibility to erosion based on a selection of particular attributes such as soil type and the percent slope on which a soil is located. The majority of erodible soils are included in the Varna (2,026 acres) soil type. Most of the highly erodible soils in the watershed are located in upland areas and are currently stabilized by existing land uses/cover. Several stream channels associated with erodible soils are problematic and documented in this plan (see Section 3.11). Streambank and channel restoration will be extremely important in the future to control erosion to downstream waterbodies.

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 to estimate 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 importantly however is the link between hydrologic soil groups and groundwater recharge areas. Groundwater recharge is discussed in detail in Section 3.12.

HSG's are classified into four primary categories; A, B, C, and D, and three dual classes, A/D, B/D, and C/D. The HSG categories and their corresponding soil texture, drainage description, runoff potential, infiltration rate, and transmission rate are shown in Table 2. Table 3 includes a list of the soil types in the watershed with a column indicating the soil's hydrologic group.

Poorly drained areas (Hydrologic Groups C, C/D and D) account for 2,956 acres or 54% of the watershed. Excessively and moderately drained (Hydrologic Group A, A/D, B, and B/D) areas make up an additional 2,422 acres or 44% of the watershed. The remaining 127 acres (2% of watershed) soil have unknown hydrologic groups because they are associated with water or gravel pits.

Table 2. 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 3. Soil series including hydric status, hydrologic soil group, erodible status, acres, & percent of watershed.

Soil Series (Type)	Soil Unit	Hydric Rating	Hydrologic Group	Highly Erodible (Y/N)	% Slope Range	Total Area (acres)	% of Watershed
Ashkum	232	All Hydric	B/D	No	0-2%	620.0	11.3%
Beecher	298	Not Hydric	C	No	2-4%	9.5	0.2%
Birkbeck	233	Not Hydric	B	Yes	5-10%	5.1	0.1%
Brenton	149	Not Hydric	B	No	0-2%	43.3	0.8%
Casco	323	Not Hydric	B	Yes	4-6%	0.1	0.0%
Casco-Rodman	969	Not Hydric	B	Yes	12-30%	43.1	0.8%
Clare	663	Not Hydric	B	No	0-5%	35.4	0.6%
Comfrey	877	All Hydric	B/D	No	0-2%	22.9	0.4%
Dakota	379	Not Hydric	B	No	2-4%	10.0	0.2%
Danabrook	512	Not Hydric	B	No	0-5%	7.7	0.1%
Dickinson	87B	Not Hydric	B	No	0-5%	84.6	1.5%
Drummer	152	All Hydric	B/D	No	0-2%	48.5	0.9%
Dunham	523	All Hydric	B/D	No	0-2%	68.5	1.2%
Elliott	146	Not Hydric	C	No	0-4%	890.8	16.2%
Elpaso	356	All Hydric	B/D	No	0-2%	1.8	0.0%
Fox	327	Not Hydric	B	No	2-4%	3.8	0.1%
Griswold	363	Not Hydric	B	Yes	6-12%	2.2	0.0%
Grundelein	526	Not Hydric	B	No	0-2%	27.4	0.5%
Harpster	67A	All Hydric	B/D	No	0-2%	98.0	1.8%
Harvard	344	Not Hydric	B	Yes	2-10%	9.5	0.2%
Hoopeston	172	Not Hydric	B	No	0-2%	7.2	0.1%
Hooppole	488	All Hydric	B/D	No	0-2%	27.2	0.5%
Houghton	110	All Hydric	A/D	No	0-2%	143.0	2.6%
Kane	343	Not Hydric	B	No	0-2%	13.7	0.2%
Kidami	527	Not Hydric	B	Yes	2-12%	64.7	0.6%
Kish	626	All Hydric	B	No	0-2%	250.6	4.6%
La Rose	60C	Not Hydric	B	Yes	5-18%	82.3	1.5%
Lahoguess	528	Not Hydric	B	No	0-2%	23.1	0.4%
Lena	121	All Hydric	A/D	No	0-2%	91.7	1.7%
Lisbon	59A	Not Hydric	B	No	0-2%	25.4	0.5%
Lorenzo	318	Not Hydric	B	Yes	2-12%	128.8	2.3%
Markham	531	Not Hydric	C	Yes	4-6%	1.5	0.0%
Millington	808	All Hydric	B/D	No	0-2%	50.6	0.9%
Mundelein	442	Not Hydric	B	No	0-2%	37.5	0.7%
Octagon	656	Not Hydric	B	Yes	4-6%	20.1	0.4%
Orthents	802	Not Hydric	B	No	undulating	4.9	0.1%
Ozaukee	530	Not Hydric	C	Yes	4-20%	19.1	0.3%
Palms	100	All Hydric	A/D	No	0-2%	0.0	0.0%

Soil Series (Type)	Soil Unit	Hydric Rating	Hydrologic Group	Highly Erodible (Y/N)	% Slope Range	Total Area (acres)	% of Watershed
Parr	221	Not Hydric	B	Yes	2-10%	24.9	0.5%
Pella	153	All Hydric	B/D	No	0-2%	6.6	0.1%
Peotone	133	All Hydric	B/D	No	0-2%	14.9	0.3%
Gravel Pit	865	Unknown Hydric		No	-	52.2	0.9%
Proctor	148	Not Hydric	B	No	2-5%	1.6	0.0%
Ringwood	297	Not Hydric	B	No	0-4%	42.8	0.8%
Selmass	529	All Hydric	B/D	No	0-2%	18.3	0.3%
Senachwine	618	Not Hydric	B	Yes	12-30%	82.0	1.5%
Thorp	206	All Hydric	C	No	0-2%	9.8	0.2%
Troxel	197	Not Hydric	B	No	0-2%	4.3	0.1%
Varna	223	Not Hydric	C	Yes	2-12%	2025.9	36.8%
Warsaw	290	Not Hydric	B	Yes	0-6%	71.2	1.3%
Water	W	Unknown Hydric		No	-	75.0	1.4%
Waupecan	369	Not Hydric	B	No	0-4%	43.3	0.8%
Will	329	All Hydric	B/D	No	0-2%	6.6	0.1%
Zurich	696	Not Hydric	B	No	2-4%	2.4	0.0%
Totals						**5,508**	**100%**

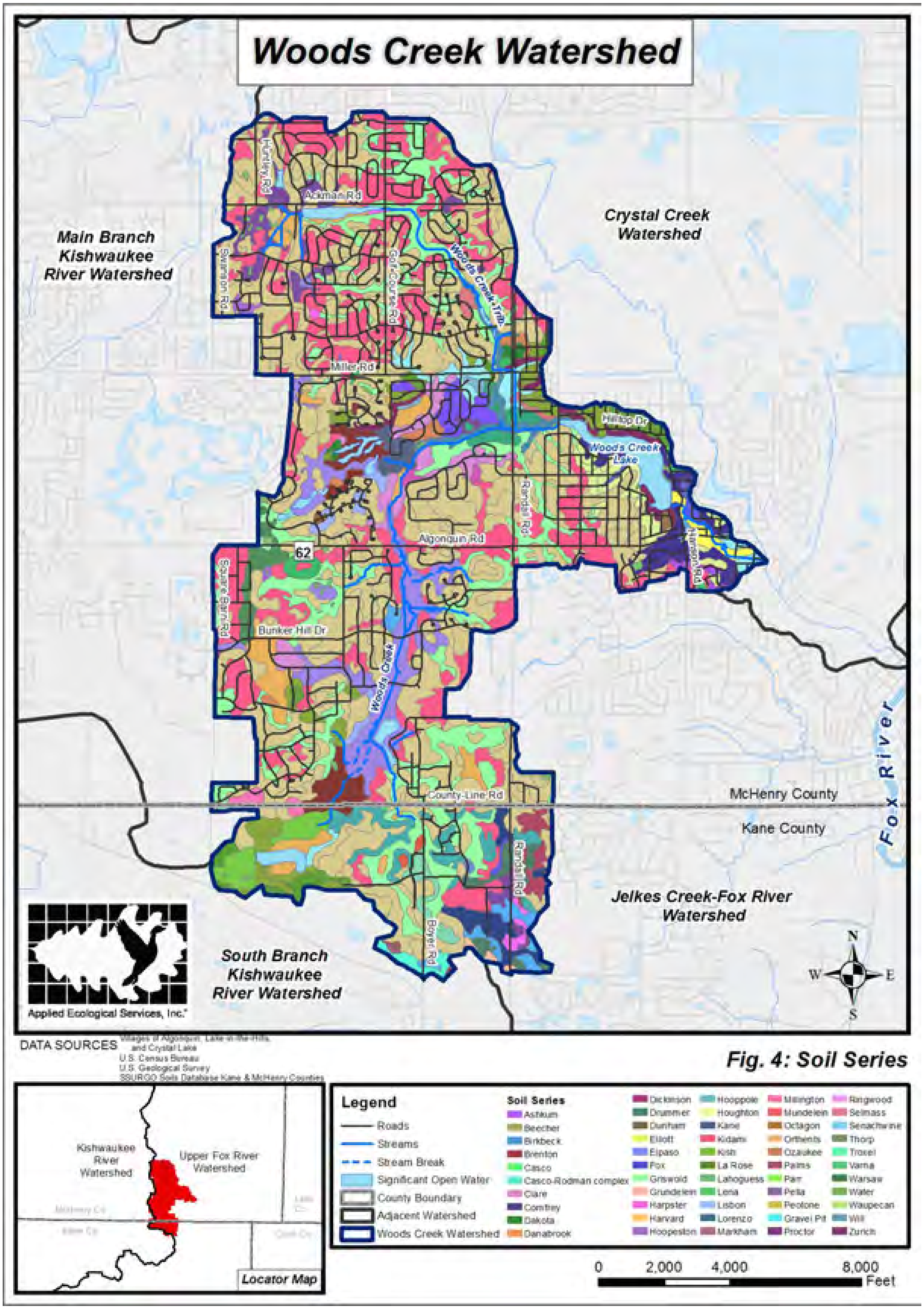


Fig. 4: Soil Series

3.2 Pre-European Settlement Ecological Communities & Changes

An ecological community is made up of all living things in a particular ecosystem and is usually named by its dominant vegetation type. 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 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, and wetlands prior to European settlement in the 1830s.

Pre-European settlement prairie landscape at nearby LITH Fen

The surveyors described nearly the entire Woods Creek watershed as "Prairie". One island of "Timber" was identified along Woods Creek on the far east side of the watershed (Figure 5). This mixture of "Prairie" and "Timber" 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". 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, wet prairie and highly unique seeps, springs, and fen wetlands hydrated by alkaline rich groundwater discharge.

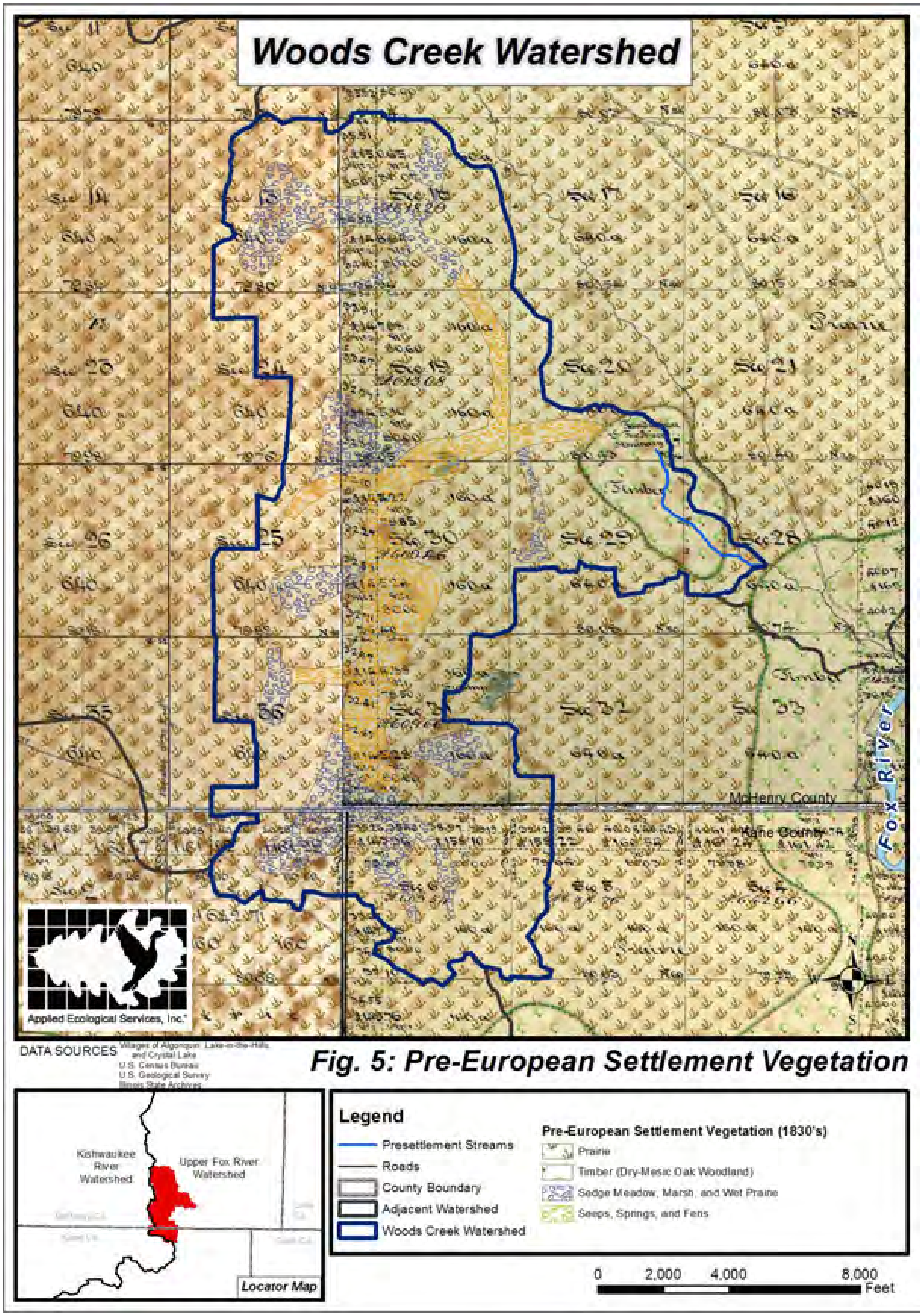
Pre-European settlement savanna

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. Infiltration and absorption of water was so great that most of the defined stream channels seen today were wetland complexes of sedge meadow, marsh, springs, seeps, and fens. In fact, records from the *History of McHenry County,* *Illinois* (1922) do not show Woods Creek as a stream south of Algonquin Road but rather as a large wetland complex of springs, seeps, and fen wetlands.

European settlement resulted in drastic changes to the fragile ecological communities. Fires no longer occurred, prairie was tilled under for farmland or developed, wetlands were drained, and many stream reaches were channelized. The earliest aerial photographs taken in 1939 (Figure 6) depict Woods Creek watershed when row crop farming was the primary land use but before residential and commercial development seen today. Much of the oak trees described in the eastern portion of the watershed were still present around Woods Creek Lake in 1939. However, the dam created in 1923 to form Woods Creek Lake as private recreational area appears to have flooded much of the area. Farmland can clearly be seen throughout the watershed. With the advent of farming came significant changes in stormwater runoff. By 1939 defined stream channels had formed through the historic wetland communities.

Figure 7 shows a 2011 aerial image of Woods Creek watershed. Residential development now dominates the watershed. Retail and commercial development is also common along Randall Road. Two 18-hole golf courses occupy area in the western portion of the watershed that were once wetland. And, a gravel quarry and some farmland remain in the southern portion of the watershed. Also apparent on the 2011 image is a relatively intact green infrastructure corridor along Woods Creek and Woods Creek Tributary that was preserved during the development process. Although generally degraded, this corridor contains most of the remaining ecological communities in the watershed. And, the oak savanna on the east side of the watershed is now dominated by residential homes. Unfortunately, oak regeneration is no longer occurring and the oak community may be lost forever without drastic intervention.

With degraded ecological conditions comes the opportunity to implement ecological restoration to improve the condition of Woods 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.


Woods Creek Watershed
Applied Ecological Services, Inc.
DATA SOURCES
Fig. 5: Pre-European Settlement Vegetation
Legend
Presettlement Streams
Roads
County Boundary
Adjacent Watershed
Woods Creek Watershed
Pre-European Settlement Vegetation (1830's)
Prairie
Timber (Dry-Mesic Oak Woodland)
Sedge Meadow, Marsh, and Wet Prairie
Seeps, Springs, and Fens
Kishwaukee River Watershed
Upper Fox River Watershed
Locator Map
McHenry County
Kane County
Fox River
0
2,000
4,000
8,000
Feet

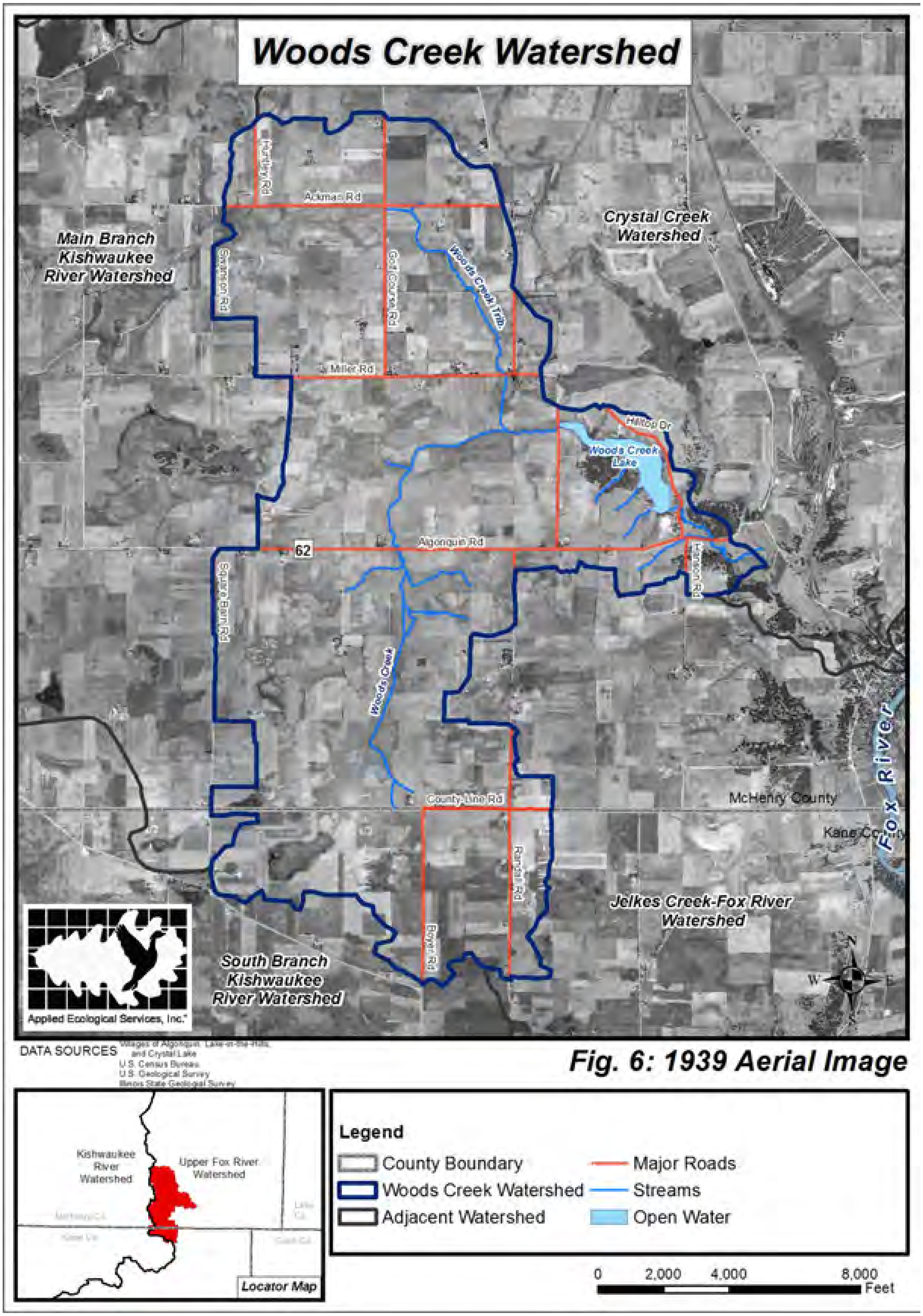


Fig. 6: 1939 Aerial Image

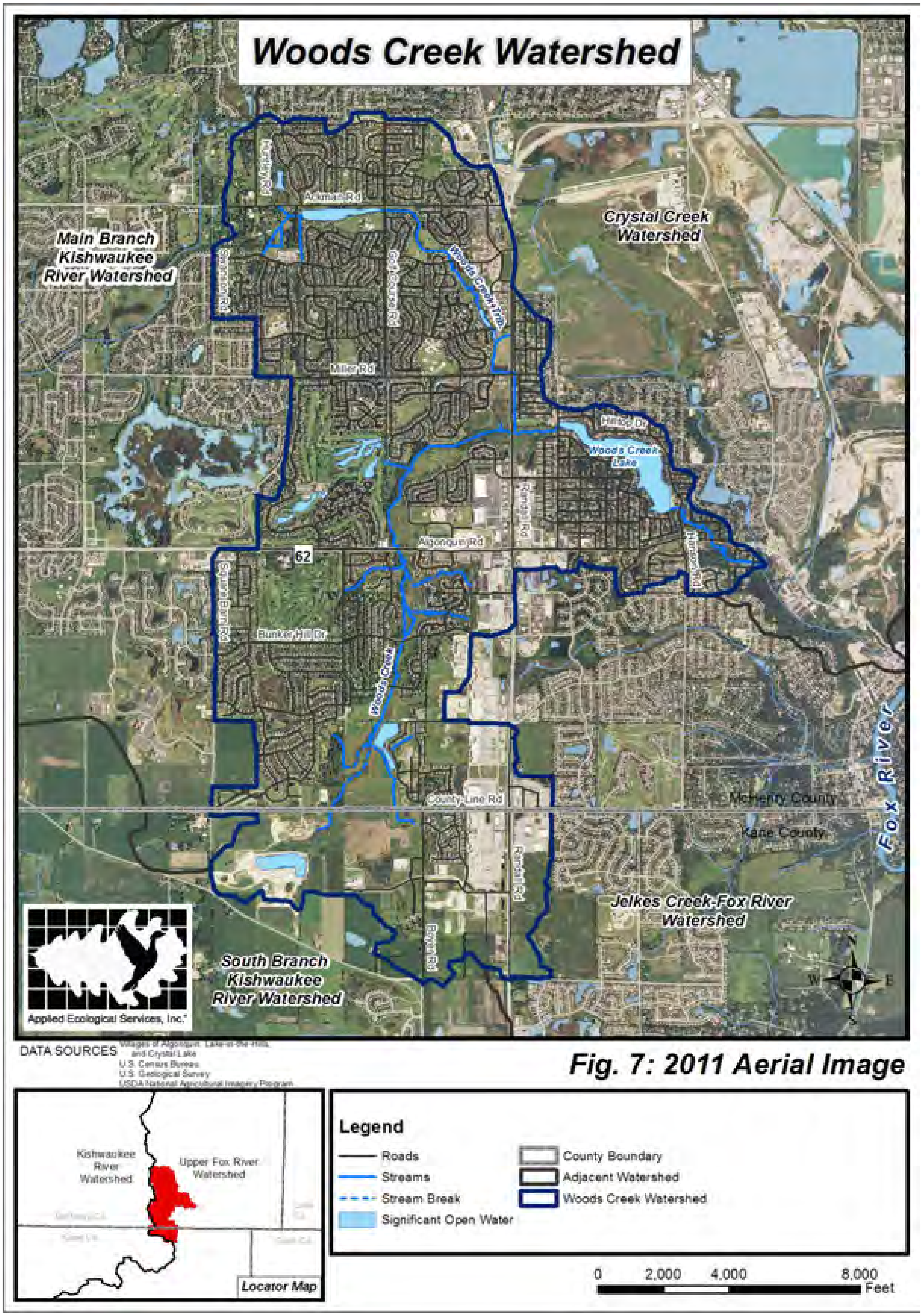


Fig. 7: 2011 Aerial Image

3.3 Topography, Watershed Boundary, & Subwatershed Management Units

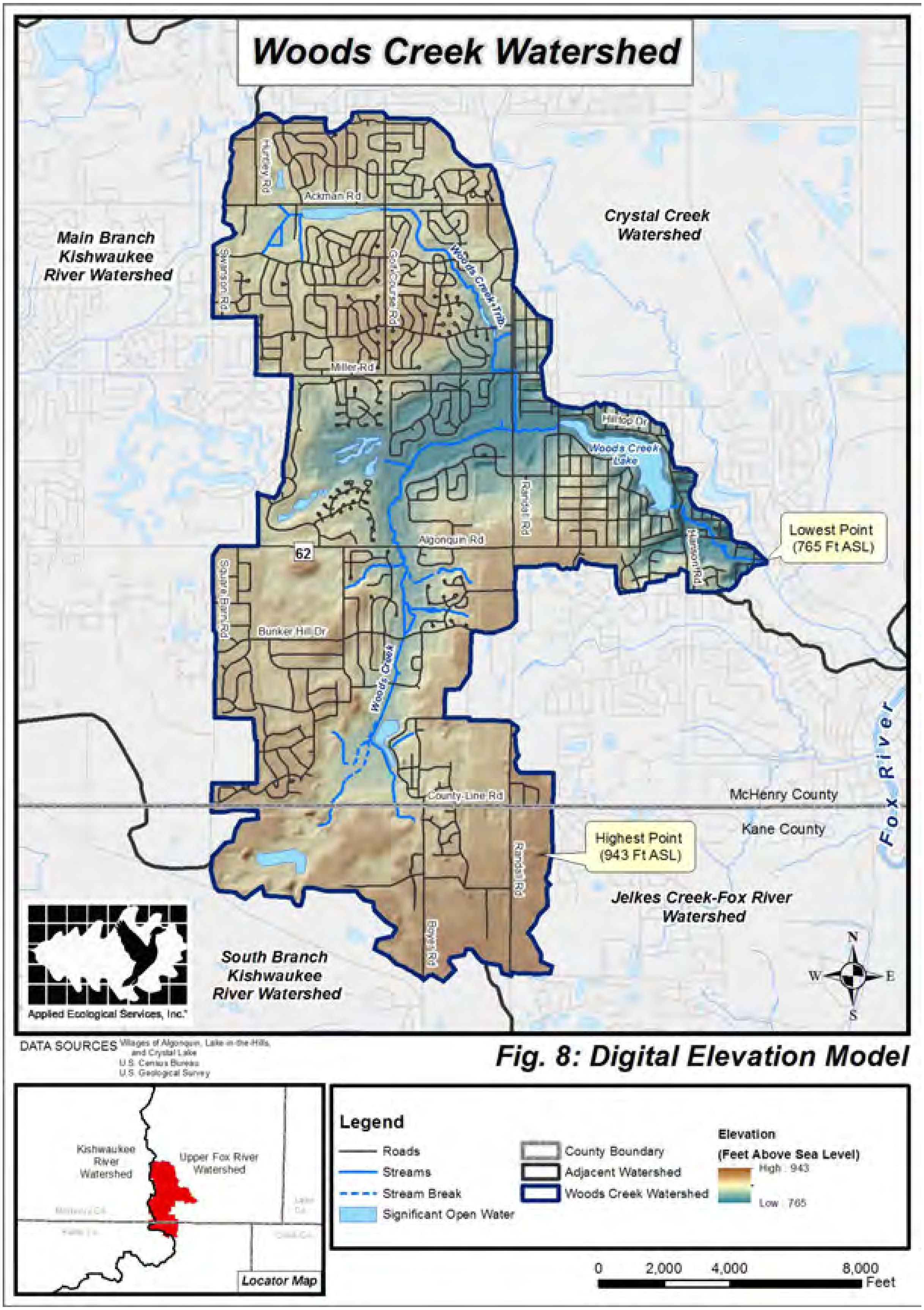
Topography & Watershed Boundary

The Wisconsin glacier that retreated 14,000 years ago formed the topography and defined the Woods Creek watershed boundary. Topography refers to elevations of a landscape that describe the configuration of its surface and ultimately defines watershed boundaries. And, the specifics of watershed planning can not begin until a watershed boundary is clearly defined.

The Woods Creek watershed boundary was updated in 2011 for this study using the most up-to-date 2-foot topography data from McHenry and Kane Counties. Available stormsewer data provided by Algonquin, Lake in the Hills, and Crystal Lake was also used to refine the boundary. The refined watershed boundary was then input into a GIS model (Arc Hydro) that generated a Digital Elevation Model (DEM) of the watershed (Figure 8). Woods Creek watershed is 5,507 acres or 8.6 square miles in size.

Rolling topography viewed from Spella Sled Hill in Algonquin.

The Woods Creek watershed generally drains from west to east before entering Crystal Creek and eventually the Fox River within the municipality of Algonquin. The highest point in the watershed (943 feet above sea level) is found in the far southeast corner of the watershed. As expected, the lowest point (765 feet above sea level) is found where Woods Creek enters Crystal Creek. The difference in the highest and lowest points reflects a 178 foot change in elevation. The DEM (Figure 8) depicts the rolling topography of the land south of Miller Road (10-20% slopes) while most of the land north of Miller Road is relatively flat (0-5% slopes). Depressional areas can be seen along stream reaches. The DEM also shows the flat landscape along Randall Road resulting from mass grading to build retail stores.


Woods Creek Watershed
Main Branch Kishwaukee River Watershed
Crystal Creek Watershed
Ackman Rd
Miller Rd
Hilltop Dr
Woods Creek Lake
Algonquin Rd
62
Bunker Hill Dr
Woods Creek
Woods Creek Trib.
County Line Rd
Lowest Point (765 Ft ASL)
Highest Point (943 Ft ASL)
McHenry County
Kane County
Fox River
Jelkes Creek-Fox River Watershed
South Branch Kishwaukee River Watershed
Applied Ecological Services, Inc.
DATA SOURCES
Fig. 8: Digital Elevation Model
Kishwaukee River Watershed
Upper Fox River Watershed
Locator Map
Legend
Roads
Streams
Stream Break
Significant Open Water
County Boundary
Adjacent Watershed
Woods Creek Watershed
Elevation
(Feet Above Sea Level)
High : 943
Low : 765
0
2,000
4,000
8,000
Feet

Subwatershed Management Units (SMUs)

The Center for Watershed Protection (CWP) is a leading watershed planning agency and has defined appropriate watershed and subwatershed sizes to meet watershed management 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. Because Woods Creek watershed is only 8.6 square miles, this plan allows for a detailed look at watershed characteristics and problem areas. However, an even more detailed look at smaller drainage areas must be completed to find site specific problem areas or "Critical Areas" that require immediate attention.

To address issues at a small scale, a watershed can be divided into subwatersheds called Subwatershed Management Units (SMUs). Woods Creek watershed contains 17 SMUs as delineated using a combination of the Digital Elevation Model (DEM) and available stormwsewer data from municipalities. 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 4 presents each SMU and size within the watershed. Figure 9 depicts the location of each SMU boundary delineated within the larger Woods Creek watershed.

Table 4. Subwatershed Management Units and size.

SMU #	Total Acres	Total Square Miles
SMU 1	214.6	0.3
SMU 2	446.1	0.7
SMU 3	665.8	1.0
SMU 4	478.6	0.7
SMU 5	305.5	0.5
SMU 6	373.1	0.6
SMU 7	527.1	0.8
SMU 8	207.6	0.3
SMU 9	384.6	0.6
SMU 10	105.8	0.2
SMU 11	62.5	0.1
SMU 12	221.9	0.3
SMU 13	116.3	0.2
SMU 14	129.2	0.2
SMU 15	196.1	0.3
SMU 16	798.3	1.2
SMU 17	274.1	0.4
Totals	**5,507**	**8.6**

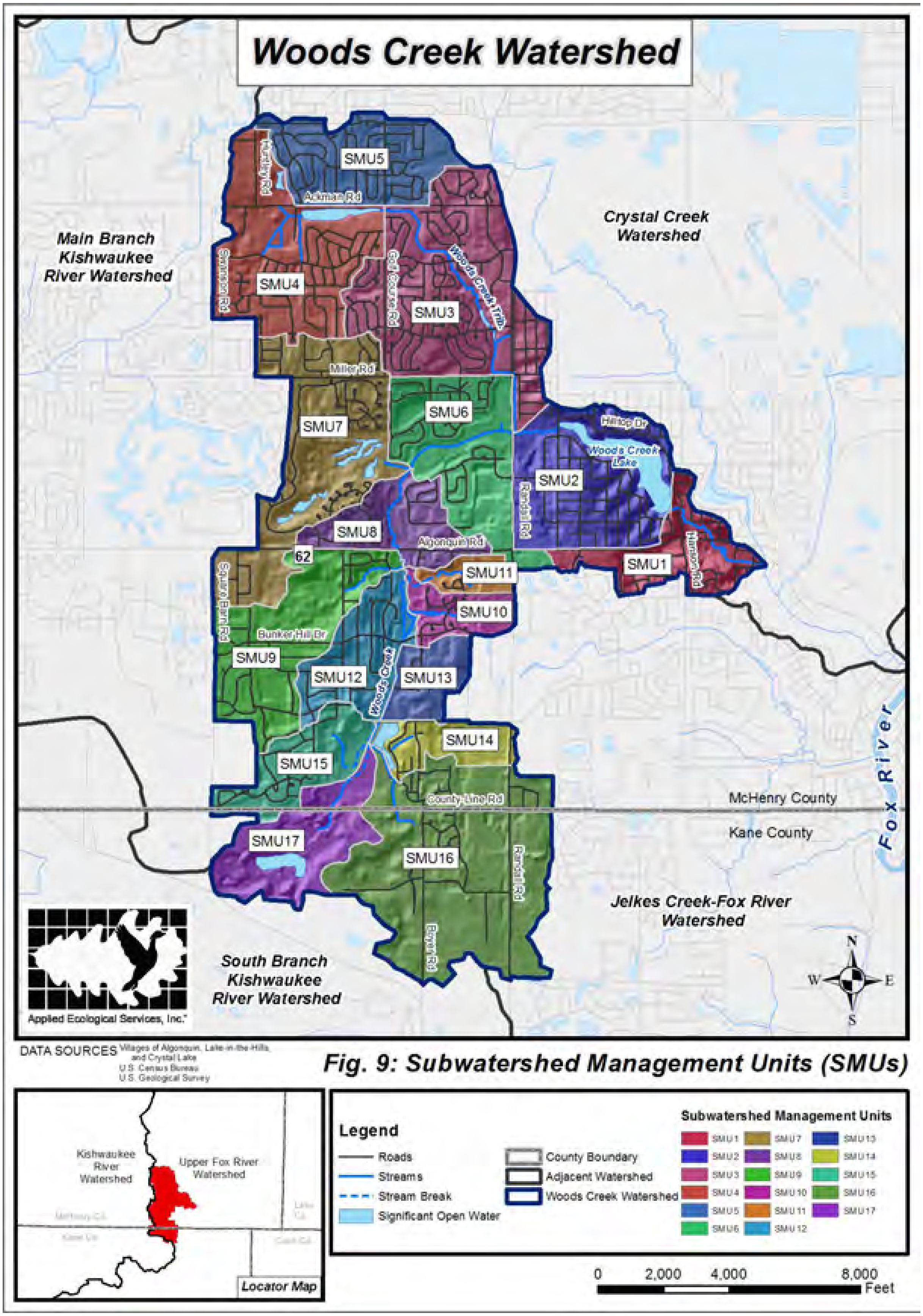


Fig. 9: Subwatershed Management Units (SMUs)

3.4 Jurisdictions, Roles & Responsibilities

Woods Creek watershed is located in two counties, portions of four townships/unincorporated areas, and four municipalities (Table 5, Figure 10). Most of the watershed is located in McHenry County (4,639 acres/84%); the southern tip is located in Kane County (868 acres/16%). Municipalities comprise 90% of the watershed area. The municipality of Algonquin occupies 2,113 acres/38% of the watershed south of Algonquin Road (Route 62). Lake in the Hills occupies 1,461 acres/27% in the central portion of the watershed between Algonquin Road and Miller Road. Crystal Lake occupies 1,350 acres/25% north of Miller Road. Only 10 acres of Lakewood is located in the far northwest portion of the watershed. The remaining 10% of the watershed falls within unincorporated areas in Algonquin Township (59 acres/1%), Dundee Township (158 acres/3%), Grafton Township (136 acres/2%) and Rutland Township (221 acres/4%). The Crystal Lake Park District also has 162 acres of holdings in several parks within the city of Crystal Lake. In addition, there are no Drainage Districts in the watershed.

Table 5. County, township, unincorporated, and municipal jurisdictions.

Jurisdiction	Acres	% of Watershed
County	**5,508**	**100%**
Kane	868	16%
McHenry	4,639	84%
Township	**5,508**	**100%**
Algonquin Township	3,136	57%
Dundee Township	645	12%
Grafton Township	1,503	27%
Rutland Township	223	4%
Unincorporated Areas	**573**	**10%**
Unincorporated Algonquin Twp.	59	1%
Unincorporated Dundee Twp.	158	3%
Unincorporated Grafton Twp.	136	2%
Unincorporated Rutland Twp.	221	4%
Municipalities	**4,934**	**90%**
Algonquin	2,113	38%
Crystal Lake	1,350	25%
Lake in the Hills	1,461	27%
Lakewood	10	<1%
Park Districts	**162**	**3%**
Crystal Lake Park District	162	3%

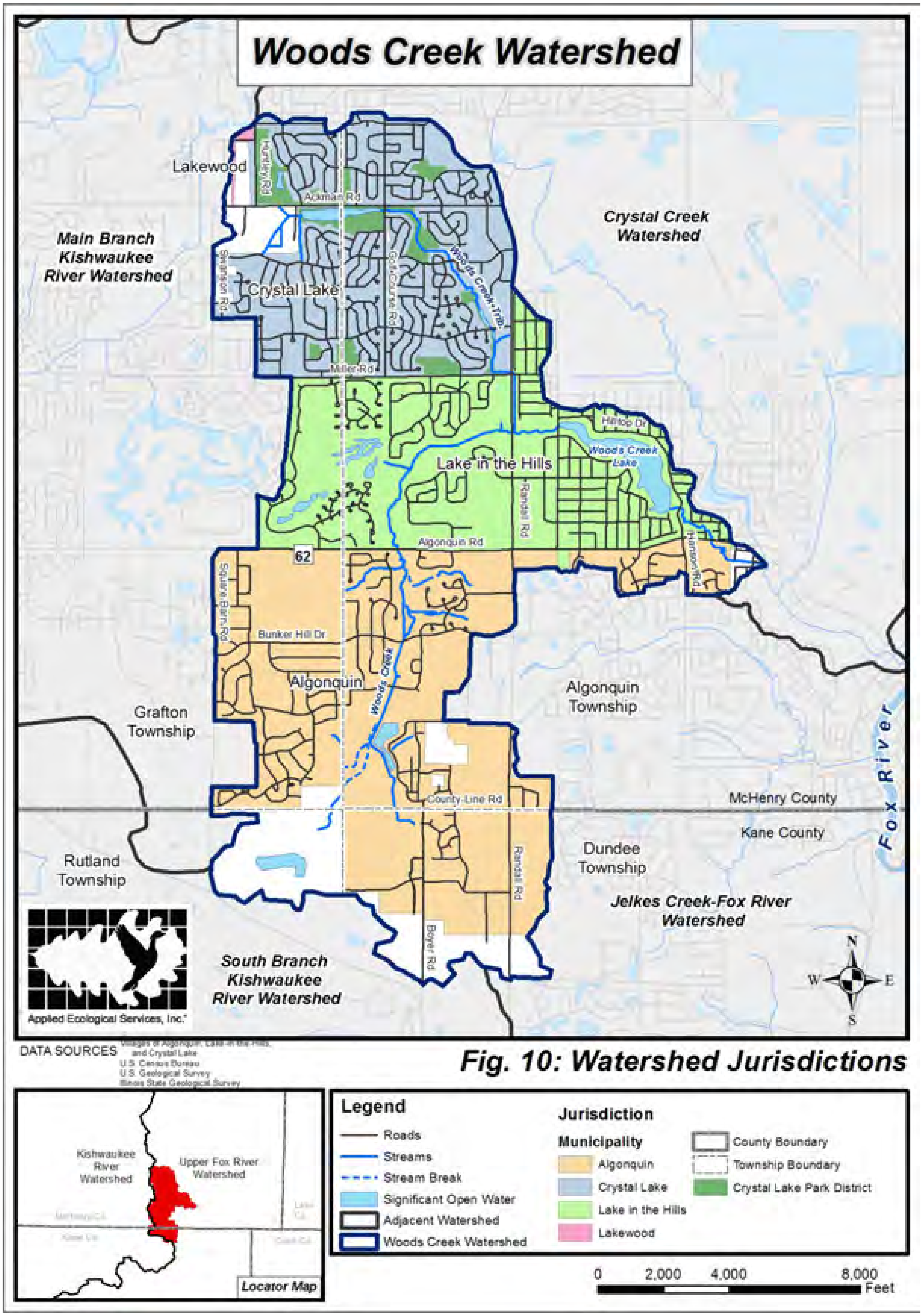


Fig. 10: Watershed Jurisdictions

Jurisdictional Roles and Responsibilities

Many types of natural resources throughout the United States are protected to some degree under federal, state, and/or local law. In the Chicagoland region, the U.S. Army Corps of Engineers (USACE) and surrounding counties regulate wetlands through Section 404 of the Clean Water Act and county Stormwater Ordinances respectively. 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 codes that address other natural resource issues. The Illinois EPA Bureau of Water regulates wastewater and stormwater discharges to streams and lakes. Watershed protection in McHenry and Kane Counties is primarily the responsibility of county and city level government.

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 connected to navigable waters. The USACE primarily regulates filling activities and requires buffers or wetland mitigation for developments that impact jurisdictional wetlands.

Land development in each county is regulated by Stormwater Ordinances including the McHenry County Stormwater Management Ordinance (amended March 15, 2011) and Kane County Stormwater Ordinance (amended January 1, 2005). These ordinances are enforced by county agencies or by "Certified Communities". All of the municipalities in the watershed are certified. Crystal Lake, Lake in the Hills, and Lakewood are certified in McHenry County and Algonquin is certified in Kane County.

Water resources located on unincorporated land within McHenry and Kane Counties are ultimately regulated by the McHenry County Department of Planning and Development and Water Resources Division of the Kane County Development & Resource Management Department. Unincorporated areas include 59 acres in Algonquin Township, 158 acres in Dundee Township, 136 acres in Grafton Township, and 221 acres in Rutland Township. Development affecting water resources in these townships must be reviewed by the respective agencies listed above. It is important to note that McHenry County passed the "Conservation Design Standards and Procedures" in February 2008. However, this will likely not affect future development that is primarily planned for the southern portion of the watershed in Kane County.

Other governments and private entities with watershed jurisdictional or technical advisory roles include the USFWS and IDNR, County Board Districts, and the McHenry and Kane 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.

Municipalities in the watershed may or may not 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 natural landscaping.

The Village of Algonquin currently provides extra protection of Woods Creek watershed south of Algonquin Road under the "Algonquin Zoning Ordinance" (adopted April 1, 2003). This ordinance contains the "Woods Creek Watershed Protection Overlay District" which promotes preservation, protection, and enhancement of the natural areas associated with Woods Creek by requiring specific development practices, site design, structural requirements, and watershed protection fees. The Village plans to use the watershed plan to update the existing zoning language. Other municipalities in the watershed are encouraged to do the same.

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 stormsewer 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 stormsewer 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) including; 1) Develop a stormwater management program comprised of BMPs and measurable goals for at least 6 control measures such as public education and pollution prevention; 2) Submit a completed Notice of Intent (NOI) to share Phase II requirement with other municipalities; and 3) Submit an annual report to Illinois EPA reporting on the status of the implemented programs.

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 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.

3.5 Demographics

The Chicago Metropolitan Agency for Planning (CMAP) provides a 2040 regional framework plan for the greater Chicagoland area to plan more effectively with growth forecasts. CMAP's 2010 to 2040 forecasts of population, households, and employment was used to project how these attributes will impact Woods Creek watershed (Table 6). 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. The data is generated by Township, Range, and quarter Section and is depicted on Figures 11-12. It is also important to note that much of CMAP's work was done prior the economic downturn and may not be accurately reflected. Note: Applied Ecological Services, Inc. (AES) used GIS to overlay the Woods Creek watershed boundary onto CMAP's quarter Section data. If any part of a quarter Section fell inside the watershed boundary, the statistics for the entire quarter Section were included.

The combined population of the watershed is expected to increase from 42,407 in 2010 to 59,943 by 2040, a 40% increase. Household change follows this trend and is predicted to increase from 13,857 to 19,346 (40% increase). The highest population and household increase is expected just north of the McHenry-Kane County border where multifamily and medium density single family residential development is already occurring or is planned to occur. Other population and household increases are predicted in existing multifamily residential complexes located behind commercial development on the west side of Randall Road, proposed mixed use development in the far southeast corner of the watershed, and additional building in a relatively new residential subdivision in the far northwest corner of the watershed. CMAP does not predict substantial population and household increase in the southwest corner of the watershed where a gravel quarry and agricultural fields now reside. However, mixed use commercial, retail, and residential development is expected in this area. Employment change is predicted to increase from 6,205 jobs in 2010 to 16,001 by 2040, a 158% increase. Almost all employment change is predicted in the southern portion of the watershed along Randall Road and south of the McHenry-Kane County border where mixed commercial-retail development is expected.

Table 6. CMAP 2010 data and 2040 forecast data.

Data Category	2010	2040	Change (2010-2040)	Percent Change
Population	42,407	59,943	14,536	+41.4%
Household	13,857	19,346	5,489	+39.6%
Employment	6,205	16,001	9,796	+158.9%

Source: Chicago Metropolitan Agency for Planning 2040 Forecasts

Socioeconomic Status

The portions of Algonquin, Crystal Lake, and Lake in the Hills within Woods Creek watershed can best be described as actively growing with a vibrant community spirit. These "satellite" suburbs of the Chicago region offer excellent amenities such as parks, shopping, nature preserves, quality schools and libraries, safe neighborhoods, and are in close proximity to commuter rail and tollway access. A 2010 U.S. Census Bureau profile report of the area comprising Woods Creek watershed revealed a mostly white population (>90%) with a median household income over $85,000. In addition, approximately 90% of housing units are owner occupied, over 40% of residents aged 25+ hold a bachelor's degree or higher, and over 73% of the employed population work in white collar/professional jobs.

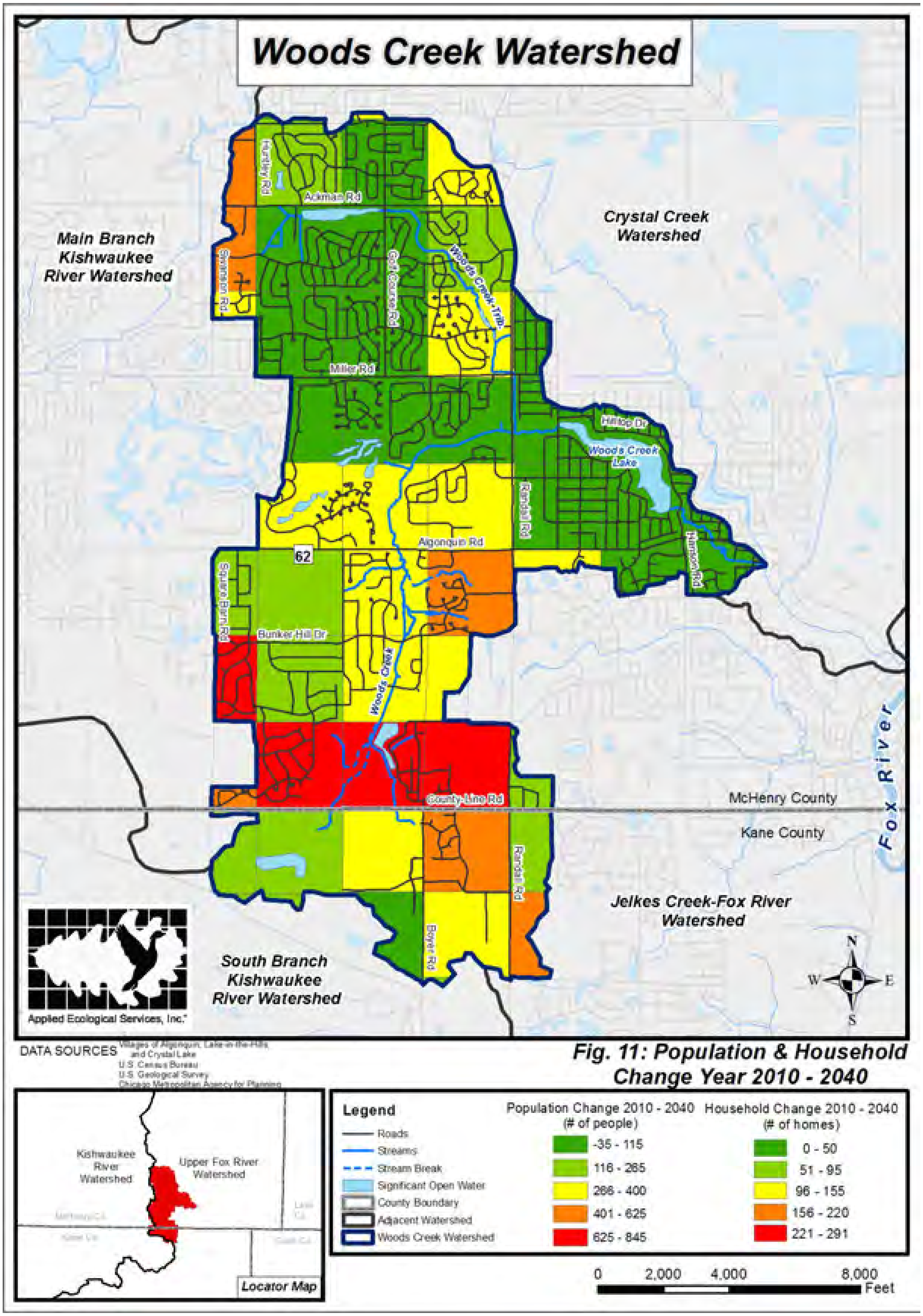
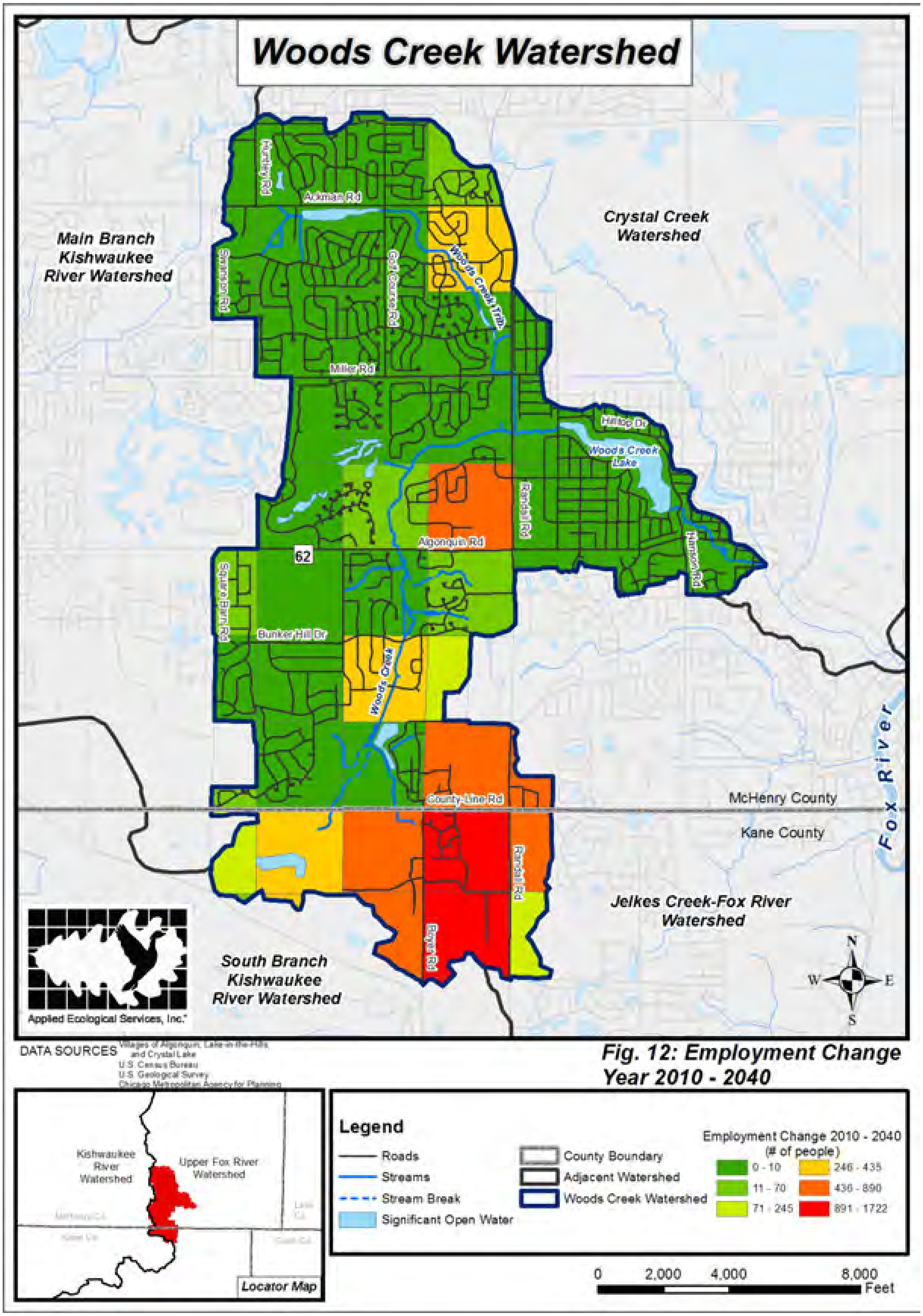


Fig. 11: Population & Household Change Year 2010 - 2040


Woods Creek Watershed
Main Branch Kishwaukee River Watershed
Crystal Creek Watershed
Jelkes Creek-Fox River Watershed
South Branch Kishwaukee River Watershed
Ackman Rd
Swanson Rd
Golf Course Rd
Woods Creek Trib.
Miller Rd
Hilltop Dr
Wood's Creek Lake
Randall Rd
Algonquin Rd
Harrison Rd
62
Square Barn Rd
Bunker Hill Dr
Woods Creek
County Line Rd
Boyer Rd
McHenry County
Kane County
Fox River
N
W
E
S
Applied Ecological Services, Inc.
DATA SOURCES
U.S. Census Bureau
U.S. Geological Survey
Fig. 12: Employment Change Year 2010 - 2040
Kishwaukee River Watershed
Upper Fox River Watershed
Locator Map
Legend
Roads
Streams
Stream Break
Significant Open Water
County Boundary
Adjacent Watershed
Woods Creek Watershed
Employment Change 2010 - 2040 (# of people)
0 - 10
11 - 70
71 - 245
246 - 435
436 - 890
891 - 1722
0
2,000
4,000
8,000
Feet

3.6 Existing & Future Land Use/Land Cover

2012 Land Use/Land Cover

Highly accurate land use/land cover data was produced for Woods Creek watershed using several processes. First, the most recent land use/land cover data from the municipalities of Crystal Lake, Lake in the Hills, and Algonquin was obtained and mapped in GIS. Next, 2011 USDA aerial photography of the watershed was overlaid on municipal data so that discrepancies could be corrected. Finally, uncertainties in land uses and cover types were field verified and corrected if needed to produce the 2012 land use/land cover data and map for Woods Creek watershed (Table 7; Figure 13).

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 agricultural processing. 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.).

Construction-Residential: Scraped earth/construction activity indicating construction of residential land use.

Golf Course: Public or private golf courses, country clubs and driving ranges; including associated buildings and parking.

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

Medium & Low Density Residential: Land use that includes single family homes and farmhouses and immediate residential area around them.

Multifamily Residential: 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.

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

Office Space: Land use that includes office campuses and research parks defined as non-manufacturing and characterized by large associated manicured landscape.

Open Water: Land cover that includes rivers, streams and canals, lakes, reservoirs, and lagoons.

Park: Recreational open space with greater than 50% manicured turf.

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

Upland Forest and Grassland: Natural land cover that includes private and public property that has not been developed for any human purpose.

Utility Facility: Land use that includes telephone, radio and television towers, dishes, gas, sewage pipeline, ComEd rows, waste water facilities, etc.

Wetland: Land cover that includes all wetlands on public and private land as mapped by Kane and McHenry County.

Table 7. 2012 land use/land cover classifications and acreage.

Land Use	Area (acres)	% of Watershed
Agricultural	293.6	5.3%
Commercial/Retail	458.3	8.3%
Construction-Commercial/Retail	41.8	<1%
Construction-Industrial	66.4	1.2%
Construction-Medium Density Residential	41.7	<1%
Construction-Multifamily Residential	130.0	2.4%
Golf Course	296.7	5.4%
Industrial	36.5	<1%
Industrial-Quarry	128.9	2.3%
Low Density Residential	61.2	1.1%
Medium Density Residential	1,812.3	32.9%
Multifamily Residential	291.6	5.3%
Municipal/Institutional	160.9	2.9%
Office Space	14.7	<1%
Open Water	120.8	2.2%
Park	168.4	3.0%
Transportation	753.1	13.7%
Upland Forest & Grassland	222.1	4.0%
Utility Facility	4.7	<1%
Wetlands	404.9	7.4%
Total	**5,508**	**100%**

Medium density residential comprises the most acreage in the watershed (1,812.3 acres; 32.9%) followed by transportation (753.1 acres; 13.7%), commercial/retail (458.3 acres; 8.3%), and wetlands (404.9 acres; 7.4%). Medium density residential subdivisions are located throughout most of the northern two-thirds of the watershed while most commercial/retail is located along Randall Road. Roads are dense throughout both of these land uses. In addition, almost all developed areas in the watershed are serviced by municipal stormsewer networks and public sewer systems; the only known septic systems are found servicing residential areas along Boyer Road. Only the older residential houses surrounding Woods Creek Lake are not serviced by stormsewers. Wetlands, located primarily along Woods Creek and Woods Creek Tributary, make up the fourth largest land cover in the watershed.

A few other common land use/cover types include golf course (296.7 acres; 5.4%), multifamily residential (291.6 acres; 5.3%), agriculture (293 acres; 5.3%), upland forest & grassland (222.1 acres; 4.0%), and park (168.4 acres; 3.0%). Boulder Ridge Country Club and Terrace Hill Golf Course are located in the west central portion of the watershed. Multifamily residential is scattered along the Randall Road corridor. Almost all remaining agricultural land is found in the southern tip of the watershed. Upland forest & grassland is found mostly along Woods Creek west of Randall Road while most parks are located north of Algonquin Road in Crystal Lake and Lake in the Hills.

Total open space land uses comprised of agricultural lands, golf courses, open water, parks, upland forest & grassland, and wetlands make up 1,507 acres or 27% of the watershed. Developed land uses account for the remaining 4,001 acres or 73% of the watershed.

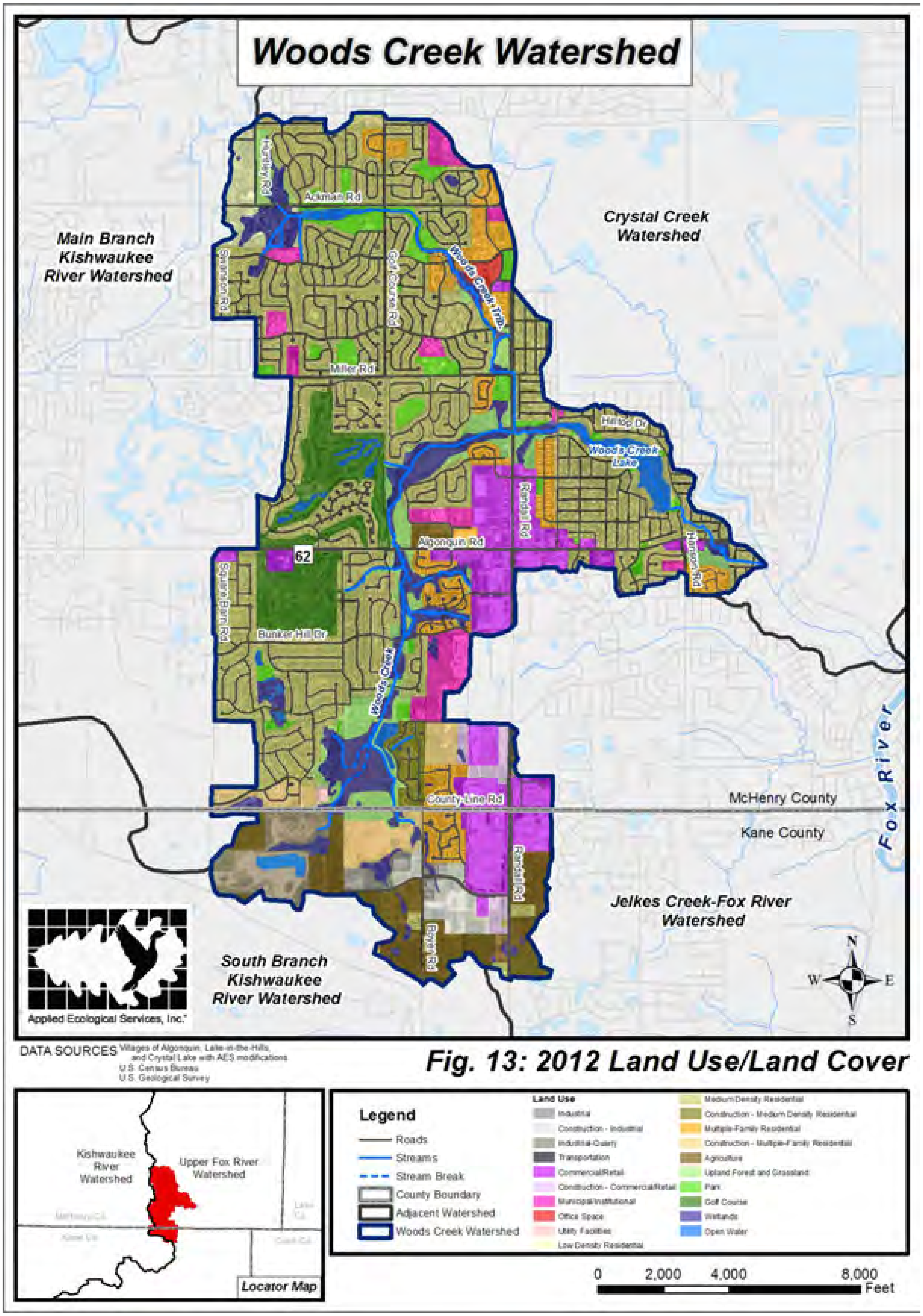


Fig. 13: 2012 Land Use/Land Cover

Future Land Use/Land Cover Predictions

Information on predicted future land use/land cover for the watershed was first obtained from municipal and park district comprehensive plans where available (City of Crystal Lake 2001, Village of Algonquin 2008, Village of Lake in the Hills 2001, Crystal Lake Park District 2009). The Village of Algonquin was contacted to discuss future development in more detail because of large proposed annexation and redevelopment areas in the southern two-thirds of the watershed. Available data was analyzed and GIS used to map predicted land use/land cover changes. The results are summarized in Table 8 and depicted on Figure 14.

Table 8 compares existing land use/land cover acreage to predicted future (2040) land use/land cover acreage. The largest loss of a current land use/land cover is expected to occur on agricultural land (-293.6 acres; -5.3%) in the southern portion of the watershed where 100% of current agricultural land is expected to be developed to mostly commercial/retail, industrial, and multi-family uses. Other significant losses occur on areas that are currently under construction (-294.3 acres; -5.3%) as these areas will eventually become developed.

Conversely, commercial/retail development is predicted to increase the most (+244.3 acres; +4.4%) followed by industrial (+209.1 acres; +5.1%), multifamily residential (+152.9 acres; 2.8%), and medium density residential (102.2 acres; +1.9%). Most of the predicted commercial retail will occur along Randall Road in the southern portion of the watershed. Most of the industrial, multifamily, and medium density family developments will occur west of Randall Road in areas that are currently agricultural and gravel quarry. At least 7.9 acres of wetlands are expected to be lost due to future development in the south portion of the watershed.

Several road expansion and extension projects are proposed for the watershed (Figure 14). First, County Line Road is expected to extend west to Square Barn Road with adjacent residential, industrial, and park development. Corporate Parkway may also extend west to Huntley Road through commercial/retail and industrial development. The proposed Longmeadow Parkway road extension would traverse the southern tip of Woods Creek watershed and also connect up with Huntley Road. This expansion will likely impact many wetlands along its route across the Fox River and wetland mitigation will be required by the United States Army Corps of Engineers (USACE) and/or counties involved.

Finally and most to the overall protection and improvement of Woods Creek watershed is the proposed Randall Road expansion from 4 lanes to 6 lanes throughout much of the watershed. This will likely result in numerous environmental impacts to adjacent natural areas/wetlands and increase impervious cover. Watershed stakeholders impacted by the Randall Road expansion project should strive to leverage wetland mitigation dollars from the project to implement recommendations in this plan because the USACE can give preference to wetland mitigation dollars going to implementation of Illinois EPA 319 Watershed Based Plans over mitigation banks (which otherwise take priority).

Table 8. 2012 (current) and 2040 (predicted) land use/land cover, including percent change for each land use/land cover.

Land Use/Land Cover	Current Area (acres)	Current % of Watershed	Predicted Area (acres)	Predicted % of Watershed	Change (acres)	Change (%)
Agricultural	293.6	5.3	0	0	-293.6	-5.3
Commercial/Retail	458.3	8.3	696.7	12.6	+238.4	+4.3
Compensatory Storage	0	0	8.6	<1	+8.6	<1
Construction-Commercial/Retail	41.8	<1	0	0	-41.8	<1
Construction-Industrial	66.4	1.2	0	0	-66.4	-1.2
Construction-Medium Density Residential	41.7	<1	0	0	-41.7	<1
Construction-Multifamily Residential	130.0	2.4	0	0	-130.0	-2.4
Golf Course	296.7	5.4	296.7	5.4	0	0
Industrial	36.5	<1	282.1	5.1	+209.1	+5.1
Industrial-Quarry	128.9	2.3	0	0	-128.9	-2.3
Low Density Residential	61.2	1.1	61.2	1.1	0	0
Medium Density Residential	1,812.3	32.9	1,914.5	34.8	+102.2	+1.9
Multifamily Residential	291.6	5.3	450.4	8.2	+158.8	+2.9
Municipal/Institutional	160.9	2.9	160.9	2.9	0	0
Office Space	14.7	<1	14.7	<1	0	0
Open Water	120.8	2.2	120.8	2.2	0	0
Park	168.4	3.0	206.2	3.7	+37.8	+0.7
*Transportation	753.1	13.7	753.1	13.7	0	0
Upland Forest & Grassland	222.1	4.0	169.9	3.1	-52.2	-0.9
Utility Facility	4.7	<1	4.7	<1	0	0
Wetlands	404.9	7.4	397.5	7.2	-7.9	-0.2

*Road expansion and extension acreage is included in the surrounding land use change where applicable.

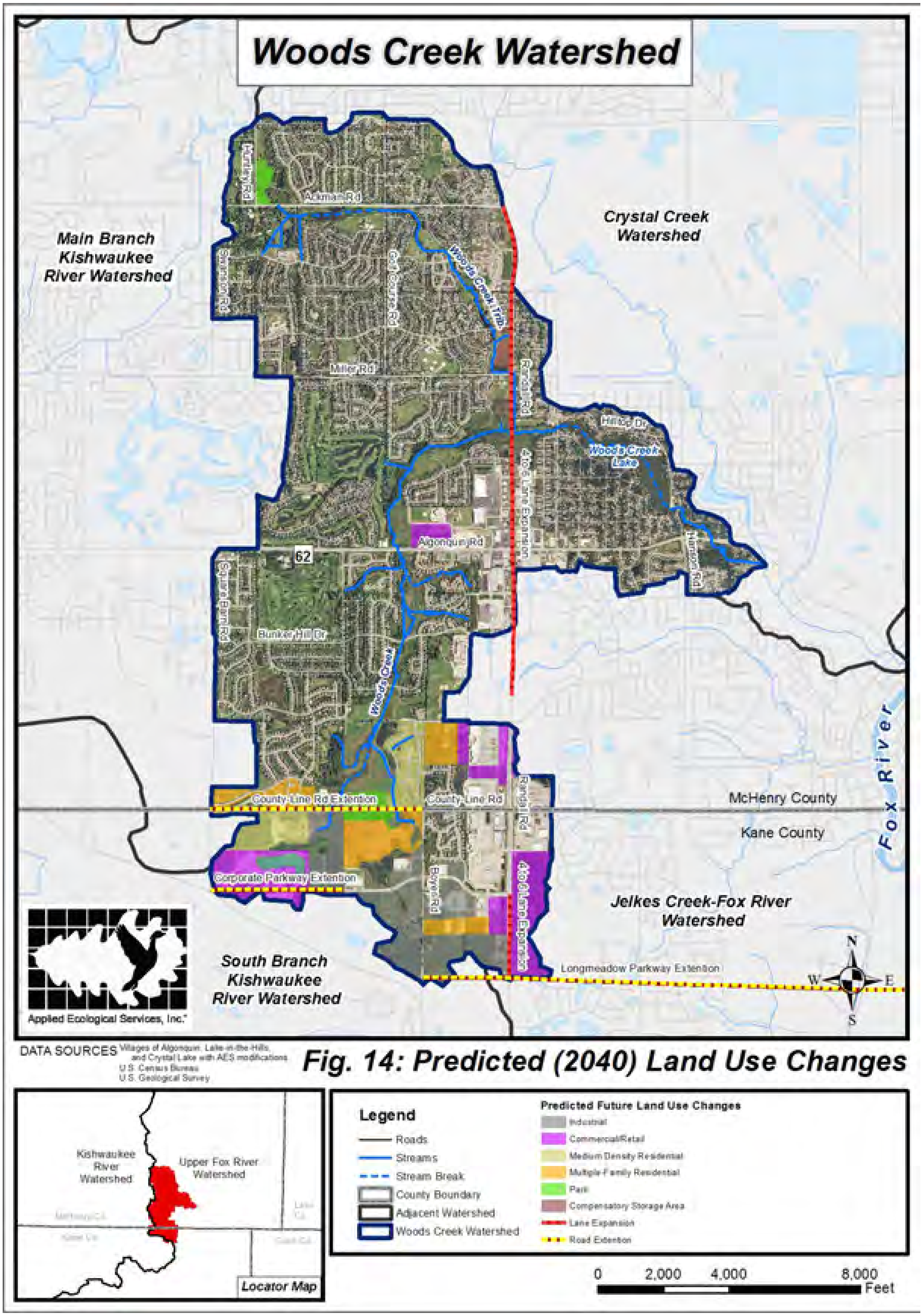


Fig. 14: Predicted (2040) Land Use Changes

3.7 Transportation Network

Roads

There are 108 miles of roads in the watershed. Two lane roads make up 101.2 miles and four lane roads make up the remaining 6.8 miles. Randall Road is the most highly used four lane road in the watershed (Figure 15). It is designated as a Strategic Regional Arterial (SRA). SRAs are highways designated to accommodate long distance regional traffic. Randall Road is a north-south arterial road in southern McHenry County and Kane County. The road is also used as a connection to Interstate 90. Development along Randall Road in the past 10-15 years contributes to congested traffic conditions seen today. Hence, the McHenry County Division of Transportation (MCDOT) is taking steps to address the situation by implementing the Randall Road Improvements Study between County Line Road and Ackman Road. This study was initiated in 2007 and identifies road projects that will improve conditions while also addressing safety, community, and environmental issues.

Randall Road at Route 62 facing north

Several other major roads are worth mentioning. Algonquin Road (Route 62) is a four lane east-west artery traversing the central portion of the watershed. Slightly less traveled but still major two lane roads include east-west Ackman and Miller Roads in the northern half of the watershed and County Line Road in the southern portion of the watershed. Golf Course, Square Barn, and Boyer Roads are other important two lane north-south roads in the watershed.

Walking/Bike Trails

Public trails are an important transportation component of Woods Creek watershed. Crystal Lake, Lake in the Hills, and Algonquin have done an excellent job connecting 19.5 miles of trails across jurisdictions. As seen on Figure 15, trails extend across most of the watershed. Some of the more important trails are found along Woods Creek Tributary and Woods Creek. These trails give the community a unique opportunity to interact with nature and see the benefits of green infrastructure along stream corridors. It is also important to note that secondary trails extend to most major parks and schools in the watershed. Possible trail connections for future consideration include Talaga Drive/Harvest Gate Road crossings at Algonquin Road (between Algonquin and LITH) and County Line Road to Boyer Road to Harish Drive to connect Woods Creek Trial (in Algonquin).

Winding Creek Trail in Crystal Lake

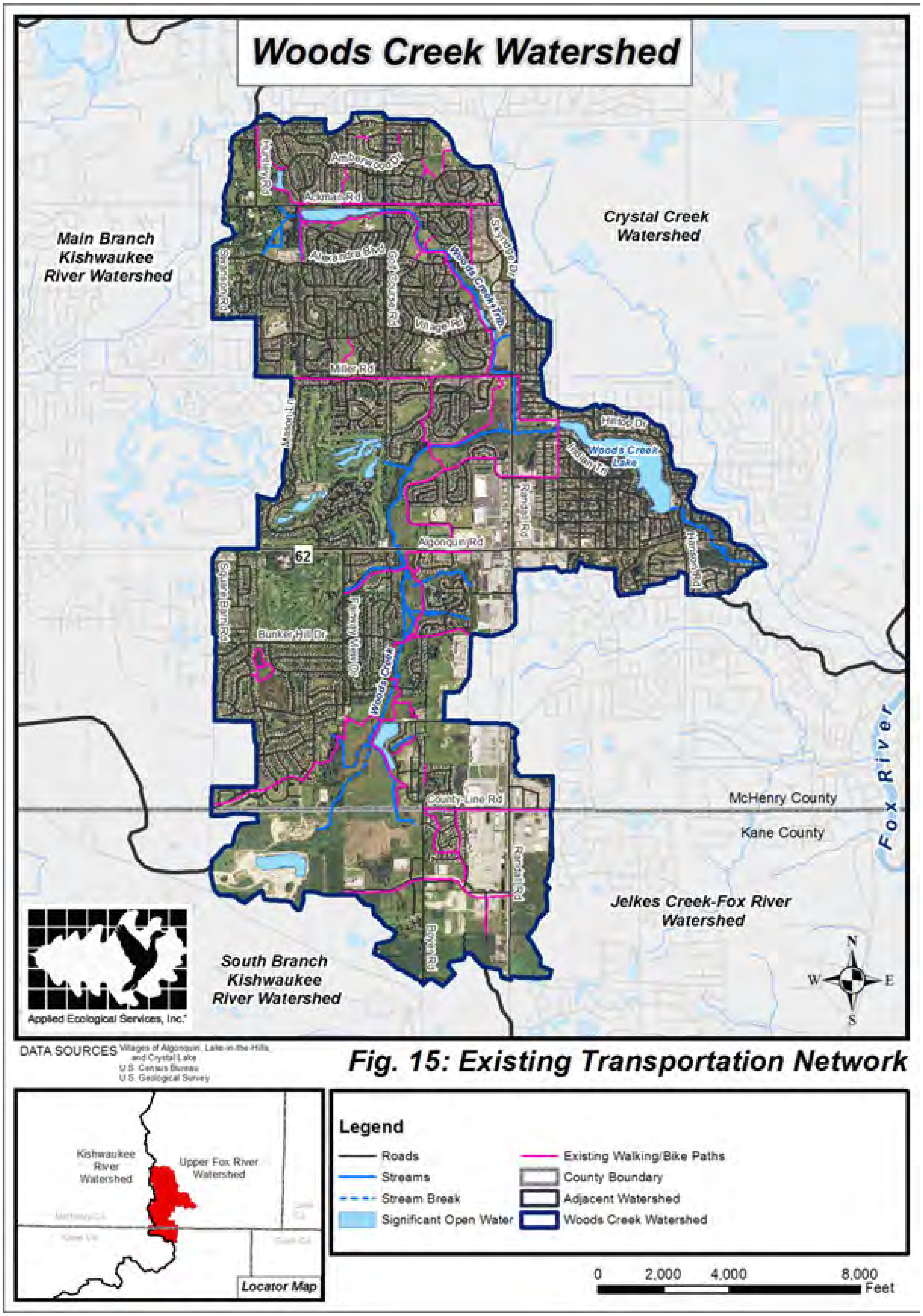
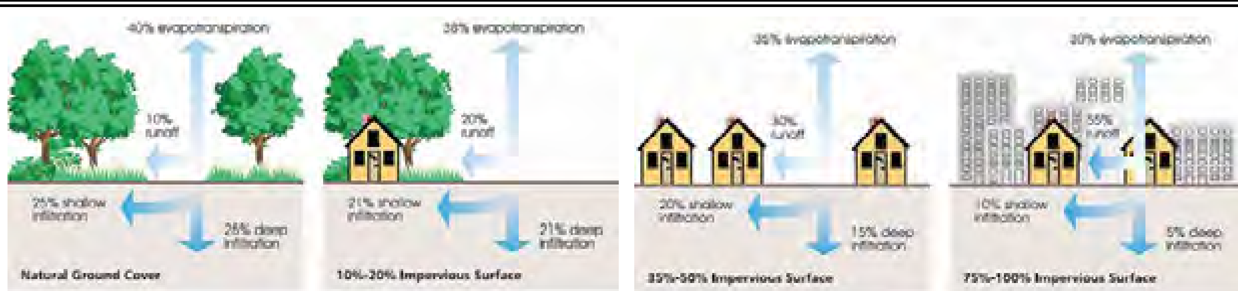


Fig. 15: Existing Transportation Network

3.8 Impervious Cover Impacts

Impervious cover is generally defined as the sum of roads, parking lots, sidewalks, rooftops, and other 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 16).

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 9). 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. As a result, biological communities 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 16. Relationship between impervious surfaces, evapotransporation, & Infiltration.

Table 9. Impervious categories and descriptions based on the CWP's Impervious Cover Model.

Category	% Impervious Cover	Subwatershed Description
Sensitive	10% or less	Generally exhibits very little impervious cover (≤10%), stable stream channels, excellent habitat, good water quality, and diverse biological communities.
Impacted	Greater than 10% and less than 25%	Generally possesses moderate impervious cover (11-25%), and somewhat degraded stream channels, altered habitat, decreasing water quality, and fair-quality biological communities.
Non-Supporting	Greater than 25%	Generally has high impervious cover (>25%), and highly degraded stream channels, degraded habitat, poor water quality, and poor-quality biological communities.

Source: (Zielinski 2002)

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. 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.

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).

AES used a modified *Vulnerability Analysis* to compare each SMU's vulnerability to projected land use changes across Woods Creek watershed. Three steps were used to generate a vulnerability ranking of the SMUs. The results are 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 in the following pages:

Step 1: Initial classification of SMUs based on existing (2012) land use/land cover and impervious cover
Step 2: Future classification of SMUs based on predicted land use/land cover and impervious cover
Step 3: Vulnerability Ranking of SMUs based on changes in impervious cover

Step 1: Initial Classification

Step 1 in the Vulnerability Analysis is an initial classification of each SMU based on existing (2012) measured impervious cover. Calculating existing (2012) and predicted impervious cover in Woods Creek watershed begins with an analysis of land use/land cover. Existing (2012) impervious cover is calculated by assigning an impervious cover percentage for each land use/land cover category based upon the U.S. Department of Agriculture's (USDA) Technical Release 55 (TR55) (USDA 1986). TR55 provides estimates of impervious cover based on land use categories. GIS analysis is used to estimate the percent impervious cover for each SMU in the watershed using existing and predicted land use/land cover data. Each SMU then receives an initial classification (Sensitive, Impacted, or Non-Supporting) based on percent of existing impervious cover (Table 10; Figure 17).

One SMU is classified as Sensitive, six as Impacted, and ten as Non-Supporting based on existing (2012) impervious cover. The only Sensitive SMU (SMU 17) is located in the far southwest portion of the watershed. This SMU includes an excavated gravel quarry surrounded by open space land uses. Most of the Impacted SMUs are located in the western half of the watershed where medium density residential development dominates. Nearly all Non-Supporting SMUs are associated with highly impervious land uses along Randall Road and Algonquin Road.

Table 10. Existing (2012) & predicted (2040) impervious cover for Subwatershed Management Units (SMUs).

SMU #	Step 1: Existing Impervious %	Existing (2012) Impervious Classification	Step 2: Predicted Impervious %	Predicted Impervious Classification	Percent Change	Step 3: Vulnerability
SMU1	37.9%	Non-Supporting	37.9%	Non-Supporting	0%	Low
SMU2	31.7%	Non-Supporting	31.7%	Non-Supporting	0%	Low
SMU3	32.5%	Non-Supporting	33.5%	Non-Supporting	+1%	Low
SMU4	18.9%	Impacted	18.9%	Impacted	0%	Low
SMU5	30.6%	Non-Supporting	30.6%	Non-Supporting	0%	Low
SMU6	38.6%	Non-Supporting	38.6%	Non-Supporting	0%	Low
SMU7	19.9%	Impacted	19.9%	Impacted	0%	Low
SMU8	26.3%	Non-Supporting	34.6%	Non-Supporting	+8.3%	Medium
SMU9	17.8%	Impacted	17.8%	Impacted	0%	Low
SMU10	53.8%	Non-Supporting	53.8%	Non-Supporting	0%	Low
SMU11	61.6%	Non-Supporting	61.6%	Non-Supporting	0%	Low
SMU12	19.5%	Impacted	19.5%	Impacted	0%	Low
SMU13	45.8%	Non-Supporting	46.0%	Non-Supporting	+0.2%	Low
SMU14	24.9%	Impacted	49.9%	Non-Supporting	+25%	High
SMU15	11.9%	Impacted	22.3%	Impacted	+10.4%	Medium
SMU16	34.1%	Non-Supporting	68.2%	Non-Supporting	+34.1%	High
SMU17	3.3%	Sensitive	47.5%	Non-Supporting	+44.2%	High

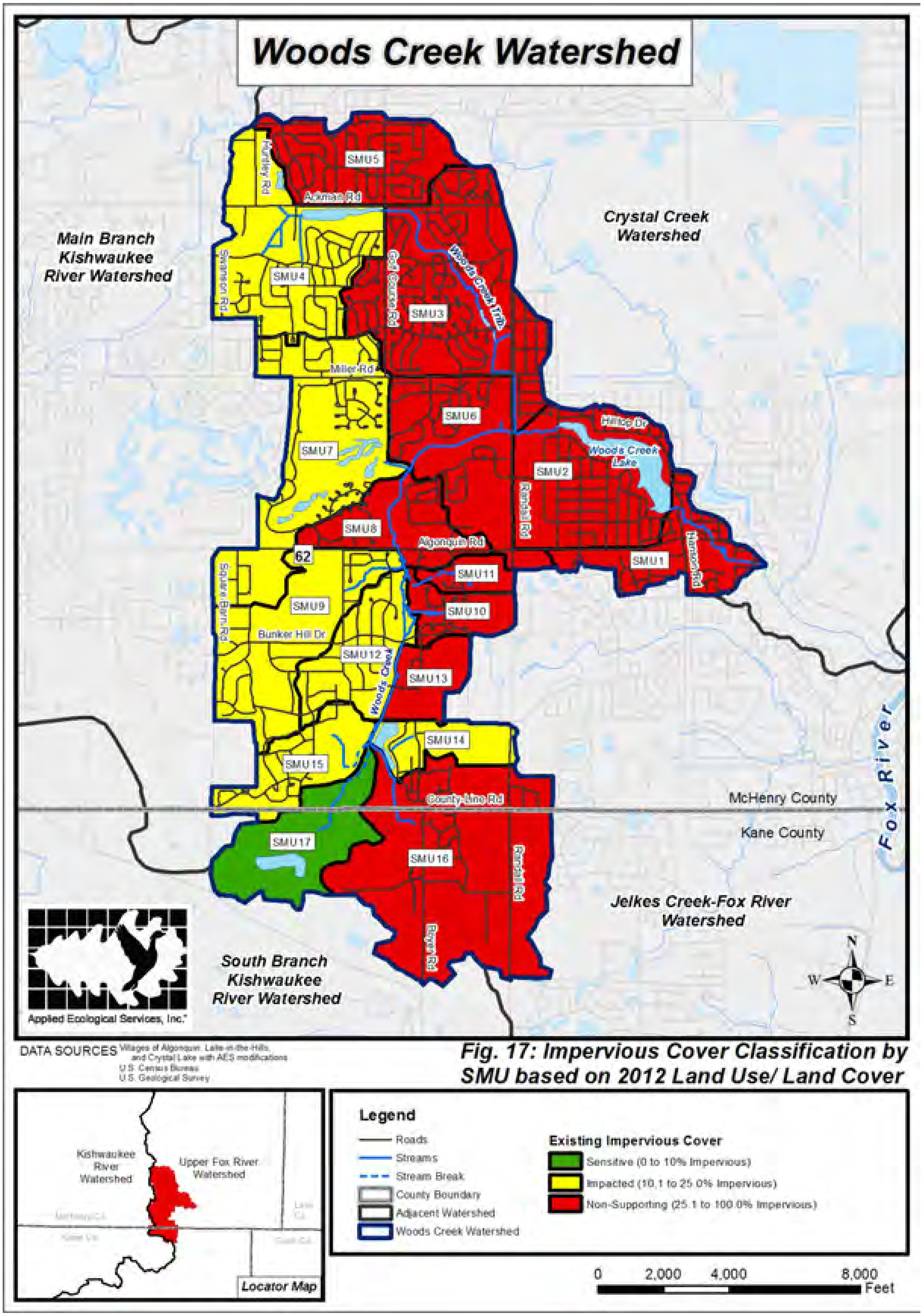


Fig. 17: Impervious Cover Classification by SMU based on 2012 Land Use/ Land Cover

Step 2: Future Classification
Predicted (by 2040) impervious cover was evaluated in Step 2 of the vulnerability analysis by classifying each SMU as Sensitive, Impacted, or Non-Supporting. Figure 18 depicts predicted 2040 impervious cover classifications for each SMU. This step identifies Sensitive and Impacted SMUs that are most vulnerable to future development pressure. SMUs 14 and 17 changed impervious classification compared to existing (2012) conditions. SMU 14 changed from Impacted to Non-Supporting and SMU 17 changed from Sensitive to Non-Supporting. These changes are attributed to predicted commercial, industrial, and residential development that will increase 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 projected conditions?

Vulnerability to future development for each SMU was categorized as Low, Medium, or High:
Low = no change in classification; <2% change in impervious cover
Medium = classification close to changing (within 2%) and/or 5-10% change in impervious cover
High = classification change or close to changing (within 2%) and >10% change in impervious cover

The vulnerability analysis resulted in 3 High, 2 Medium, and 12 Low ranked SMUs (Table 10; Figure 19). SMUs 14, 16, and 17 are ranked as highly vulnerable to future problems associated with impervious cover. SMUs 14 and 17 are expected to change classification and both are expected to see at least a 25% increase in impervious cover. SMU 16 is classified as Non-Supporting based on existing conditions but could see a 34% increase in impervious cover based on future land use predictions. SMUs 8 and 15 are ranked as moderately vulnerable to predicted land use changes because each is likely to see around a 10% increase in impervious cover.

The results of this analysis clearly point to the southern portion of the watershed as the critical area where future development could result in negative impacts to Woods Creek and Woods Creek Lake downstream. It will be important to develop this area using Conservation Design 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 site.

*Noteworthy-Conservation Design**

"Conservation Design" facilitates development while preserving the most valuable natural features and functions of a site. It does this through flexible land development techniques to the arrangement and construction of dwellings, roads, drainage systems, and infrastructure improvements in relation to valuable natural features.

Source: Randall Arendt (1999)

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. The approach first takes into account 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 all 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.

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 while at the same time acknowledging the need to preserve and protect environmental resources.

Example of Stormwater Treatment Train within Conservation Development.

*Paraphrased from City of Woodstock, Illinois Conservation Design section of Unified Development Ordinance

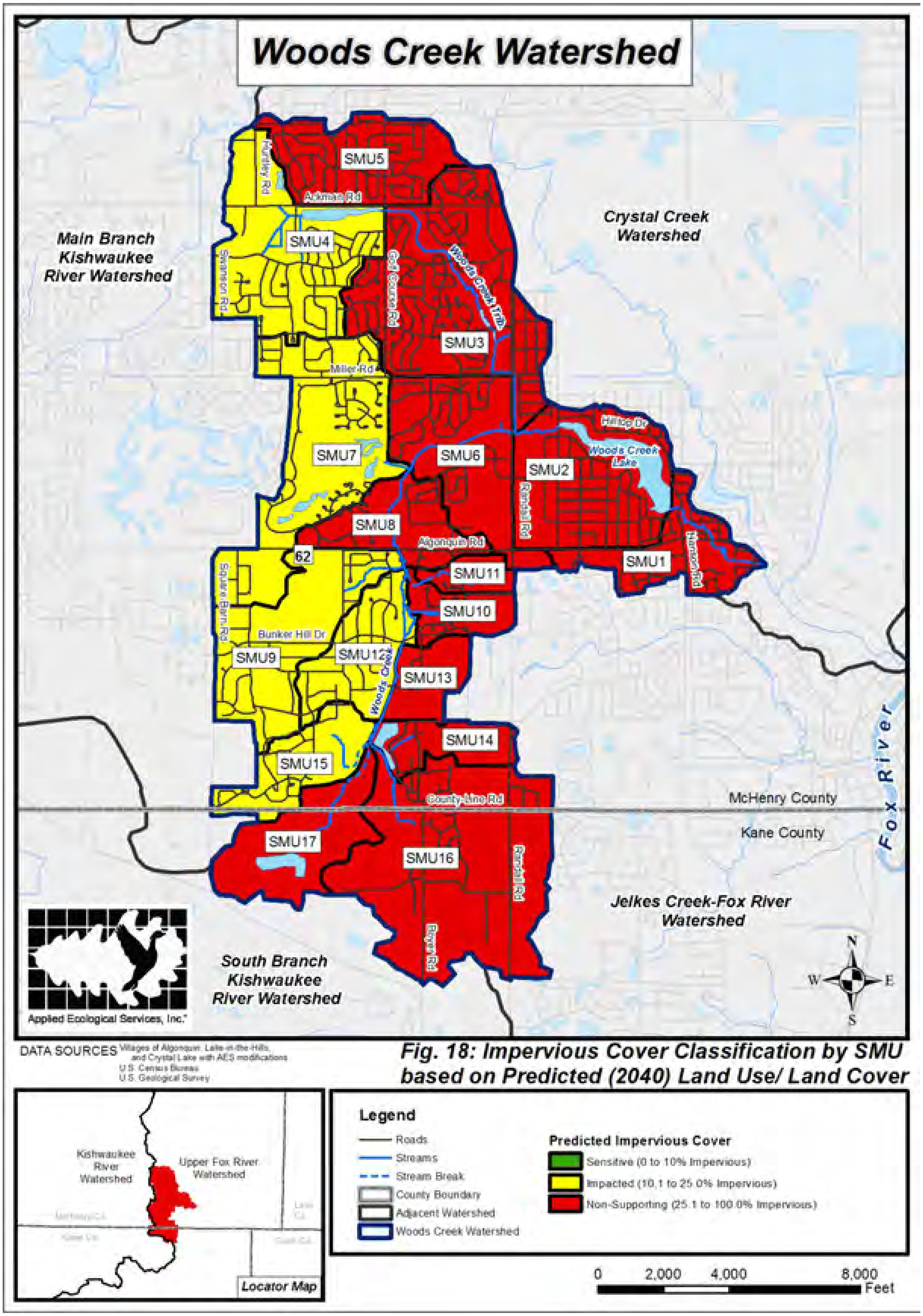


Fig. 18: Impervious Cover Classification by SMU based on Predicted (2040) Land Use/ Land Cover

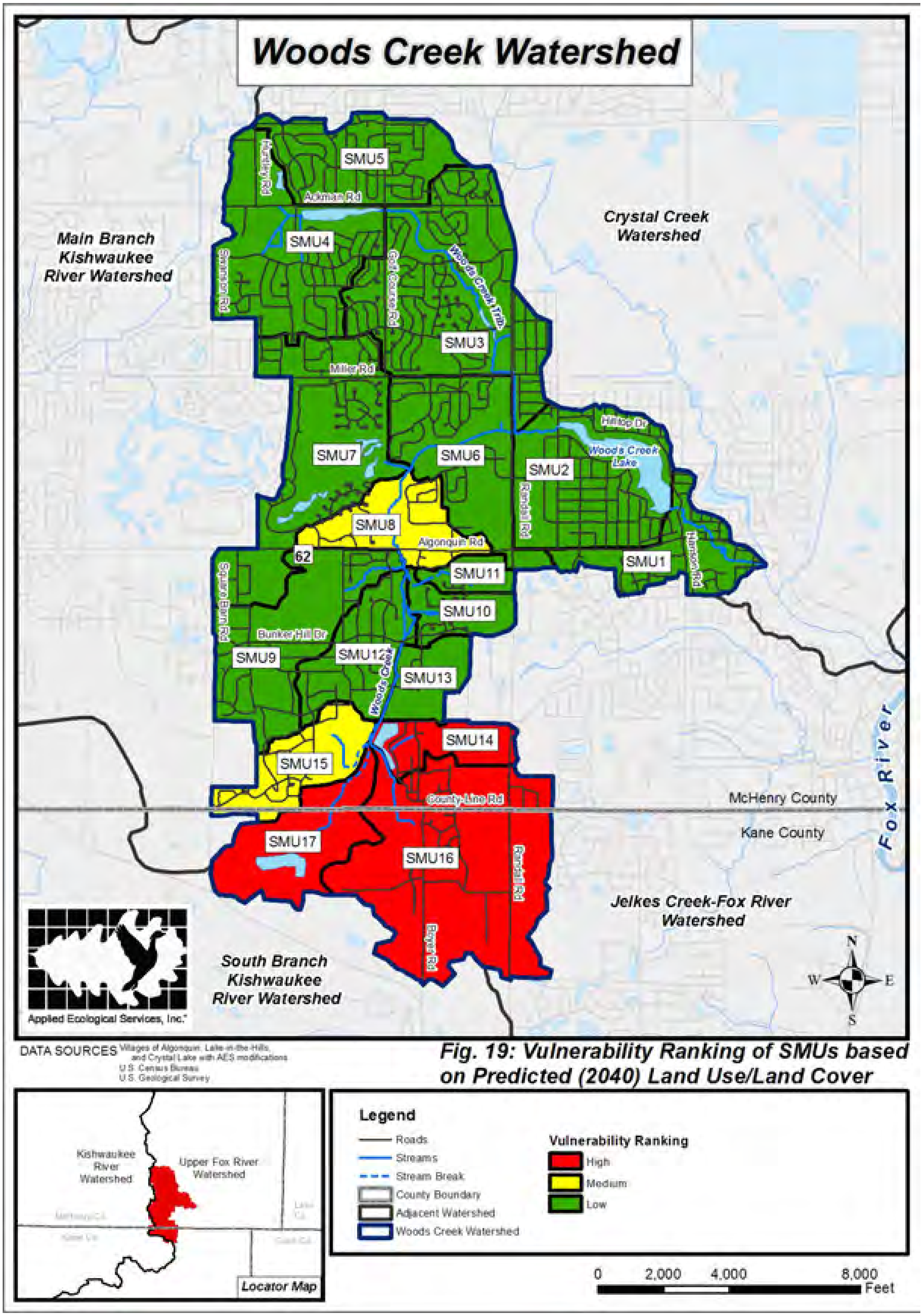


Fig. 19: Vulnerability Ranking of SMUs based on Predicted (2040) Land Use/Land Cover

3.9 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" which 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 developed areas such as ball fields, golf courses, schools, naturalized detention basins, and some large residential or smaller lots that back up to natural areas are also considered components of a Green Infrastructure Network.

A three step process was used to create a Green Infrastructure Network for Woods 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, linking parcels, Ecologically Significant Areas, and stakeholder recommendations were combined to form a network.

For this watershed plan, an "open space" parcel is generally defined as any parcel that is not developed. "Partially open" parcels have been developed to some extent, but the parcels still offer potential open space opportunities. Parcels that are mostly built out are considered "developed". Public versus private and protected versus unprotected status of open and partially open space parcels are other important green infrastructure attributes.

Open, Partially Open, & Developed Parcels

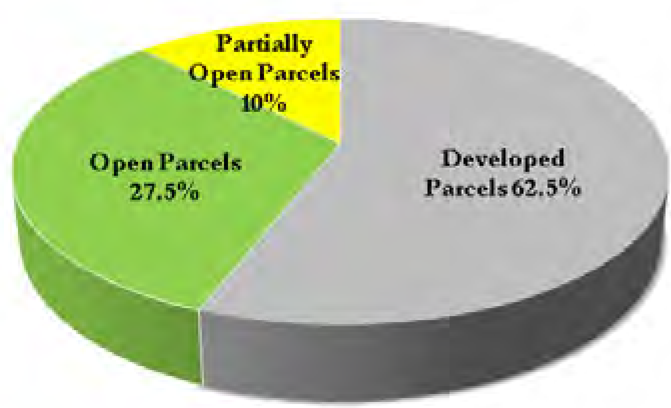


Figure 20. Distribution of open, partially open, and developed parcels.

Step 1 in creating a Green Infrastructure Network was completed by categorizing all parcels in the watershed as open, partially open, or developed. Open space parcels comprise approximately 1,487 acres or 27.5% of the watershed. Parcels range from 0.1 to 82 acres with a 7 acre average. Partially open parcels make up another 570 acres or 10% of the watershed. Parcels range from 0.02 to 61 acres with a 7.3 acre average. Developed parcels and unclassified roads account for another 2,611 acres or 62.5% of the watershed. Figures 20 and 21 summarize and depict Step 1 results used to develop the Green Infrastructure Network. Most open and partially open parcels are located along Woods Creek, Woods Creek Tributary, golf courses, and agricultural land in the southern portion of the watershed.

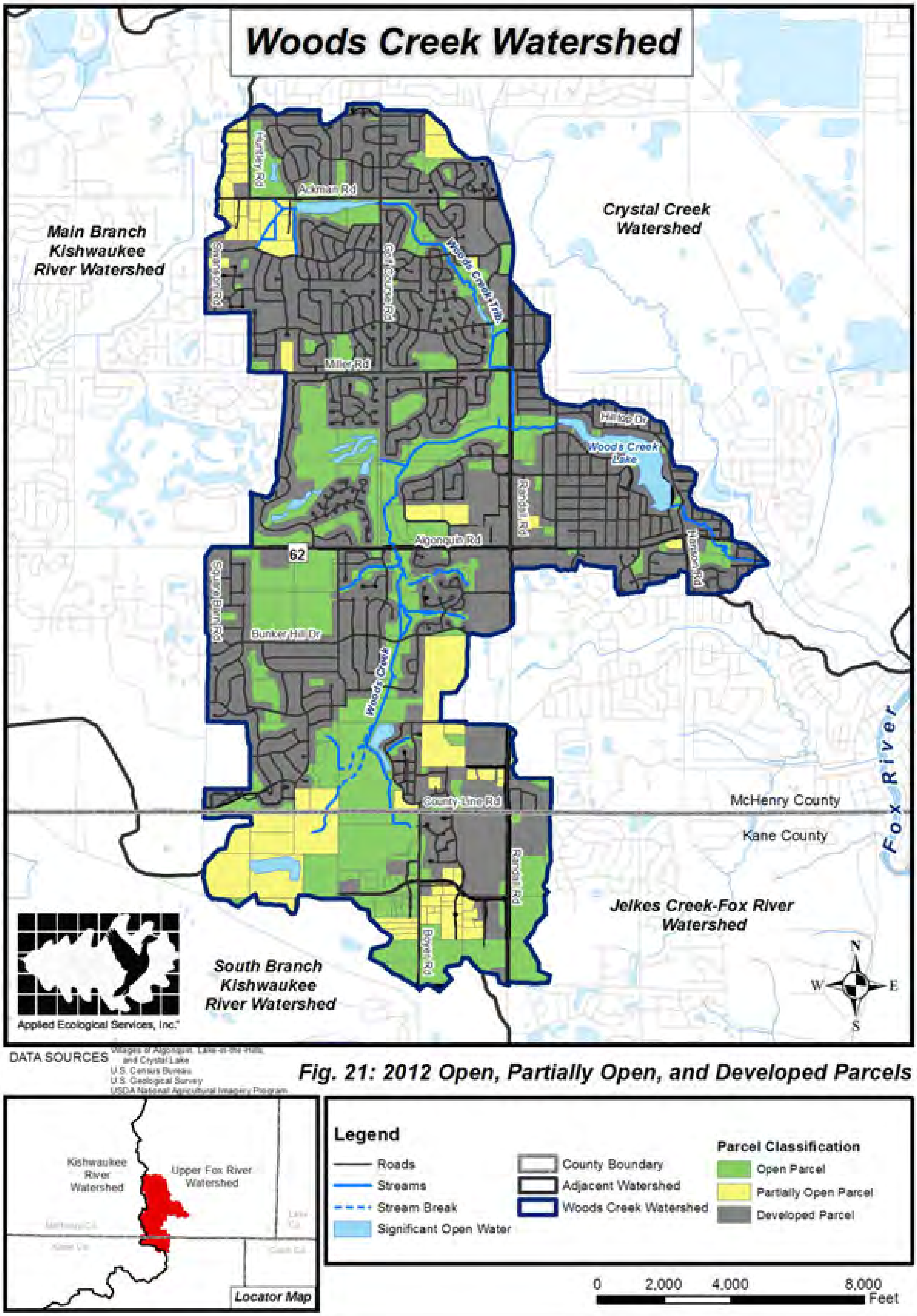


Fig. 21: 2012 Open, Partially Open, and Developed Parcels

Public/Private Ownership of Open and Partially Open Parcels

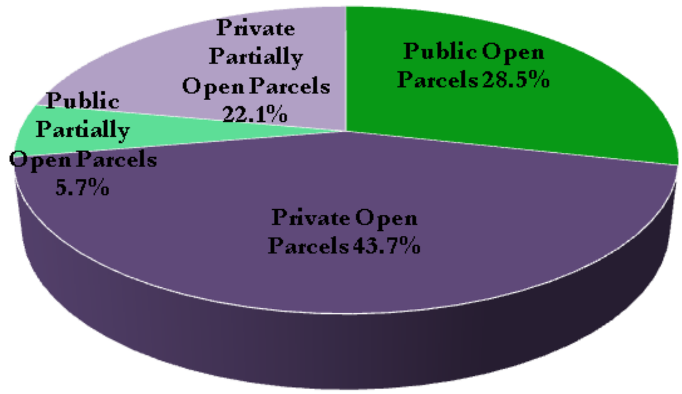


Figure 22. Distribution of private and public open and partially open parcels.

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 federal, state, county, or municipal government, park districts, and school districts. Public open and partially open parcels account for 28.5% and 5.7% of the open and partially open acreage respectively (Figures 22 & 24). Private ownership types include homeowners/business associations, land conservancy, commercial, residential, agricultural, golf clubs, etc. Private open parcels comprise 43.7% of the open and partially open acreage whereas private partially open parcels comprise 22.1% (Figures 22 & 24). Most public open and partially open parcels are owned by municipalities or park districts and are located along Woods Creek and Woods Creek Tributary.

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 36% of the open and partially open parcel acreage in the watershed while unprotected open and partially open parcels account for the remaining 64% (Figures 23 & 25). Most protected open or partially open parcels are owned by municipalities or park districts and are located along Woods Creek and Woods Creek Tributary.

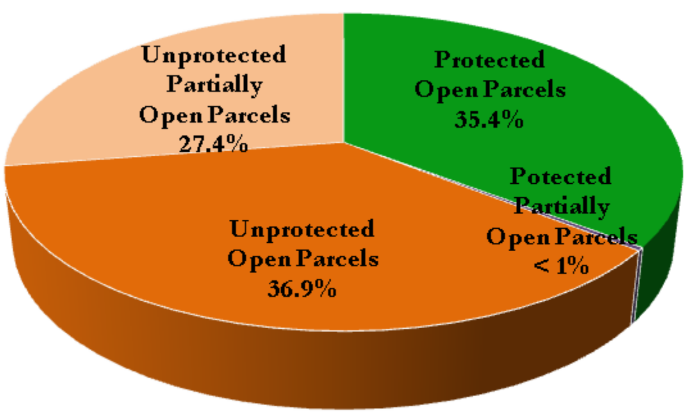


Figure 23. Distribution of protected and unprotected open and partially open parcels.

The most critical unprotected open and partially open parcels include Boulder Ridge and Terrace Hill golf courses on the west side of the watershed and the undeveloped agricultural and gravel quarry areas in the southern portion of the watershed. All of these areas are currently open space connected or adjacent to protected green infrastructure along Woods Creek. It is not likely that the golf courses will change land uses in the future but the agricultural areas will likely be developed to commercial/retail, residential, and light industrial. 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 the headwaters of Woods Creek while also expanding the protected green infrastructure south.

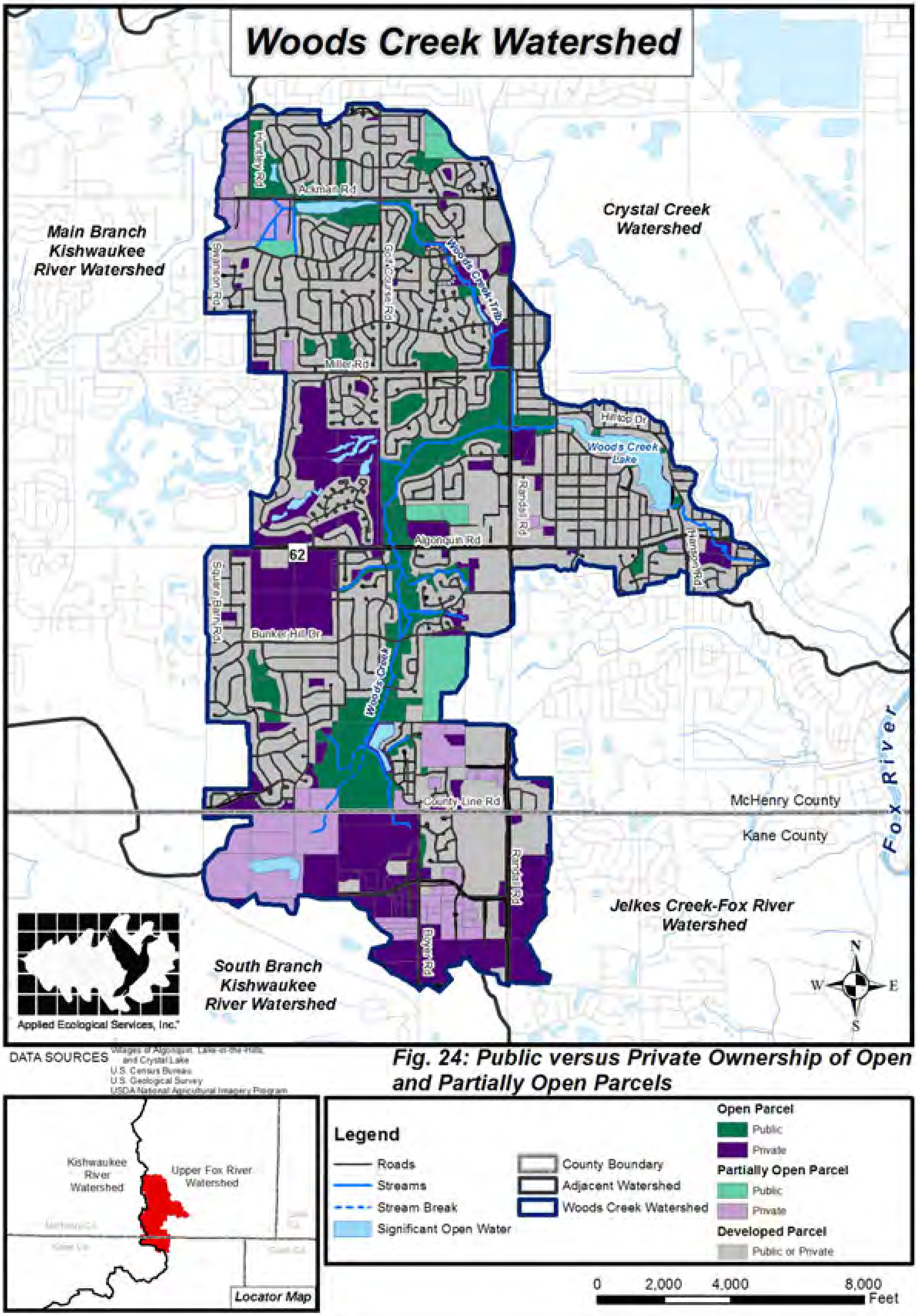


Fig. 24: Public versus Private Ownership of Open and Partially Open Parcels

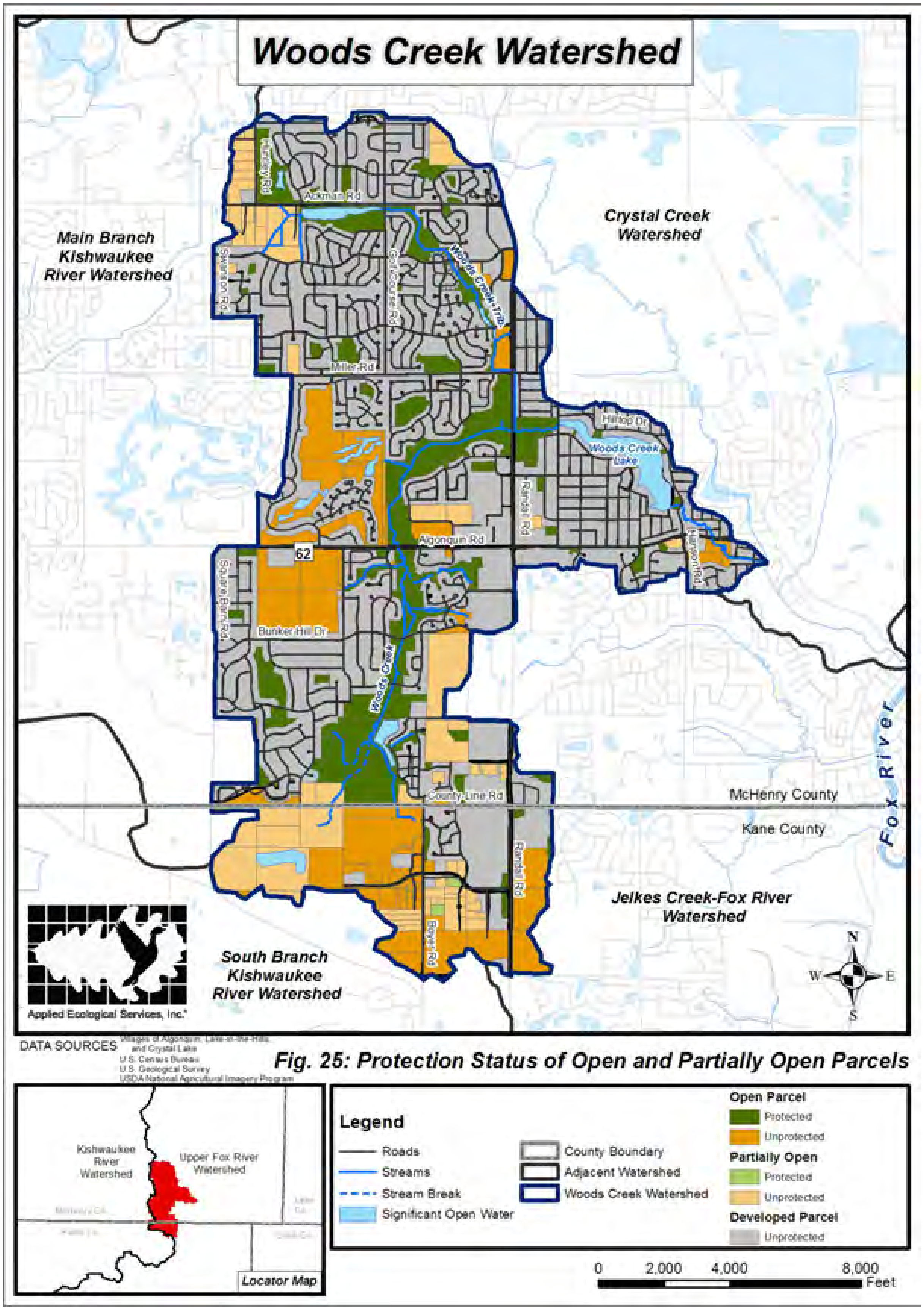


Fig. 25: Protection Status of Open and Partially Open Parcels

Open Space Parcel Prioritization

Step 2 in creating a Green Infrastructure Network for Woods 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 11). 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 total points received for each parcel were summed to determine parcel importance within the Green Infrastructure Network. Parcels with the highest number of points are more important to green infrastructure than parcels that met fewer criteria. Note: the prioritization process was not completed for developed parcels.

The combined possible total of points any one parcel can accumulate is 11 (11 of 11 total criteria met). The highest total value received by a parcel in the weighting process was 9 (having met 9 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 6-9 of the criteria are designated High Priority for inclusion into the Green Infrastructure Network while parcels meeting 4-5 criteria are designated Medium Priority. Parcels with a combined value of 1-3 are categorized as Low Priority but are not necessarily excluded from the Green Infrastructure Network based on their location or position as linking parcels.

Figure 26 depicts the results of the parcel prioritization. An obvious correlation can be seen between High Priority green infrastructure parcels and their relation to Woods Creek and its tributaries. Many of the Medium Priority parcels abut existing protected green infrastructure such as Terrace Hill Golf Course and Boulder Ridge Country Club on the west side of the watershed. The area including the gravel quarry and agricultural land in the south portion of the watershed are also Medium Priority. It is important to note that this area is located on high and moderately high sensitive aquifer recharge areas. Low Priority parcels are generally associated with outlying parks, large residential lots, and schools. Parcel size did not play a role in the parcel prioritization process for this watershed plan.

Table 11. 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 intersect a high quality (ADID) wetland
5. Open or partially open parcels that intersect a potential wetland restoration site
6. Open or partially open parcels that are within 100 feet of a watercourse or lake
7. Open or partially open parcels in a "Highly or Moderately 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 that intersect "Critical" groundwater recharge areas
10. Open or partially open parcels that intersect existing or planned trails
11. Open or partially open parcel that intersects a McHenry County NAI site

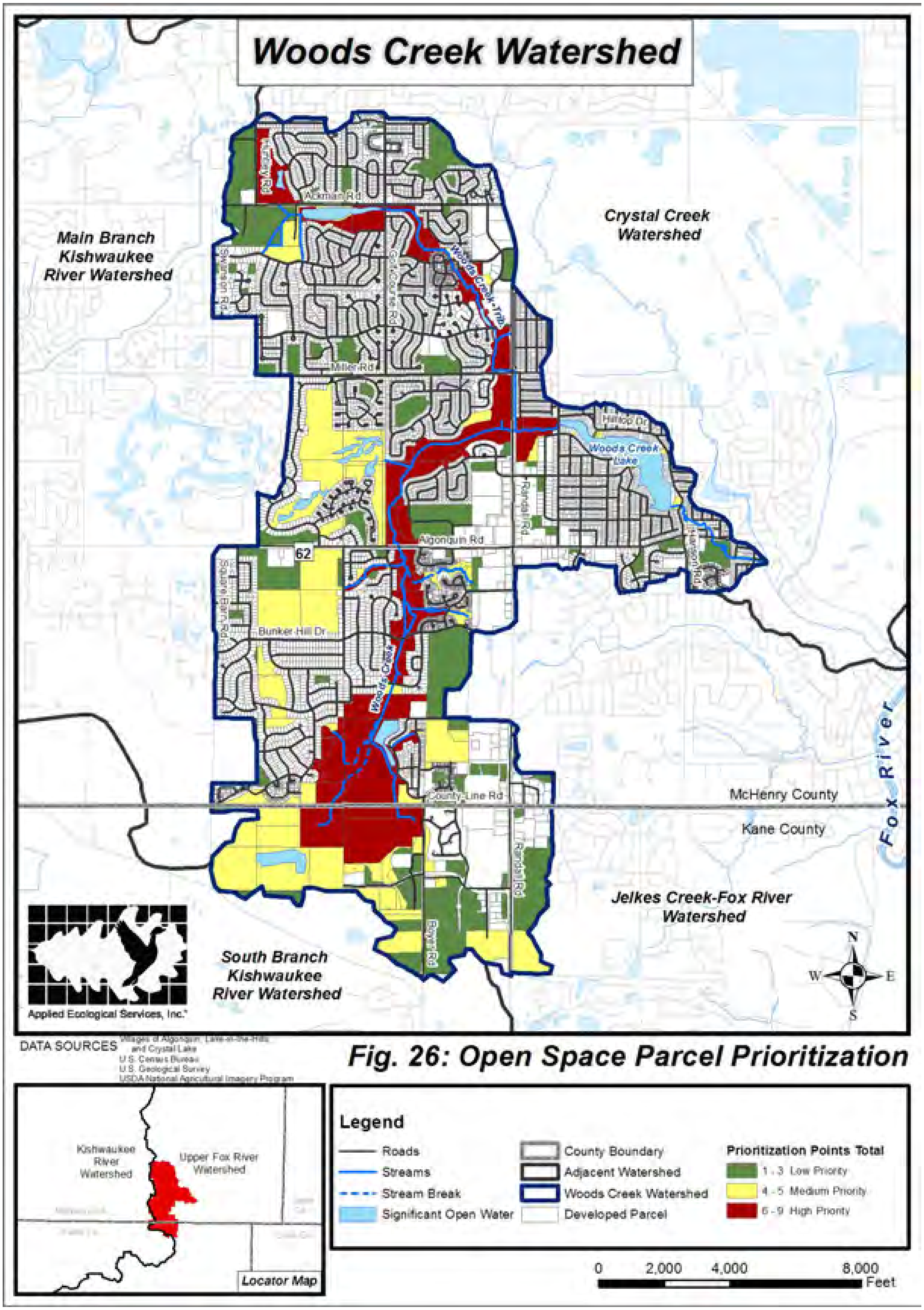


Fig. 26: Open Space Parcel Prioritization

Green Infrastructure Network

The final step (Step 3) in creating a Green Infrastructure Network for Woods Creek watershed involves laying out the network by incorporating; 1) prioritized open space results from Step 2, 2) Ecologically Significant Areas (see Section 3.10), 3) information gathered during the watershed characteristics inventory, and 4) stakeholder recommendations. County and regional 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 Woods Creek watershed captures all the natural components and other green infrastructure such as recreational parks, large residential lots, schools, and golf courses 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.

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 that should incorporate conservation design standards, and areas that do not affect green infrastructure.

Green Infrastructure Network *implementation* has several actions:

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

A Green Infrastructure Network for Woods Creek watershed is shown on Figure 27. The network is a system of *Hubs*, *Links*, and *Sites*. Hubs generally consist of the largest and least fragmented areas. Golf Courses and most of the immediate riparian corridors along Woods Creek and Woods Creek Tributary that are currently owned by local municipalities/park district are considered hubs. Links are generally formed by smaller private/unprotected parcels around Woods Creek Lake continuing downstream to the junction with Crystal Creek. These links are extremely important because they provide biological conduits between hubs. However, most of the linking parcels are not ideal green infrastructure until residents embrace the idea of naturalizing lakeshore and streambank property. Sites are in many cases not connected to the larger green infrastructure network but can still provide important ecological and social values. Some of the recreational parks in the watershed serve this purpose while many others do not and therefore are not included in the network.

Most of the green infrastructure parcels that may become available for purchase in the future are located in the far southern portion of the watershed and will likely be developed. Other parcels or sections of parcels such as those immediately south of the county line at the headwaters of Woods Creek and parcels adjacent to existing protected corridors may be better utilized as protected natural open space via several potential tools; 1) acquisition, 2) regulation, 3) incentives, and/or conservation development. The simplest form of acquisition is through outright purchase or donation of land but can also occur through conservation easements and land trusts. Protection of land through state and federal regulation covers natural features such as wetlands or threatened and endangered species/important habitat. Local regulation protection occurs by enforcing stormwater, zoning, comprehensive plans, and subdivision ordinances. Regulatory action can also come in the form of Special Service Area assessments and Development Impact Fees. Land protection through incentives usually occurs on smaller private lands. Some incentives include landowner recognition/rewards, tax incentives, or benefits for farms through the Conservation Reserve Program. A more detailed list of the tools and methods for protecting green infrastructure are included in Table 12.

Table 12. Tools for protection of green infrastructure.

Tool	Method of Implementation
Land Acquisition	Outright purchase Conservation easements Land donations Land trusts
Regulation	Buffer or landscape ordinance Comprehensive plans Development Impact Fee Mitigation and mitigation banking Special Service Area taxes Stormwater regulations Subdivision ordinances Zoning Wetland permitting T&E species and habitats
Incentives	Management agreements Landowner recognition and rewards Tax incentives Technical assistance from local agencies Conservation Reserve Program incentives

Source: Benedict 2006.

A Green Infrastructure Network can only be realized by coordinated planning efforts of local municipalities, park districts, developers, and private land owners. Algonquin, Crystal Lake, Crystal Lake Park District, and Lake in the Hills should follow the recommended process below to initiate and implement the Green Infrastructure Network for Woods Creek watershed.

1) Identify and designate a lead Woods Creek watershed stakeholder to serve as a "coordinator" and meet with other stakeholders to plan for future green infrastructure.
2) Include all green infrastructure parcels in updated community comprehensive plans and development review maps.
3) Create zoning overlay and update development ordinances to require conservation development design on all green infrastructure parcels.
4) Require Development Impact Fees and/or Special Service Area taxes for all new development to help fund future management of green infrastructure.
5) Identify important unprotected green infrastructure parcels not suited for development then protect and implement long term management.
6) Work with private land owners along Woods Creek Lake and stream/tributary corridors to manage their land for green infrastructure benefits.
7) The Green Infrastructure Network could be used to identify new trails and trail connections.

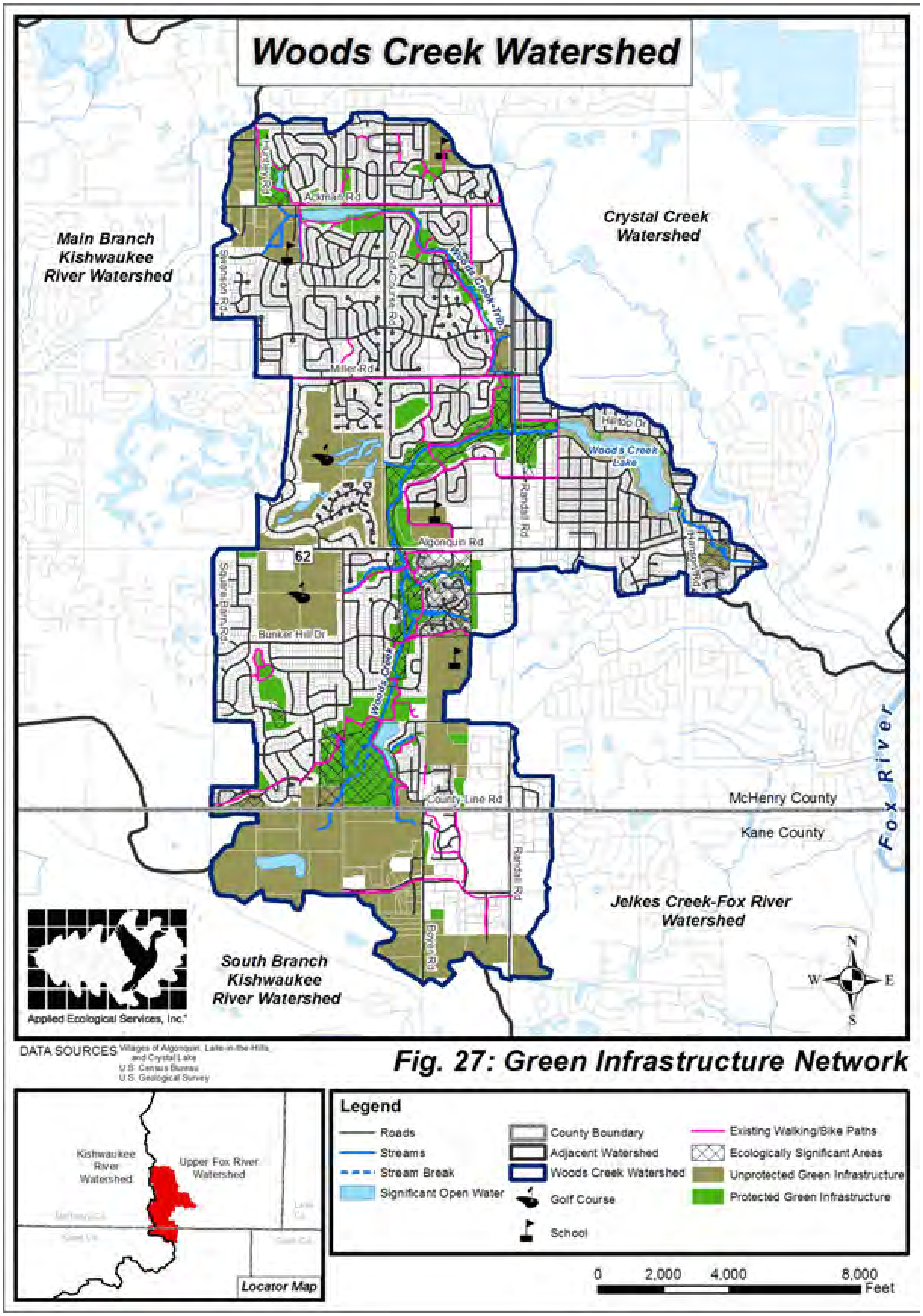


Fig. 27: Green Infrastructure Network

3.10 Ecologically Significant Areas

Moderate to high quality wetlands, prairie, and woodlands are all considered "Ecologically Significant Areas" within Woods Creek watershed (Figure 30). Most of these areas are public and owned/managed by local municipalities. No county, state, or federal forest or nature preserves are located within the watershed. However, the McHenry County Conservation District (MCCD) acknowledges two Natural Area Inventory Sites (McNAI). Ecological Significant Areas provide habitat for and harbor uncommon or conservative plant and animal species. These areas also form much of the Greenway Infrastructure Network that interconnects land and waterways, supports native species, maintains natural ecological processes, sustains air and water resources, and contributes to the health and quality of life for communities and people.

ADID and Other High Quality Wetlands

The Advanced Identification (ADID) wetland inventory was completed for McHenry and Kane Counties in 1998 and 2004 respectively. These inventories identify the functional and ecological values of individual wetlands as well as wetlands where special protection should be enforced. Local communities can use the ADID inventory to help them better understand the values and functions of wetlands under their jurisdiction. The 5 ADID wetlands located in the watershed are mapped on Figure 30. Three of the largest ADID wetlands (L127, L157, & L331) extend along Woods Creek and Woods Creek Tributary. These wetland complexes include rare fen wetland, sedge meadow, and wet prairie remnants. These unique ecological remnants are discussed in more detail below. A separate wetlands map and detailed ADID wetland information is found in Section 3.11.

Spella Park Wetland restoration site

Spella Park Wetland is a wetland restoration project undertaken by the Village of Algonquin in 2007-2011 (Figure 30). Approximately 60 acres of historic wetland and prairie was reestablished by breaking old drain tiles and planting with over 50 native species. Several uncommon wetland and grassland birds currently use the site including marsh wren, sedge wren, dickcissel, and willow flycatcher. Spella Park Wetland is now a high quality wetland that expands and connects green infrastructure at the headwaters of Woods Creek. The Village manages the site via controlled burns and spot herbicide treatments to invasive species.

McHenry County Natural Area Inventory Sites

The McHenry County Conservation District (MCCD) identified two Natural Area Inventory Sites (McNAI) in Woods Creek watershed (Figure 30). Both sites overlap with portions of ADID wetlands L331 and L157 discussed above. The first site is "Algonquin Hanging Fen", a 40 acre Grade C graminoid fen wetland that is owned, protected, and managed by the Village of Algonquin. The site harbors uncommon/conservative plants such as bog lobelia (*Lobelia kalmii*) and fen betony (*Pedicularis lanceolata*). MCCD sites hydrology changes, invasive species, siltation, and brush encroachment as the primary management problems. The Village of Algonquin began invasive brush removal in 2012 and plans to burn the site in conjunction with adjacent Spella Park Wetland in the future.

Figure 28. NRI of Winding Creek Fen in Algonquin.

The second McNAI site is "Woods Creek Fen", a 240 acre natural area that extends along Woods Creek generally between Bunker Hill Road in Algonquin north and just east of Randall Road in Lake in the Hills (Figure 30). The entire area south of Algonquin Road is owned, protected, and managed by the Village of Algonquin. Lake in the Hills owns and manages the portion between Algonquin and Randall Roads within Ken Carpenter Park. The area east of Randall Road is also protected and owned by the Land Conservancy of McHenry County. The highest quality natural community in Woods Creek Fen is "Winding Creek Fen", located along a small seep south of Algonquin Road and east of Woods Creek (Figure 28). The Village of Algonquin cleared invasive species and planted the buffer from 2009-2012.

MCCD lists remnant wet prairie, graminoid fen, and sedge meadow as important in Woods Creek Fen although all were rated Grade C due to siltation, water table alteration, brush encroachment, invasive species, and adjacent development effects. Many uncommon or conservative plant species are found here including early fen sedge (*Carex crawei*), bog lobelia (*Lobelia kalmii*), swamp thistle (*Cirsium muticum*), narrow-leaved loosestrife (*Lysimachia quadriflora*), fen betony (*Pedicularis lanceolata*), yellow star grass (*Hypoxis hirsuta*), and bog valerian (*Valeriana uliginosa*). The entire 240 acre area is being managed to some extent by Algonquin, Lake in the Hills, and Land Conservancy via controlled burns, invasive brush removal, and spot herbicide applications to invasive species.

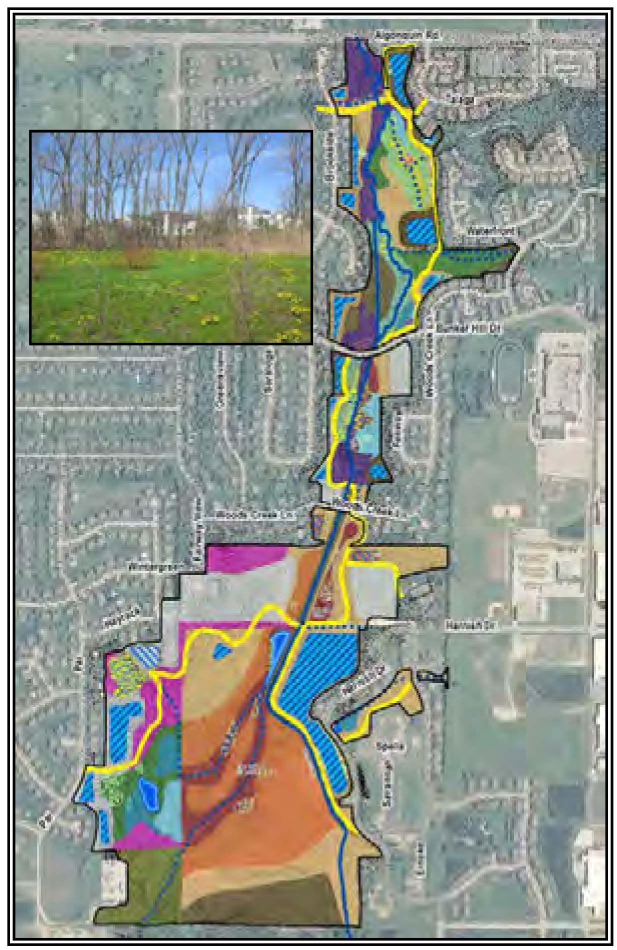


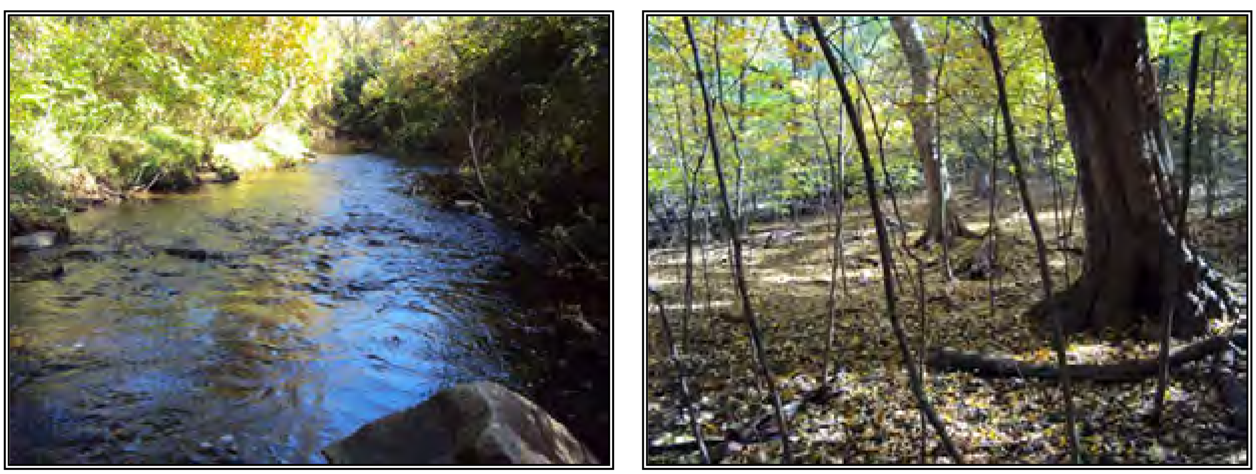
Figure 29. NRI of Woods Creek Corridor in Algonquin.

The Village of Algonquin has recognized the importance of maintaining the high quality remnant areas along Woods Creek. In 2008-2010, the Village hired an Ecological Consultant to prepare a Natural Resource Inventory (NRI) & Management Plan for "Winding Creek Riparian Corridor" and the entire "Woods Creek Riparian Corridor" south of Algonquin Road (Figure 29). These plans include detailed maps of the natural areas with specific management recommendations for each. The Village currently uses these plans to implement ecological restoration.

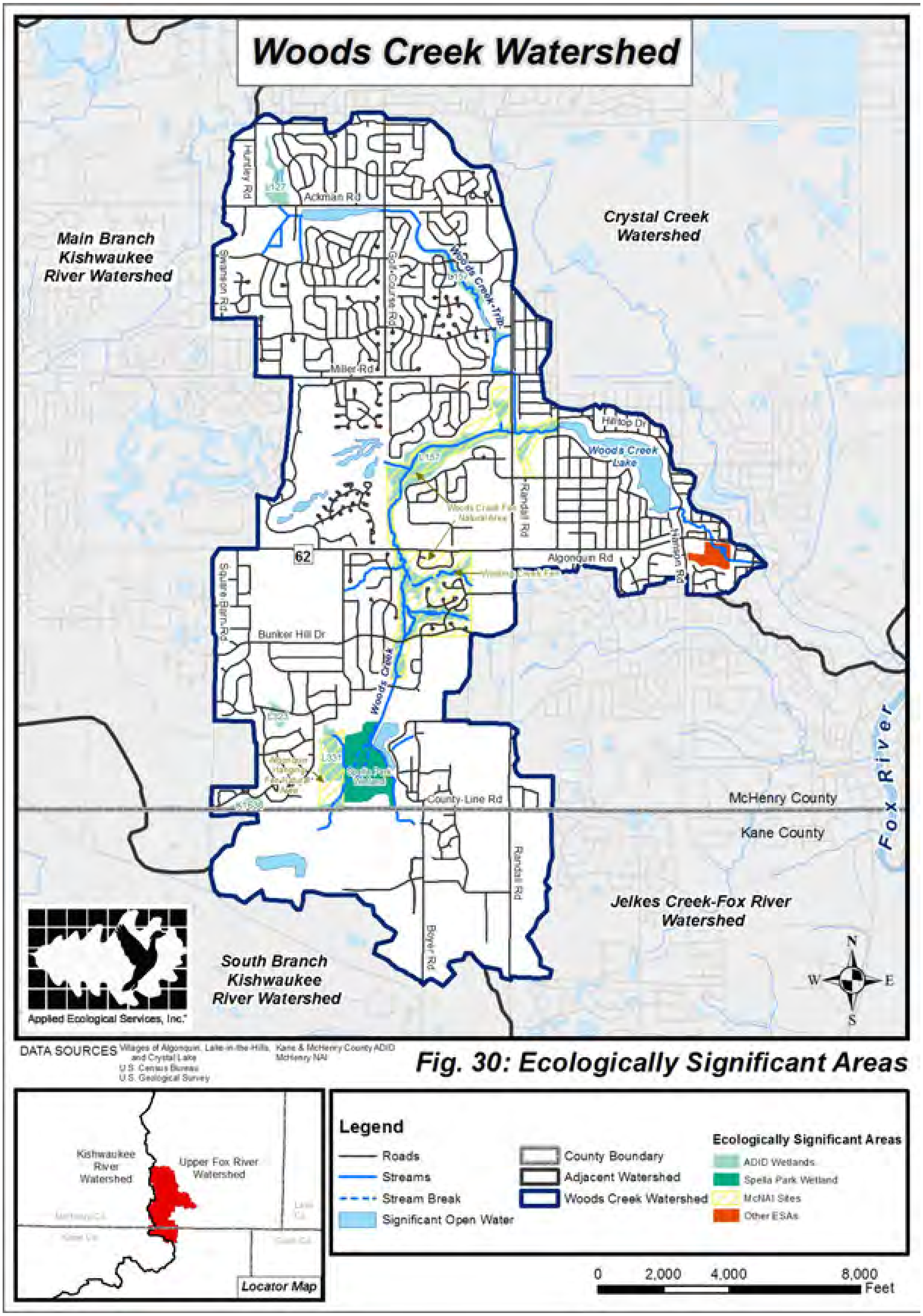
Invasive species continue to increase in abundance and pose future threats to nearly all Ecologically Significant Areas owned and managed by the Village of Algonquin, Village of Lake in the Hills, City of Crystal Lake, and Land Conservancy. The Village of Lake in the Hills and Land Conservancy should consider teaming up and hiring an Ecological Consultant to prepare a Natural Resource Inventory & Management Plan similar to plans that the Village of Algonquin prepared for Woods Creek Riparian Corridor and Winding Creek Fen. Crystal Lake Park District should also consider preparing a similar plan for Willow's Edge Park and potentially portions of Woodscreek Park, Fetzner Park, and Winding Creek Park. These plans would provide a simple, realistic, and affordable guide to ecological restoration.

Other Ecologically Significant Areas

One additional Ecologically Significant Area is worth mentioning. The site includes portions of two private and unprotected parcels located just southeast of Woods Creek Lake and south of Algonquin Road (Figure 30). Here, Woods Creek enters the site under Algonquin Road and is the highest quality stream reach (WCR14) in the watershed. The stream exhibits high sinuosity, natural riffles and pools are abundant, and the floodplain is natural and intact. It is likely that this reach of stream harbors many fish and macroinvertebrate species migrating upstream from Crystal Creek and the Fox River. The adjacent abutting parcel to the south is owned by Highland Glen Estates HOA. This parcel includes a steep northeast facing slope supporting a moderate quality mesic woodland dominated by old growth (150+ year old) bur oak, red oak, and sugar maple and is the only remaining remnant woodland in the watershed. Together these sites account for about 20 acres and should be protected from development in the future.



Stream Reach WCR14 and adjacent moderate quality mesic woodland


Woods Creek Watershed
Main Branch Kishwaukee River Watershed
Crystal Creek Watershed
Jelkes Creek-Fox River Watershed
South Branch Kishwaukee River Watershed
Fox River
McHenry County
Kane County
Ackman Rd
Miller Rd
Algonquin Rd
Bunker Hill Dr
County Line Rd
Randall Rd
Boyer Rd
Hilltop Dr
Woods Creek Lake
Woods Creek
Woods Creek Trib
62
Applied Ecological Services, Inc.
DATA SOURCES
Fig. 30: Ecologically Significant Areas
Legend
Roads
Streams
Stream Break
Significant Open Water
County Boundary
Adjacent Watershed
Woods Creek Watershed
Ecologically Significant Areas
ADID Wetlands
Spella Park Wetland
McNAI Sites
Other ESAs
Kishwaukee River Watershed
Upper Fox River Watershed
Locator Map
0
2,000
4,000
8,000
Feet
N
S
E
W

3.11 Watershed Drainage System

3.11.1 Woods Creek & Tributaries

Woods Creek and Woods Creek Tributary are the two primary streams in Woods Creek watershed with 10 tributary streams accounting for approximately 9.5 stream and tributary miles. Woods Creek begins in the southern portion of the watershed and generally flows north for approximately 3.5 miles before joining Woods Creek Tributary just east of Randall Road. Woods Creek Tributary begins in the northwest portion of the watershed and generally flows southeast for about 2 miles before joining Woods Creek. After joining Woods Creek Tributary, Woods Creek flows east for about 0.5 miles to Woods Creek Lake, a 52 acre impoundment that was formed by creating a dam on Woods Creek. Woods Creek continues flowing east after exiting the spillway on the east side of Woods Creek Lake and flows southeast for about 1 mile prior to joining Crystal Creek. Crystal Creek flows southeast for just over 1 mile to the Fox River.

In fall 2011, Applied Ecological Services, Inc. (AES) completed a field inventory of Woods Creek and its tributaries. All streams and tributaries were assessed based on divisions into "Stream Reaches" (Table 13; Figure 31). 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 reaches, collecting measurements, taking photos, and noting channel, streambank, and riparian corridor conditions. Numerous municipal stormwater point discharges were also encountered during the inventory but were not surveyed due to time and budget constraints; no industrial point sources were encountered. Detailed notes were also recorded related to potential Management Measure recommendations and their corresponding priority for eventual inclusion into the Action Plan section of this report. Results of the inventory and detailed summaries of each stream reach can be found in Appendix B.

Table 13. Summary of stream and tributary reaches and length.

Stream or Tributary Name	Abbreviation	Number of Reaches	Stream Length Assessed (ft)	Stream Length Assessed (mi)
Woods Creek	WCR	15	24,177	4.6
Woods Creek Trib.	WCTR	5	9,615	1.8
Quarry Drain	QD	1	1,864	0.35
Cove Drain	CD	1	1,070	0.20
Grand Reserve Creek	GRCR	1	736	0.14
Creekside Creek	CCR	1	2,422	0.46
Winding Creek	WC	1	1,938	0.37
Terrace Hill Drain	THD	1	2,292	0.43
Boulder Ridge Drain	BRD	1	833	0.16
Unnamed Tributary A	TRA	1	2,534	0.48
Unnamed Tributary B	TRB	1	1,407	0.27
Unnamed Tributary C	TRC	1	537	0.10
Totals		**30**	**49,424**	**9.4**

Note: Illinois EPA does not monitor to the level of detail included in this plan. The local community conducted additional monitoring and developed a localized waterbody code system. Therefore, the codes used in this plan are not found in the Illinois EPA's *Illinois Integrated Water Quality Report and Section 303d List*.

Woods Creek

Woods Creek (Reach Code WCR) was divided into 15 distinct reaches flowing for 4.6 linear miles north/east from the headwaters near Boyer Road to Crystal Creek (Table 13; Figure 31). The majority of the headwaters to Algonquin Road is owned and managed by the Village of Algonquin in a 250 acre corridor known locally as "Woods Creek Riparian Corridor". Interestingly, records from the *History of McHenry County, Illinois* (1922) do not show Woods Creek as a stream south of Algonquin Road when farming practices were less common but rather as a complex of springs, seeps, and fens. Much of Woods Creek south of Bunker Hill Drive was excavated by landowners to create a drainage channel making it easier to farm adjacent land.

The upper most reaches of Woods Creek (WCR1 & WCR2) are bordered by relatively narrow and degraded old field riparian areas. The stream channel is actively widening and downcutting due to an increase in the volume of stormwater entering this reach via a stormsewer originating from recently developed areas in the southeast portion of the watershed. The channel bottom is mostly sand, gravel, and cobble. In addition, debris loading is not problematic in these reaches.

Reach WCR3 north to Bunker Hill Drive (WCR5) is highly channelized but the restored prairie riparian buffer is wide (greater than 100 feet) and in fair to good ecological condition. Streambank erosion is moderate to high while silt and sand accumulation in these reaches is moderately high. Debris loading is not problematic in this reach.

Woods Creek is naturally meandering north of Bunker Hill Drive to Algonquin Road (WCR6 and WCR8). Reach WCR7 is a drainage channel that was excavated in the past west of Woods Creek/just north of Bunker Hill Drive in an attempt to drain the wet riparian area for farming. This drainage channel carries very little water during base flow conditions. The riparian area adjacent to Woods Creek between Bunker Hill Drive and Algonquin Road is a wide complex of remnant and restored marsh and prairie in fair to good ecological condition. The only debris jam is this stretch of Woods Creek is a beaver dam located just south of Algonquin Road. The dam has been inspected by the Village of Algonquin and determined not to be problematic.

Woods Creek Headwaters (WCR1)

Woods Creek Reach 4 (WCR4)

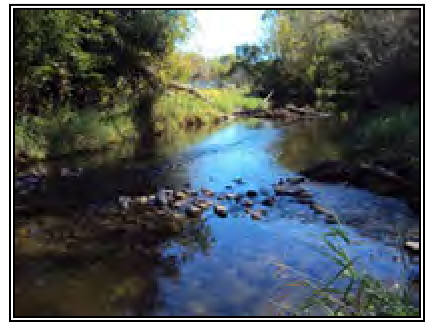
Woods Creek Reach 5 (WCR5)

From Algonquin Road, Woods Creek flows north then east through Ken Carpenter Park to Randall Road (WCR9-WCR11). This section of stream is owned by the Village of Lake in the Hills. Here, the stream has been moderately to severely channelized in the past by landowners and exhibits moderate to high streambank erosion. The channelization disrupts the natural connection between the stream and the adjacent floodplain. The channel bottom in Reach WCR9 is a mostly cobble while the channel bottom in Reaches WCR10 and WCR11 is mostly sand and silt deposition. Problematic debris jams are not present. The riparian corridor is this stretch is degraded by invasive trees, shrubs, and herbaceous vegetation in some areas and is restored wet and mesic prairie in average ecological condition in other areas.

Woods Creek is naturally meandering through land owned by the Village of Lake in the Hills and The Land Conservancy of McHenry County east of Randall Road to Woods Creek Lake (WCR12). The streambanks in this reach are actively eroding, silt and sand accumulation is moderately high, and debris loads are not present. The remnant wet to mesic prairie riparian buffer is wide and natural but in a degraded state due to dominance by invasive species.

Woods Creek Reach 10 (WCR10)

Woods Creek Reach 11 (WCR11)



Woods Creek Reach 12 (WCR12)

Water flowing over the spillway on the east end of Woods Creek Lake again forms Woods Creek Reach 13 (WCR13). This reach is naturally meandering but the banks are highly modified by adjacent residential development to control erosion. The streambanks in this reach are moderately eroded and the channel is comprised mostly of gravel and cobble. The riparian area is narrow and dominated by manicured turf grass. This is also one of few areas where overbank flooding causes damage to structures (see Section 3.11.5).

Woods Creek Reach 14 (WCR14) flows south under Algonquin Road to Scotty Drive. This is the highest quality reach of stream in the watershed. It exhibits a naturally meandering channel consisting of cobble and gravel that forms a series of natural riffles and pools through a wide and moderate quality riparian corridor. The streambanks are moderately eroded as a result of increased stromwater runoff but problematic debris jams are not present.

The last reach (WCR15) east of Scotty Drive is highly channelized within an older residential development prior to joining Crystal Creek. The channel in this reach is mostly cobble and gravel. The riparian corridor is narrow and dominated by manicured turf grass.

Spillway at Woods Creek Lake

Woods Creek Reach 13 (WCR13)

Woods Creek Reach 14 (WCR14)

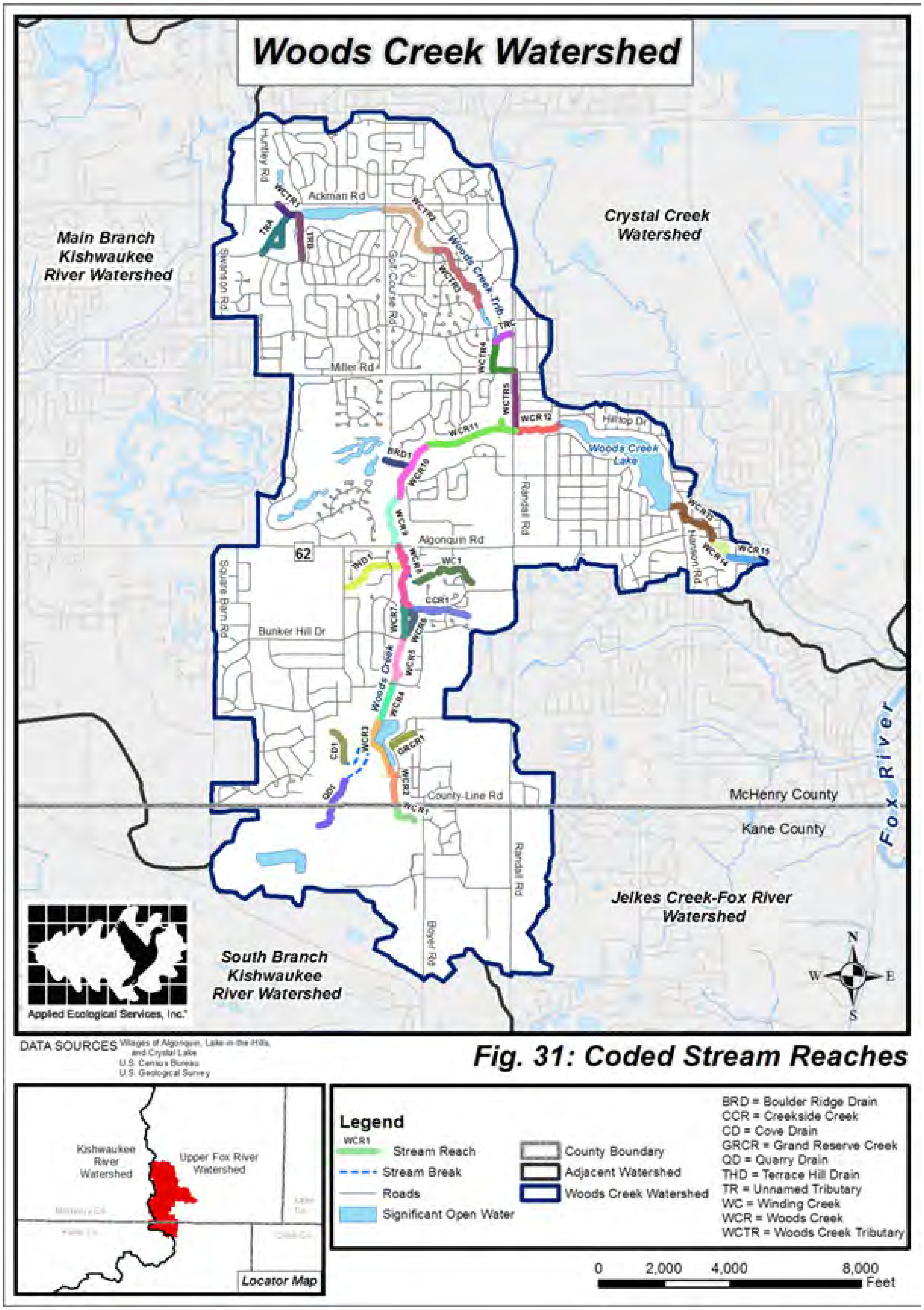


Fig. 31: Coded Stream Reaches

<u>Woods Creek Tributary</u>
Woods Creek Tributary (Reach WCTR) begins south of Ackman Road near the intersection with Huntley Road in the City of Crystal Lake and flows east then southeast for about 1.8 miles before joining Woods Creek at Richard Taylor Park in Lake in the Hills (Table 13; Figure 31). Five different Reaches (WCRT1-WCRT5) were delineated along Woods Creek Tributary.

The first small reach of Woods Creek Tributary (WCRT1) flows to the pond at Woodscreek Park. Streambank erosion and sediment deposition is minimal but the riparian area is small and dominated by invasive plant species.

Woods Creek Tributary Reach 2 (WCTR2) begins on the east side of Golf Course Road and flows southeast through Fetzner Park (owned by Crystal Lake Park District) where it is highly channelized with a narrow degraded riparian buffer consisting of invasive trees and manicured turf grass. Streambank erosion in this reach is minimal. The channel bottom is comprised on cobble but sand and silt are moderately accumulated. Problematic debris jams are not present.

Woods Creek Tributary Reach 3 and 4 (WCTR3 and WCRT4) flow southeast beginning where Fetzner Park ends and becomes residential subdivisions in Crystal Lake. This stretch of stream is naturally meandering within a moderately wide (50 feet) riparian buffer to Miller Road. The ecological condition of the riparian buffer in this reach is generally average. In addition, streambank erosion is low to moderate and no problematic debris jams are present. Sediment accumulation is low and the channel bottom is mostly gravel and cobble.

Woods Creek Tributary Reach 5 (WCTR5) is channelized east under Randall Road then south along Randall Road to Woods Creek within Lake in the Hill's Richard Taylor Park. Interestingly, aerial imagery as far back as 1939 shows Woods Creek Tributary flowing south of Miller Road on the west side of Randall Road through what is now Ken Carpenter Park. The riparian buffer is degraded/second growth woodland. Streambanks are stable and sediment accumulation is low.

Woods Creek Trib. Reach 2 (WCTR2)

Woods Creek Trib. Reach 3 (WCTR3)

Woods Creek Trib. Reach 5 (WCTR5)

Tributary Streams

Ten additional small tributary streams join Woods Creek and Woods Creek Tributary (Table 13; Figure 31). Together these tributaries total approximately 3 miles. Several tributaries drain land near the headwaters of Woods Creek and Woods Creek Tributary while others drain golf courses, a gravel quarry, and residential areas. A brief description of each tributary stream is included below.

Boulder Ridge Drain (BRD)

Quarry Drain (QD)

Tributary A (TRA)

Quarry Drain (QD): This small stream originates at Plote Gravel Quarry and flows northeast for 1,864 linear feet prior to entering Spella Park Wetland where it becomes a series of wetland swales that continue to Woods Creek Reach 3 (WCR3).

Cove Drain (CD): This 1,070 foot tributary flows south along "Algonquin Hanging Fen" prior to entering a series of swales within Spella Park Wetland. It is highly channelized and appears to be a drainage ditch excavated for farming purposes.

Grand Reserve Creek (GRCR): This 736 foot channelized stream flows southwest through Grand Reserve Subdivision prior to entering a large detention pond on the east side of Woods Creek Reach 3 (WCR3). The Village of Algonquin stabilized the eroded banks along this tributary in 2011.

Creekside Creek (CCR): This narrow 2,422 foot stretch of stream meanders through protected natural areas prior to joining Woods Creek Reach 6 (WCR6) from the east.

Winding Creek (WC): This small seep flows through "Winding Creek Fen" and other protected areas for 1,938 linear feet prior to joining Woods Creek Reach 8 (WCR8).

Terrace Hill Drain (THD): This 2,292 foot tributary originates at a culvert draining Terrace Hill Golf Course then meanders through a protected riparian corridor prior to joining Woods Creek Reach 8 (WCR8).

Boulder Ridge Drain (BRD): This short (833 linear feet) tributary originates from a culvert draining Boulder Ridge Golf Course then flows through a ditch to Woods Creek Reach 10 (WCR10).

Tributary A (TRA): This 2,534 foot tributary is an old farm ditch excavated through a wetland complex. It flows northeast and enters Woods Creek Tributary Reach 1 (WCTR1) west of Woodscreek Park.

Tributary B (TRB): This 1,407 foot tributary begins at a series of detention basins and flows north through a ditch to Woods Creek Tributary Reach 1 (WCTR1) just west of the pond at Woodscreek Park.

Tributary C (TRC): This 537 linear foot tributary is a drainage channel extending from Randall Road to Woods Creek Tributary Reach 4 (WCTR4).

Stream Channelization

Riffles and pools are generally associated with naturally meandering streams and 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 typically piled soils excavated from the channel. These spoil piles often inhibit natural flooding into adjacent floodplains. All stream reaches in the watershed were characterized as having none to low channelization (highly sinuous, no human disturbance), moderate channelization (some sinuosity but altered), or high channelization (straightened by humans).

According to the stream inventory, 36% (17,970 lf) of stream and tributary length is naturally meandering; approximately 15% (7,295 lf) is moderately channelized; 49% (24,160 lf) is highly channelized. The most severe channelization is found along Woods Creek between Boyer Road and Bunker Hill Road (WCR1-WCR5), between Algonquin Road and Randall Road (WCR9-WCR11), and along Woods Creek Tributary east of Woodscreek Park (WCTR2) and near Miller road south to Woods Creek (WCTR4 and WCTR5).

Channelization along Woods Creek Reach 4 (WCR4)

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. Table 14 and Figure 32 summarize and depict the location and severity of channelized stream and tributary reaches in the watershed. The Action Plan section of this report addresses opportunities for improving many of these channelized stream reaches.

Table 14. Summary of stream and tributary channelization.

Stream or Tributary Name	Abbreviation	Stream Length Assessed (ft)	None or Low Channelization (ft/%)		Moderate Channelization (ft/%)		High Channelization (ft/%)	
Woods Creek	WCR	24,177	8,425	35%	4,598	19%	11,154	46%
Woods Creek Trib.	WCTR	9,615	2,893	30%	0	-	6,722	70%
Quarry Drain	QD	1,864	0	-	1,864	100%	0	-
Cove Drain	CD	1,070	0	-	0	-	1,070	100%
Grand Reserve Creek	GRCR	736	0	-	0	-	736	100%
Creekside Creek	CCR	2,422	2,422	100%	0	-	0	-
Winding Creek	WC	1,938	1,938	100%	0	-	0	-
Terrace Hill Drain	THD	2,292	2,292	100%	0	-	0	-
Boulder Ridge Drain	BRD	833	0	-	833	100%	0	-
Unnamed Tributary A	TRA	2,534	0	-	0	-	2,534	100%
Unnamed Tributary B	TRB	1,407	0	-	0	-	1,407	100%
Unnamed Tributary C	TRC	537	0	-	0	-	537	100%
Totals		**49,424**	**17,970**	**36%**	**7,295**	**15%**	**24,160**	**49%**

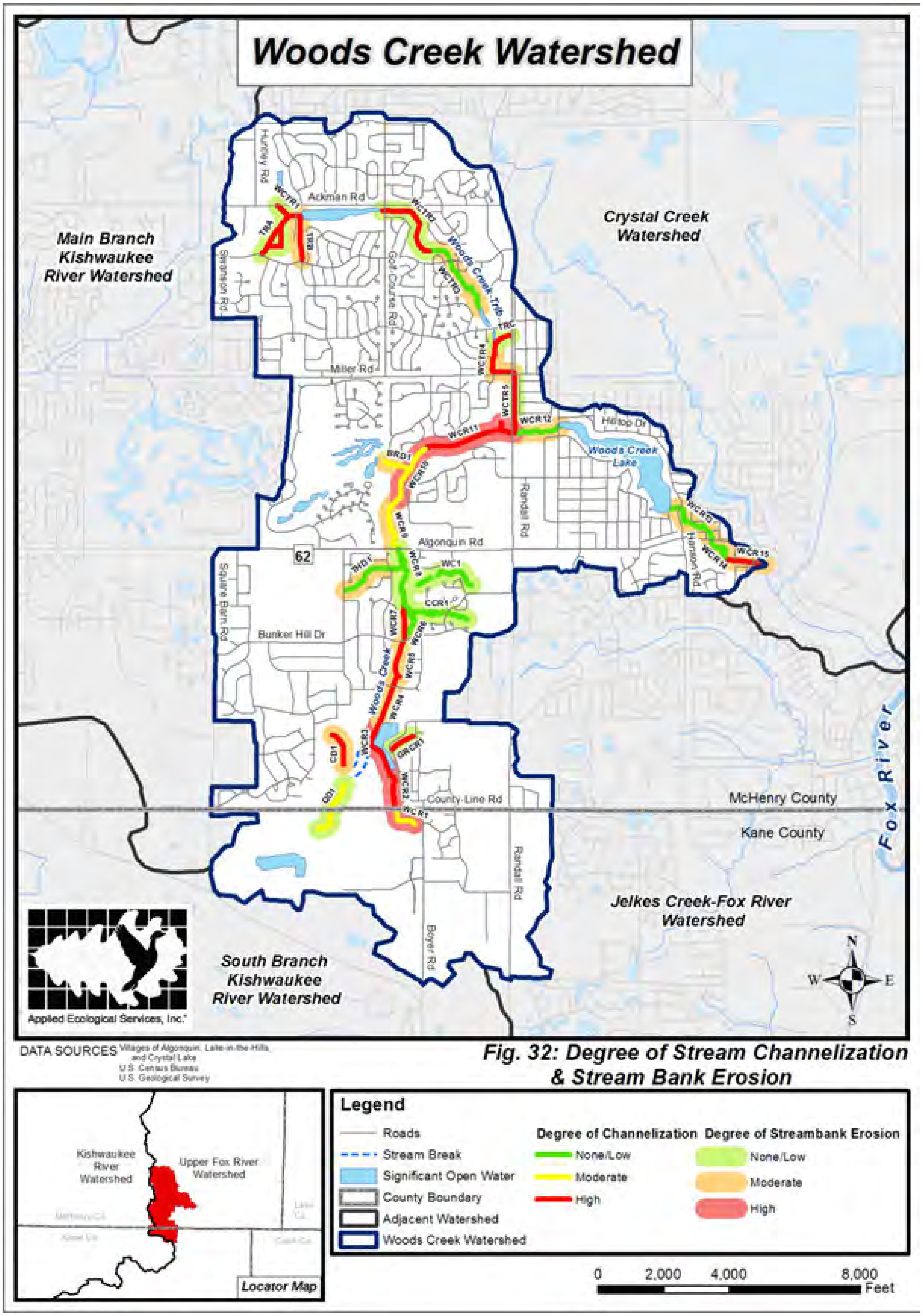


Fig. 32: Degree of Stream Channelization & Stream Bank Erosion

Streambank Erosion

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 causes significant water quality problems. Streambank erosion is moderate on average and is a reflection of increased impervious cover and stormwater runoff in the watershed. Watershed data indicates that streambank erosion is one of the leading causes of sedimentation in the watershed, especially for Woods Creek Lake.

Highly eroded banks along Woods Creek Reach 10 (WCR10)

Approximately 38% (18,793 lf) of the total stream and tributary length exhibits no or low bank erosion while moderate erosion is occurring along 44% (21,673 lf) of streambanks. Highly eroded streambanks are observed along the headwaters reaches of Woods Creek and between Algonquin Road and Randall Road accounting for 18% (8,960 lf) of the total stream length. These reaches are considered “Critical Areas” because they are actively contributing significant sediment loads downstream.

All highly eroded and some moderately eroded streambanks provide excellent opportunities for streambank stabilization projects. The location and severity of streambank erosion in the watershed is summarized in Table 15 and depicted on Figure 32. The Action Plan section of this report addresses and prioritizes opportunities for reducing streambank erosion.

Table 15. Summary of stream and tributary bank erosion.

Stream or Tributary Name	Abbreviation	Stream Length Assessed (ft)	None or Low Erosion (ft/%)		Moderate Erosion (ft/%)		High Erosion (ft/%)	
Woods Creek	WCR	24,177	3,600	15%	11,618	48%	8,960	37%
Woods Creek Trib.	WCTR	9,615	5,162	54%	4,453	46%	0	-
Quarry Drain	QD	1,864	1,864	100%	0	-	0	-
Cove Drain	CD	1,070	0	-	1,070	100%	0	-
Grand Reserve Creek	GRCR	736	736	100%	0	-	0	-
Creekside Creek	CCR	2,422	2,422	100%	0	-	0	-
Winding Creek	WC	1,938	1,938	100%	0	-	0	-
Terrace Hill Drain	THD	2,292	0	-	2,292	100%	0	-
Boulder Ridge Drain	BRD	833	0	-	833	100%	0	-
Unnamed Tributary A	TRA	2,534	2,534	100%	0	-	0	-
Unnamed Tributary B	TRB	1,407	0	-	1,407	100%	0	-
Unnamed Tributary C	TRC	537	537	100%	0	-	0	-
Totals		**49,424**	**18,793**	**38%**	**21,673**	**44%**	**8,960**	**18%**

Riparian Area Condition

Riparian corridors buffer streams and tributaries by filtering pollutants from runoff during flood events. Buffers also provide beneficial wildlife habitat and extend or connect green infrastructure. The riparian corridor along streams and tributaries was assessed during the stream inventory by noting the "Condition" as it relates to riparian area function and quality of plant communities present. Riparian areas in "Good" condition typically 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 and have been heavily farmed in the past causing degraded plant communities to establish.

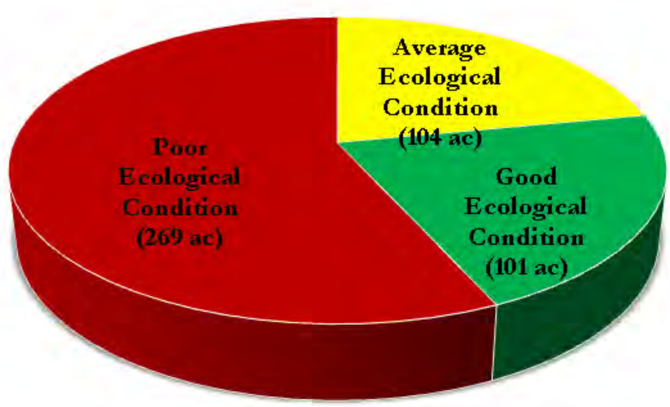


Figure 33. Summary of stream and tributary riparian area condition.

Approximately 474 riparian area acres comprised mostly of prairie, wet prairie, fen, and marsh were delineated along the streams and tributaries in the watershed (Figure 34). Of this, 269 acres (57%) is considered "Poor" ecological quality, 104 acres (22%) of the riparian area is "Average" ecological quality, and the remaining 101 acres (21%) is "Good" ecological quality (Figure 33). The majority of poor quality areas are located at the headwaters of Woods Creek, between Algonquin Road and Woods Creek Lake, and at the headwaters and narrow buffers along Woods Creek Tributary. Average quality riparian areas are scattered throughout the watershed but generally include areas where ecological restoration has been implemented. Riparian areas in good condition are all located south of Algonquin Road in areas where high quality remnant plant communities or ecological restoration has occurred.

Altered hydrology and invasive species are the leading causes of degraded conditions in the wetland riparian areas. Common reed (*Phragmites australis*), purple loosestrife (*Lysimachia salicaria*), reed canary grass (*Phalaris arundinacea*), common buckthorn (*Rhamnus catharitica*), sandbar willow (*Salix interior*), box elder (*Acer negundo*), and eastern cottonwood (*Populus deltoids*) are among the most abundant and problematic invasive plants. Fortunately, ecological restoration helps eradicate these species and encourages native plant establishment. The Action Plan section of this report lists and prioritizes opportunities for improving riparian areas through ecological restoration.

Invasive reed canary grass along Woods Creek Reach 12

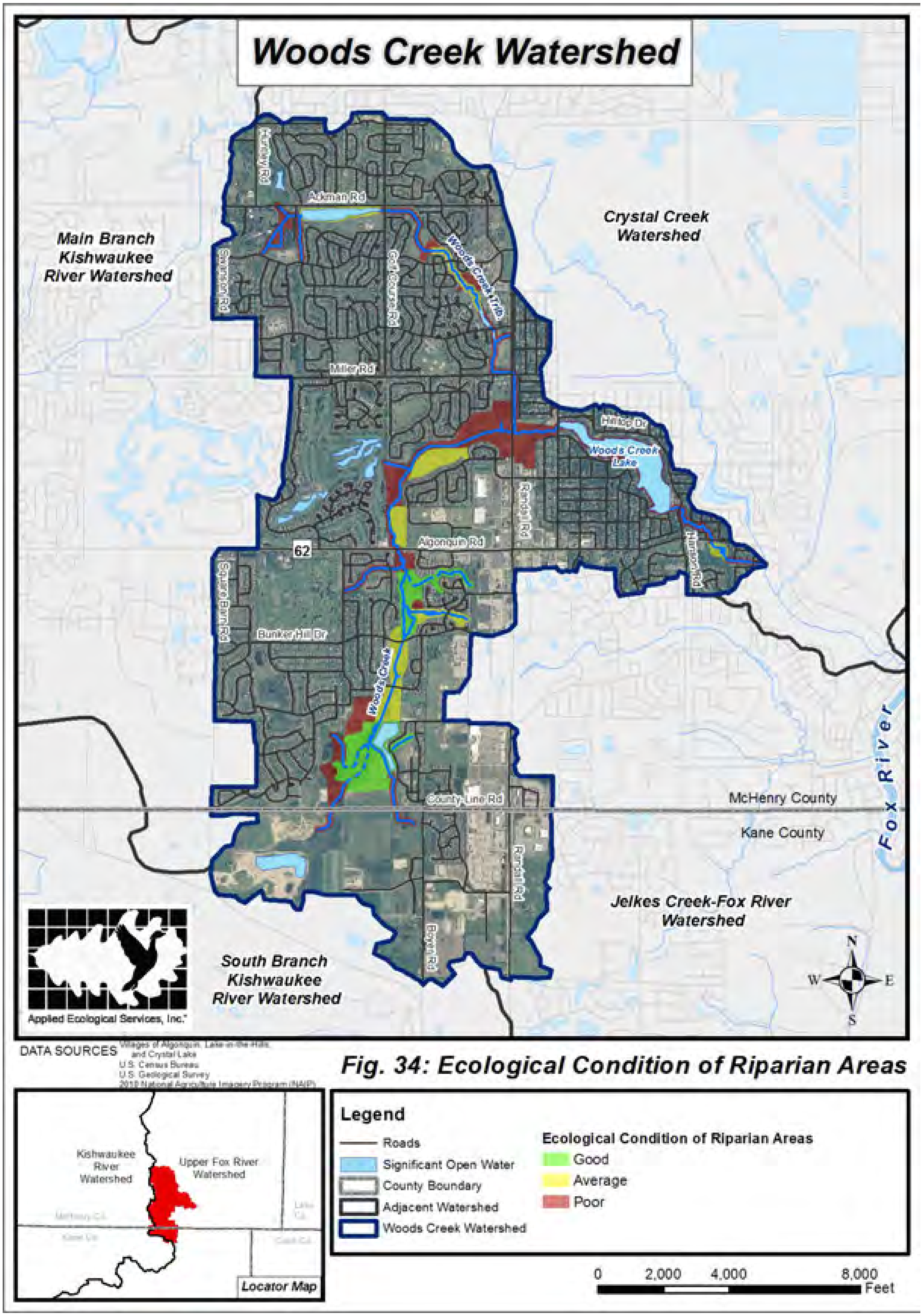


Fig. 34: Ecological Condition of Riparian Areas

3.11.2 Detention Basins

Development since the early 1990s significantly changed the way stormwater flowed across the land. Prior to the mid 1990s most stormwater sheet flowed or was tile drained off agricultural fields throughout much of Woods Creek watershed. Planners and engineers quickly realized the benefits of storing stormwater runoff in detention basins. Detention basins are human made structures for the temporary storage of stormwater runoff with a controlled release rate. The controlled release rate for most basins in the watershed is between 0.04 and 0.05 cfs/ac as regulated by county stormwater ordinances. 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. Today, detention basins capture stormwater runoff from at least 50% of the watershed making the quality of water leaving these basins critically important to the health of Woods Creek Lake downstream.

Basins can be constructed to be wet bottom, wetland bottom, or dry bottom 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. 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 according to local stormwater ordinance requirements. In addition, several of the dry bottom detention basins located in Crystal Lake are also designed to be infiltration basins.

Woods Creek watershed has 134 known detention basins (Figure 35). Applied Ecological Services, Inc. completed a basic assessment of each detention basin in fall 2011. Assessment methodology included a visit to each site and collection of data related 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 B. Twenty nine (29) dry bottom turf grass, 28 wet or wetland bottom w/turf grass slopes, 10 naturalized dry bottom, and 67 naturalized wet or wetland bottom basins were assessed (Figure 35).

Of the 134 basins, only 9 (7%) provide "Good" ecological and water quality benefits while 34 (26%) basins provide "Fair" benefits. The majority of the basins (91 (68%) provide "Poor" ecological and water quality benefits because most were designed simply for stormwater storage and did not necessarily consider designs that would also improve water quality and wildlife habitat.

Typical dry bottom turf grass detention at Fetzner Park.

The majority of dry bottom detention basins are located north of Algonquin road within residential areas in the Village of Lake in the Hills, City of Crystal Lake, and within parks owned by the Crystal Lake Park District. Many are turf grass bottom basins that do little to improve water quality or promote infiltration to replenish groundwater. This is because 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. It should be noted however that several dry bottom detention areas in Crystal Lake are designed to infiltrate water. Many of the dry bottom turf grass basins in the watershed are used for recreational purposes and are not good naturalization retrofit options. Others are not heavily used and are excellent retrofit opportunities. And, most dry bottom basins are relatively easy to naturalize with native plantings. Naturalized dry bottom basins also provide excellent wildlife habitat and expand green infrastructure. All dry bottom basins in the watershed are maintained by either homeowner or business associations, Crystal Lake Park District, or municipalities.

Typical wet bottom turf grass slope detention at The Coves subdivision.

Wet and wetland bottom detention basins are the most common in the watershed. Individual development sites tend to have basins that are all similarly planted. For example, most wet and wetland bottom basins in a development are planted with either 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 aesthetics 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 require minimal maintenance. Most if not all wet and wetland bottom basins in the watershed are maintained by either homeowner or business associations, Crystal Lake Park District, or municipalities.

Approximately half of the wet and wetland bottom detention basins in the watershed are naturalized with native vegetation. Of these, most are owned by homeowner and business associations that have limited knowledge related to managing naturalized detention basins or hire contractors not qualified to manage natural areas. The result is basins that are overgrown with non-native and invasive species that provide limited ecological and water quality benefits. It is important for homeowner and business associations to begin implementing appropriate management by qualified ecological contractors. Management recommendations for naturalized detention basins are included in the Site Specific Management Measures Action Plan.

Properly designed naturalized wet bottom detention behind Wal-Mart.

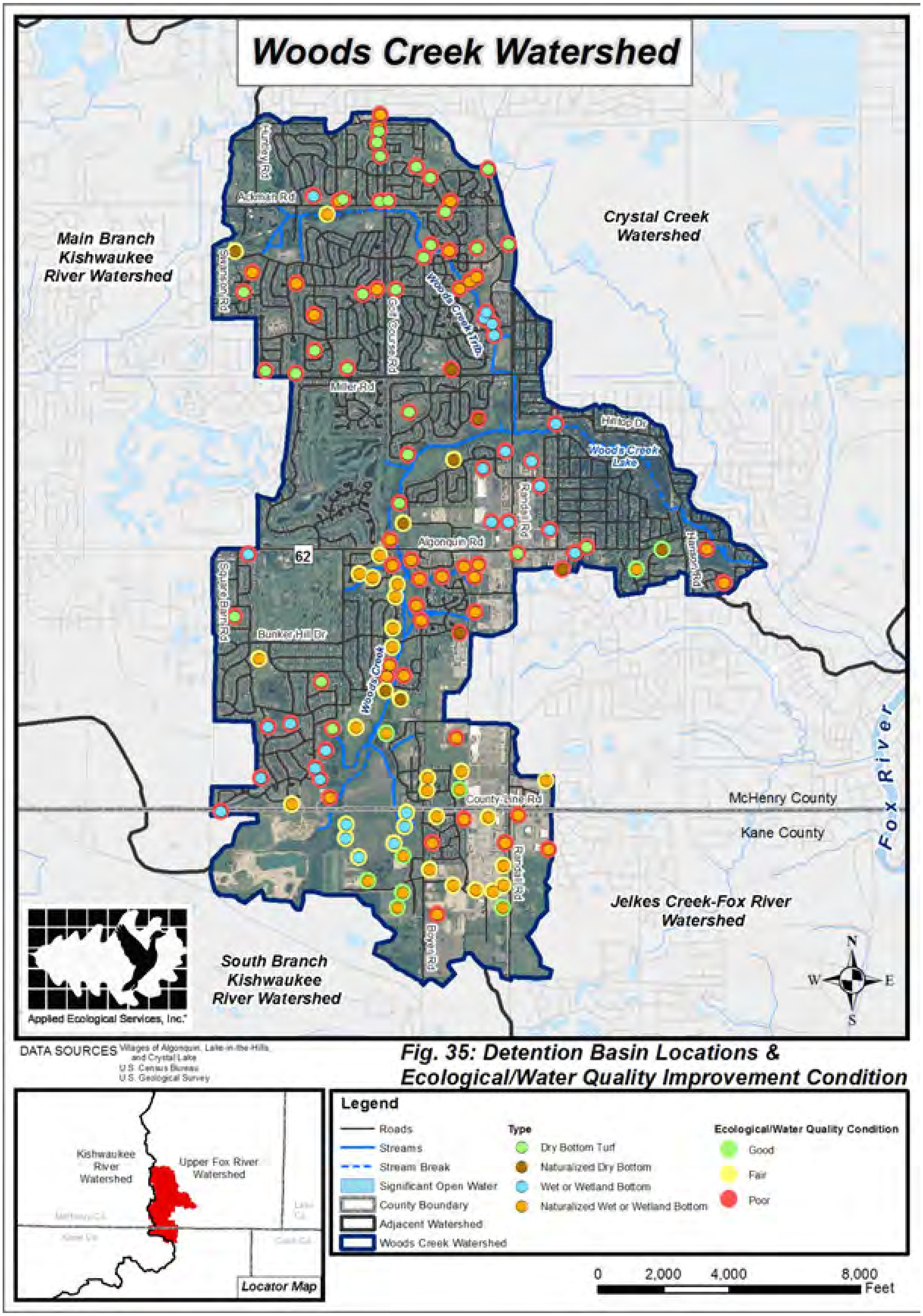


Fig. 35: Detention Basin Locations & Ecological/Water Quality Improvement Condition

3.11.3 Woods Creek Lake

Woods Creek Lake is the only lake in Woods Creek watershed. Ninety five percent (95%) or 5,292 acres of the watershed drain to the lake. The lake was formed prior to 1923 by the creation of an earthen dam and concrete spillway across Woods Creek. Pre-European settlement vegetation mapping shows the area as "Timber" (oak-hickory woodland and savanna). Surviving oak and hickory trees can still be observed within the residential community surrounding the lake but the understory vegetation has been removed. By the late 1940s lake property was up for public sale and in 1952 the Village of Lake in the Hills was incorporated which brought the lake under public ownership. Homes around the lake were serviced by individual septic systems prior to 1964. By the mid 1960s Lake in the Hills Sanitary District converted all homes to a public sewer system. In addition, the entire watershed upstream from the Lake is also serviced by a public sewer system.

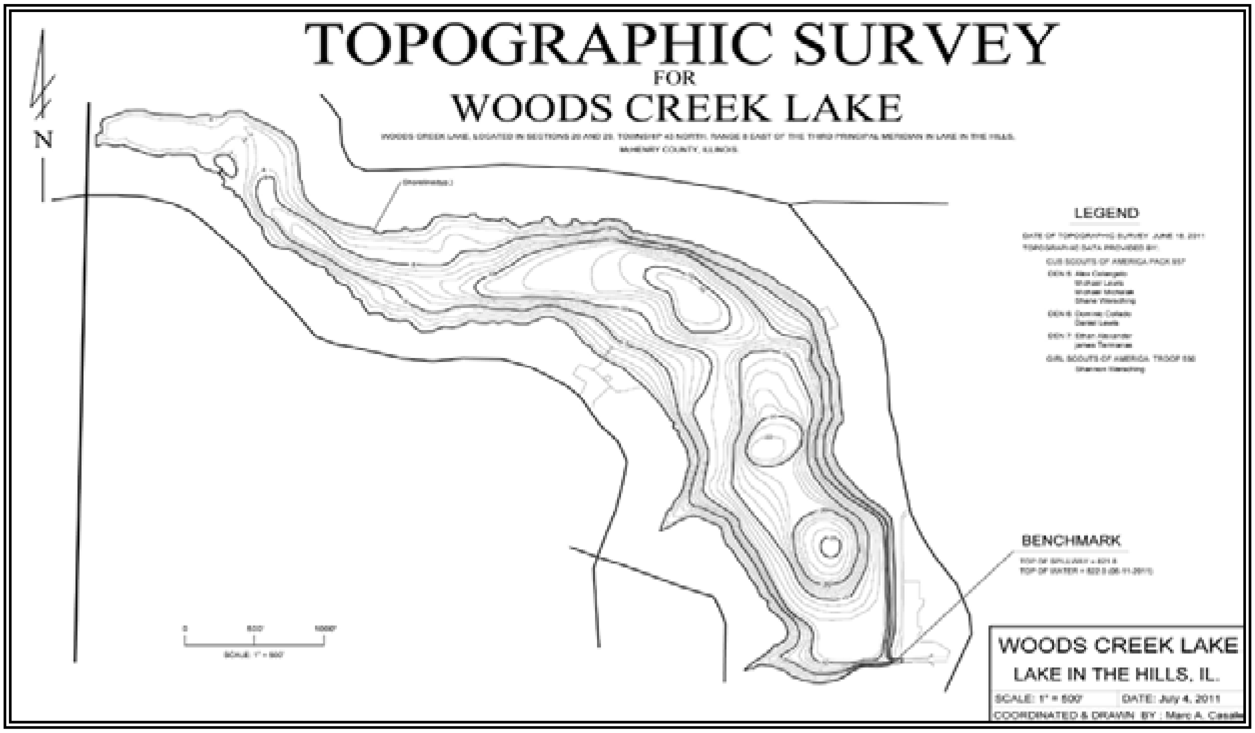
Today, the lake remains public and is surrounded by over 150 residential homes. The Village of Lake in the Hills currently has six public access points at Indian Trail Beach, Hilltop Beach, Nockels Park, Turtle Island Park, La Buy Park, and Echo Hill Park.


View of Woods Creek Lake from Indian Trail Beach and Turtle Island.

The most comprehensive study of Woods Creek Lake was conducted by Lake in the Hills in 2000. The study entitled "Clean Lakes Program Phase I Diagnostic-Feasibility Study of Woods Creek Lake" (LITH 2000) was completed via cooperation with the Illinois Environmental Protection Agency. The study includes a lake assessment and lake management plan that aims to restore and protect the lake's beneficial uses. Much of the information below is derived from this study.

Woods Creek Lake is a 52 acre eutrophic (fertile with substantial plant growth) lake with an average depth of 11.5 feet and maximum depth of 25 feet near the dam (Figure 36). The total shoreline length is 11,700 feet. The western third of the lake is relatively shallow where Woods Creek enters and deposits sediment. This sediment deposition allows for heavy aquatic plant growth transitioning to moderate growth then light growth moving east toward the dam. An aquatic plant survey conducted in 1997 found 8% of the lake with slight plant coverage, 10% with medium coverage, and 36% with high coverage. Total plant cover was estimated at 54%. According to the Illinois Department of Natural Resources (IDNR 2009), healthy lakes exhibit between 20-40% aquatic plant cover. Invasive Eurasion watermilfoil (*Myriophyllum spicatum*) and native coontail (*Ceratophyllum demersum*) are the most common plants in the lake and are found primarily in 5-10 foot water depths.

Figure 36. Bathymetric map of Woods Creek Lake.



According to the 2000 Diagnostic-Feasibility Study, Illinois EPA's Ambient Lake Monitoring Program (ALMP) data from 2007, and Volunteer Lake Monitoring Program (VLMP) data from 2000 to 2011, the overall water quality in Woods Creek Lake is generally good and ranked in the top 20% of all lakes sampled in Illinois in the late 1990s and early 2000s. Moderate spikes in total phosphorus (TP) and sediment deposition in the upper end of the lake appear to be the biggest water quality problems. In the early 1990s 27,000 cubic yards of sediment was removed from upper end of the lake over three phases. The most recent Illinois Environmental Protection Agency 303D Impaired Waters Lists from 2010 and 2012 Draft include Woods Creek Lake as Non-Supporting for *Aesthetic Quality* and *Fish Consumption*. A detailed summary of water quality in Woods Creek Lake and the remainder of the watershed can be found in Section 3.13.

Improvements to the dam at Woods Creek Lake occurred in the mid 1980s with reinforcement with gabion baskets. The Village of Lake in the Hills currently conducts annual fall drawdown of the lake for dam inspection and shoreline cleanup. Drawdown is 4-5 feet via a siphon outlet structure at the dam that occurs for about 1-2 weeks. This drawdown may be leading to some of the shoreline erosion discussed below.

Dam on east end of Woods Creek Lake

A shoreline erosion assessment was conducted in the late 1990s identifying 846 linear feet (7%) of highly eroded shoreline (3+ vertical feet eroded), 2,563 linear feet (22%) of moderately eroded shoreline (1-2 vertical feet eroded), and 8,291 linear feet (71%) exhibiting only slight or no shoreline erosion (0-1 vertical foot eroded). However, the location of these areas is not documented. LITH was able to provide information about highly eroded areas at LITH owned parks as shown on Figure 37. Some of this erosion is thought to be the result of annual water drawdown in fall which leads to soil sloughing.

Figure 37. Highly eroded shorelines at LITH owned parks.

Controlling shoreline erosion by installing native plant buffers is a recommendation made in both the 2000 Study and 2008 IDNR Fish Survey Report. Figure 38 demonstrates how lake shoreline owners can balance recreational shoreline uses with natural buffers. The Action Plan section of this report includes site specific buffer and shoreline stabilization recommendations.

Figure 38. Example shoreline buffer with recreational use areas.

Woods Creek Lake supports a good fishery with diverse and abundant fish community according to a recent study conducted by the Illinois Department of Natural Resources in September 2008 (IDNR 2009). Three hundred seventy nine (379) fish representing 15 species were collected during the survey. Bluegill made up 53% of the catch followed by largemouth bass (14%), and bluntnose minnow (12%). Others species include green sunfish, golden shiner, warmouth, yellow perch, yellow bullhead, hybrid sunfish, quillback, walleye, common carp, channel catfish, northern pike, black crappie, and white crappie.

The largemouth bass population is generally good but lack of yearlings in the survey indicates poor spawning success. Bluegill are in high abundance and relatively large. Moderate populations of catfish, walleye, and northern pike also give anglers opportunities to catch various gamefish species. The IDNR 2009 Fish Survey Report makes several recommendations related to lake nutrients, aquatic plants, and fish community:

1) Lakeshore homeowners should practice good lawn fertilizing techniques and establish buffers of native vegetation.
2) Encourage lakeshore landowners to introduce native emergent plants along shoreline areas.
3) Establish submerged aquatic plant communities that cover approximately 20% of the lake's surface area.
4) Continue to stock largemouth bass, walleye, channel catfish, and northern pike at rates recommended in IDNR's 2009 Fish Survey Report.
5) Retrofit the spillway with a horizontal bar spillway screen to prevent stocked fish from escaping.
6) Remove invasive/non-native common carp from lake whenever possible.
7) Harvest fish using recommended creel and size limits in IDNR's 2009 Fish Survey Report.

The 2000 Diagnostic-Feasibility Study includes a survey of over 200 residents living along or near Woods Creek Lake. The results indicate that residents favor the aesthetic quality of the lake over all other uses and point to nuisance aquatic weeds as the number one issue of concern. Five goals were also developed under the study and coincide with most recommendations made by IDNR:

1) Improve lake clarity through sediment and nutrient watershed management.
2) Implement shoreline projects for water quality and wildlife.
3) Manage nuisance aquatic plant growth.
4) Sustain a long term balanced fishery.
5) Introduce volunteer training and information programs.

A variety of Management Measure projects have been implemented by Lake in the Hills within and along Woods Creek Lake since the early 1990s. Many of these measures follow recommendations made in the 2000 Diagnostic-Feasibility Study and IDNR 2009 Fish Survey Report. Some of these projects include installation of rain gardens at Nockels Park and La Buy Park. Erosion control measures have been installed around Turtle Island at Turtle Island Park. The Village is also stocking gamefish based on IDNR recommendations.

Rain garden features at Nockels Park and La Buy Park

3.11.4 Wetlands & Potential Wetland Restoration Sites

Most of the wetlands in Woods 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. Where it was feasible wet areas were drained, streams channelized, and savanna and prairie cleared to farm the rich soils. There were approximately 1,479 acres of wetlands 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, 423.3 acres or 28.6% of the pre-European settlement wetlands remain (Figure 39).

Functional wetlands do more for water quality improvement and flood reduction than any other natural resource. In addition, wetlands typically provide habitat for a wide variety of plant and animal species. They also provide groundwater recharge and discharge, filter sediments and nutrients, and maintain water levels in streams during drought periods. Wetland information and mapping is available for the entire Woods Creek watershed via advanced wetland inventories and identification studies (ADID) for McHenry and Kane Counties. The wetland data was used to map and describe the existing wetlands in the watershed and to locate potential wetland restoration sites.

Wetland complex at Willows Edge Park

McHenry and Kane County ADID Wetland Inventories

The McHenry County ADID wetland inventory (NIPC 1998) was developed in 1998 and uses methodology similar to that used in nearby Lake County as well as other documented methods. The Kane County ADID wetland inventory (NIPC 2004) was completed in 2004 and builds on methods used in both Lake and McHenry Counties. Methods include evaluation of USDA wetland inventory maps, National Wetland Inventory (NWI) maps, county soil surveys, and low altitude aerial imagery. Site inspections are often conducted to verify the quality of wetlands. The ADID studies are designed to do two things: 1) identify the functions of individual wetlands and 2) identify wetlands of such high value that they merit special consideration for protection. Wetlands are ultimately categorized as "High Functional Value", "High Habitat Value", and "Other Wetlands".

Thirty nine (39) individual wetland complexes were identified in the Woods Creek watershed. Of these, 3 are "High Functional Value", 2 exhibit "High Habitat Value", and the remainder are classified as "Other Wetlands". Data for each "High Functional Value" and "High Habitat Value" wetland is summarized in Table 16. Note: where applicable, Applied Ecological Services, Inc. (AES) adjusted ADID wetland boundaries based on field reconnaissance observations conducted in fall 2011.

Table 16. McHenry & Kane Counties ADID wetlands and attributes.

ADID ID #	Acres	ADID Attributes
L127	15.6	**High Functional Value**: High stormwater storage capacity and sediment & nutrient removal.
L157	175.7	**High Quality Habitat:** Fen, sedge meadow, and wet mesic prairie remnants threatened by invasive species, brush invasion, drainage, and development.
L323	5.6	**High Functional Value:** High stormwater storage capacity and sediment & nutrient removal.
L331	24.4	**High Quality Habitat:** Diverse fen wetland remnant threatened by siltation & brush invasion.
K1638	5.6	**High Functional Value:** High stormwater storage capacity and sediment & nutrient removal.

Source: McHenry and Kane County ADID Wetland Inventories

Most of the existing wetlands in Woods Creek watershed were inspected by AES in fall 2011 during reconnaissance of the watershed (Appendix B). In general, the wetlands in the watershed were disturbed by farming practices at some point in the last 150 years to the extent that hydrology has changed and invasive species such as common reed, reed canary grass, purple loosestrife, and buckthorn shrubs now dominate. Higher quality wetland remnants are also in decline primarily as a result of groundwater and surface water hydrology changes and shrub/tree encroachment. The highest quality fen, seep, and sedge meadow wetland remnants are found south of Algonquin Road within ADID wetland L157 and L331. The ecological significance of these areas is discussed in more detail in Section 3.10.

Noteworthy- Wetland Protection

Protection of ADID wetlands is provided in McHenry and Kane Counties under existing Watershed Development Ordinances and the U.S. Army Corps of Engineers (USACE) via section 404 of the Clean Water Act. The USACE will generally require an Individual Permit (IP) for modifications to ADID wetlands. ADID wetlands are generally considered unmitigatable. In rare cases where mitigation is allowed, as much as a 5:1 mitigation ratio is required. Additionally, ADID wetlands located within developed areas require a 100-foot buffer to aid in protection.

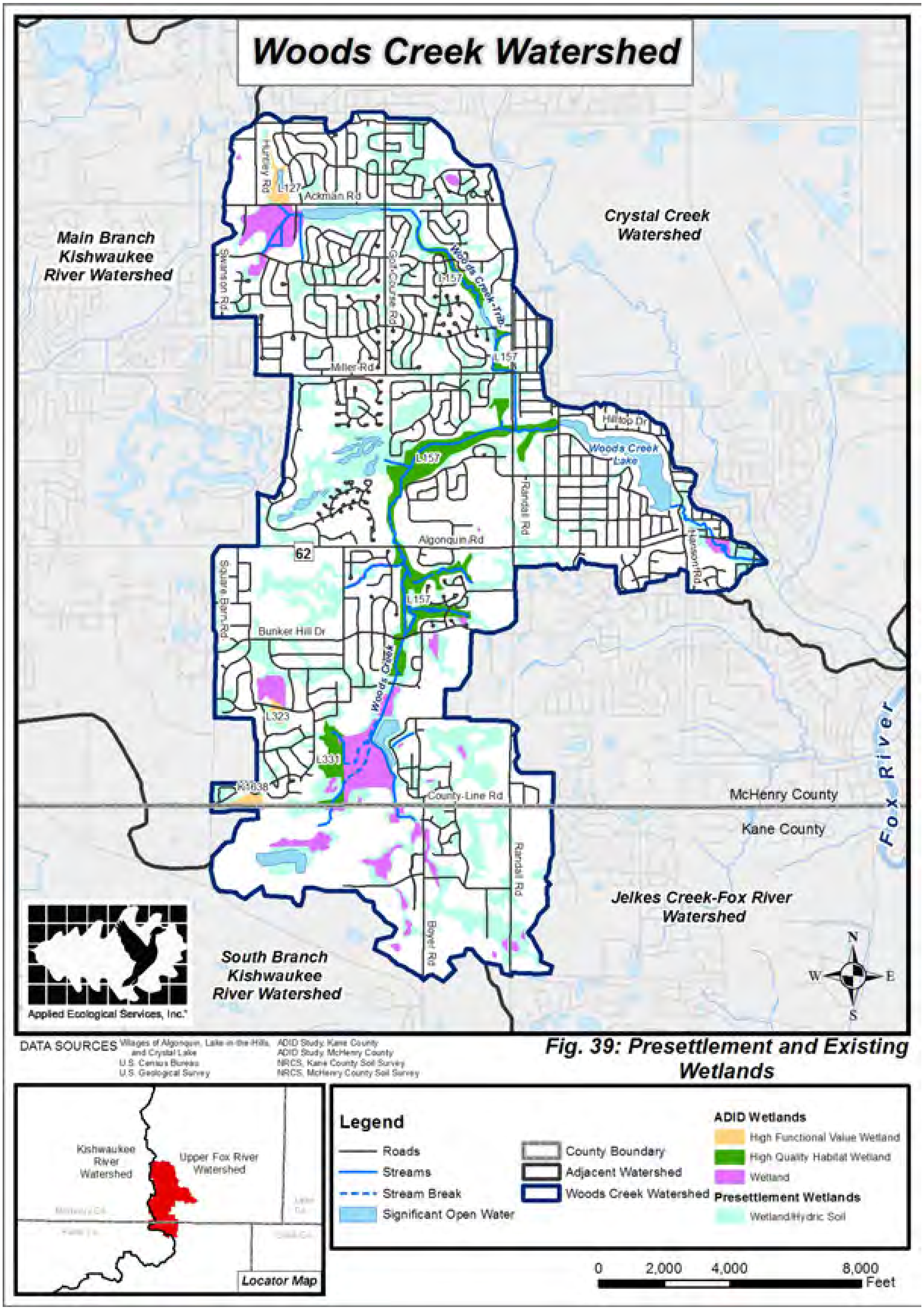


Fig. 39: Presettlement and Existing Wetlands

Potential Wetland Restoration Sites

Wetland restoration projects are among the most beneficial in the context of improving watershed conditions. They are beneficial in improving basic environmental functions that historic wetlands once served such as storing water during flood events, increasing biodiversity, creating green infrastructure, and improving water quality. Wetland restoration projects can also be completed as part of a Wetland Mitigation Bank where developers are able to buy wetland credits for wetland impacts occurring elsewhere in the watershed.

Wetland restoration sites are those where wetlands once existed but no longer exist because of human impacts such as tile draining, filling, or stream channelization. Some of these sites can be restored. Potential Wetland Restoration Sites were identified using a Geographic Information Systems (GIS) exercise and specific criteria determined to be essential for restoration of a functional and beneficial wetland. The criteria used to identify potential sites is as follows:

- *Site with at least 2.5 acres of drained hydric soils located on an open or partially open parcel.*

The initial GIS analysis resulted in 32 sites meeting the above criteria. The extent of development in Woods Creek watershed limits the number and size of potential wetland restoration sites. Only 16 of the original 32 sites were determined to be potentially feasible or have at least limited feasibility after careful review of each site using 2011 aerial photography, open space inventory results, existing (2012) land use, and field visits where appropriate (Table 17; Figure 40). Most of the sites that were eliminated as potential wetland restorations were found in areas that have been converted to detention basins or where existing development simply would not allow for wetland restoration. Note: A feasibility study beyond the scope of this project will need to be completed prior to the planning and implementation of any potential wetland restoration site.

To summarize, the GIS analysis resulted in 7 "Potentially Feasible", and 9 "Limited Feasibility" sites. Most of the potentially feasible wetland restoration sites are located in the southern portion of the watershed where agriculture is common or where existing development is on hold. The largest sites (Site #'s 9-12) are located at Terrace Hill Golf Course and Boulder Ridge Country Club. However, these sites present limited feasibility at best because historic wetlands are now mostly golf course features. Other large but limited feasibility sites are located along the south portion of the pond at Woodscreek Park (Site #13) extending east along Woods Creek Tributary Reach #2 (WCTR2) (Site #14).

Potential wetland restoration sites are included in the Action Plan section of this report. Site #'s 1, 2, 5, 8, and 16 are discussed in more detail below because of location, size, or potential to remediate watershed problems. These sites are considered "Critical Areas".

- Site #'s 1 and 2 are relatively large (12.1 & 17.5 acres respectively). They are located at the headwaters of Woods Creek in agricultural land that will likely be developed to commercial/retail and industrial use in the future. Site design should take into consideration these naturally low lying areas as potential large scale naturalized wetland bottom detention basins. It is also important to note that this area of the watershed exhibits moderately high potential for aquifer recharge where wetland restoration would be beneficial (see Section 3.12).

- Site #5 is 3.1 acre potential wetland restoration site located at the headwaters of Woods Creek along Reach 1 (WCR1). This is an excellent location to incorporate wetland restoration as part of the planned multifamily residential development surrounding the site. Wetland restoration would also provide a green infrastructure connection south to another existing wetland complex.

- Site #8 is a 14.9 acre drained wetland complex located west of commercial/retail development along Randall Road on a vacant parcel planned as multifamily residential at the headwaters of Grand Reserve Creek. This site provides an excellent location where existing features of the land can be used to incorporate large scale wetland bottom detention basin design with a green infrastructure connection to the restored natural corridor along Grand Reserve Creek.

Potential Wetland Restoration Site #5 at Headwaters of Woods Creek.

- Site #16 is approximately 2.5 acres and abuts recreational use areas to the southeast at Big Sky Park. This portion of the park is hydrologically connected to the large wetland complex to the south within Ken Carpenter Park and was once part of this wetland complex. The area floods occasionally limiting this area of Big Sky Park for recreational use and would therefore be a good location to restore wetlands.

Potential Wetland Restoration Site #16 southeast of recreational use area at Big Sky Park.

Table 17. Potential Wetland Restoration Sites.

ID #	Area (Acres)	Feasibility	Existing Condition
1	12.1	Potentially Feasible	Located on private agricultural land that is likely tile drained. Site is Hydrologically connected to Site #2 west under Randall Rd.
2	17.5	Potentially Feasible	South portion located on private agricultural land; north portion located on partially graded/under construction-industrial land.
3	4.3	Limited Feasibility	Located on private residential lots surrounding existing wetland.
4	2.5	Potentially Feasible	Located in private agricultural area adjacent to existing wetland.
5	3.1	Potentially Feasible	Located at headwaters of Woods Creek along Reach 1 (WCR1) in private agricultural area that is planned for multifamily residential.
6	2.9	Potentially Feasible	Located along the east side of Woods Creek Reach 2 (WCR2). Note: wetland and prairie restoration is planned for this area.
7	3.1	Limited Feasibility	Located on vacant lot that is planned industrial.
8	14.9	Potentially Feasible	Located in vacant parcel that is planned multifamily residential at the headwaters of Grand Reserve Creek (GRCR1).
9	45.3	Limited Feasibility	Large historic wetland complex at Terrace Hill Golf Course. Site is now mostly golf course features such as ponds, fairway, and rough.
10, 11, 12	67.1	Limited Feasibility	Large historic wetland complex at Boulder Ridge Country Club. Site is now mostly golf course features such as ponds, fairway, and rough.
13	11.9	Limited Feasibility	Historic wetland complex south of pond at Woodscreek Park that is now regraded and part of recreational use area.
14	13.9	Limited Feasibility	Historic wetland complex along Woods Creek Tributary Reach #2 (WCR2) in Fetzner Park that is now regraded with dry bottom detentions and recreational use areas.
15	2.5	Limited Feasibility	Located south of Big Sky Park in area that has been regraded and is now recreational use area.
16	2.5	Potentially Feasible	Located southeast of Big Sky Park in recreational use area that floods occasionally.

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

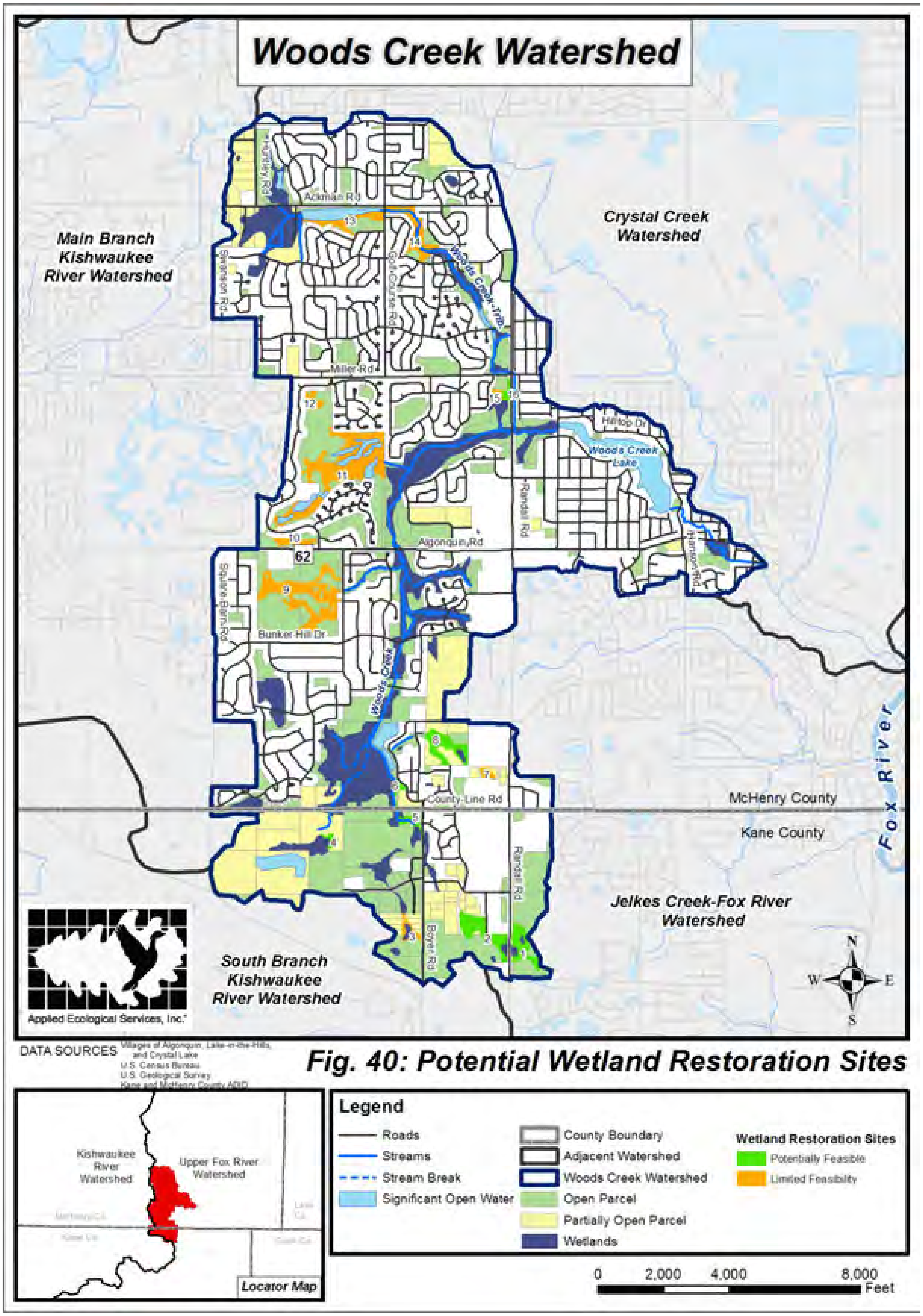


Fig. 40: Potential Wetland Restoration Sites

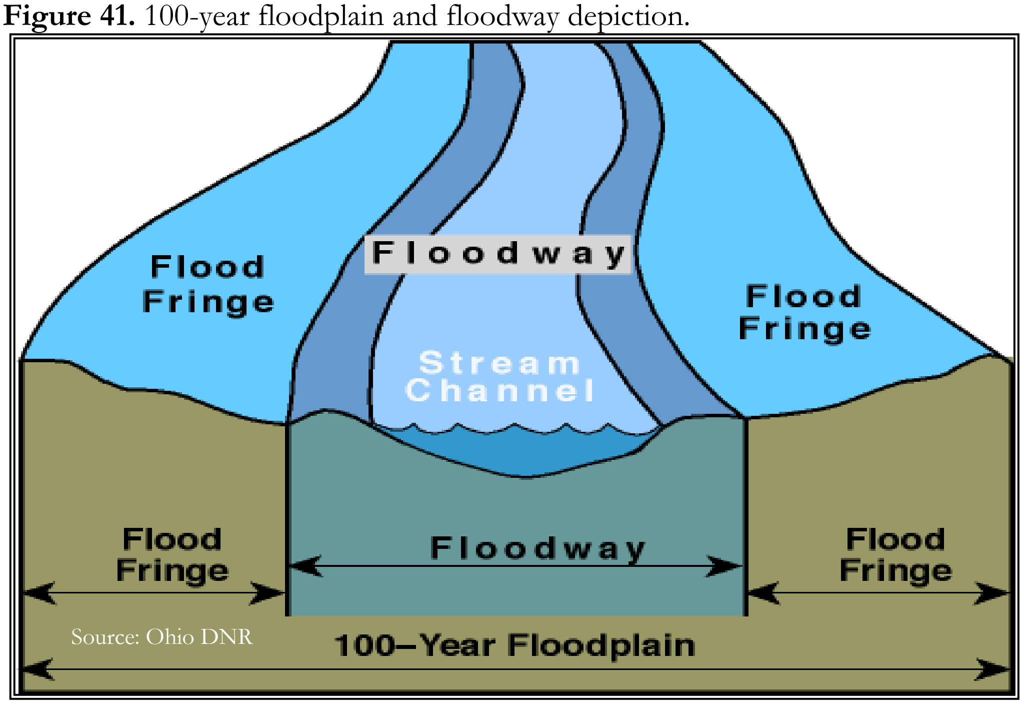
3.11.5 Floodplain & Flood Problem Areas

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 during 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 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 41 below depicts the 100-year floodplain and floodway in relation to a hypothetical stream channel. Figure 42 depicts the 100-year floodplain which occupies 478 acres or 8.7% of Woods Creek watershed. Aside from older residential development that is located in the floodplain between Hilltop Road and Algonquin Road east of Woods Creek Lake, all development that has occurred west of Randall Road since the early 1990s is constructed outside the 100-year floodplain.

Figure 41. 100-year floodplain and floodway depiction.



Documented Flood Problem Areas

For this report, a Flood Problem Area (FPA) is defined as a location where documented flooding can or does cause structural damage. Information about the location and condition of documented FPAs was gathered during one of the watershed stakeholder meetings and discussions with municipal and park district representatives.

Two documented FPAs were identified in the Woods Creek watershed (Figure 42). Information about each FPA is included in Table 18. FPA #1 is located at Wood Creek's intersection with Woods Creek Lane in the Village of Algonquin. During extremely high water events, Woods Creek overtops Woods Creek Lane. This happens because the culverts under Woods Creek Lane are likely undersized and Woods Creek Lane lies relatively low within the FEMA 100-year floodplain. Obvious mitigation opportunities include the construction of a conspan bridge over Woods Creek or increase in existing culvert size. The Village of Algonquin recently implemented a channel maintenance program in this area which is alleviating the flood problem to some degree.

FPA #2 is located downstream from the dam on Woods Creek Lake between Hilltop Drive and Algonquin Road (Route 62) within the Village of Lake in the Hills. Overbank flooding causes structural damage to homes and other buildings located within FEMA's 100-year floodplain. Potential mitigation measures in this area are limited. Options include flood proofing individual structures, increasing flood storage volume upstream, and reducing impervious cover as new and re-development occurs upstream. It is also important to note that the option to alter the outlet at Woods Creek dam to hold additional stormwater is not feasible due to flooding that would occur to structures surrounding Woods Creek Lake. It should also be noted that the dam on Woods Creek Lake is inspected annually by the Village of Lake in the Hills via a drawdown of the water level. This is important because a breach in the dam would result in massive flooding of homes downstream and downtown Algonquin along Route 31.

Table 18. Documented Flood Problem Areas.

Flood Problem Area #	Cause of Flooding	Location/Description	Potential Mitigation Measures
1	Pavement Flooding	Woods Creek floods over Woods Creek Lane within the Village of Algonquin; site is within the 100-year FEMA floodplain	Increase size of culverts or construct conspan bridge over Woods Creek; increase floodplain storage capabilities upstream
2	Overbank Flooding	Woods Creek overtops its banks downstream from the dam on Woods Creek Lake between Hilltop Drive and Algonquin Road (Route 62). Flooding causes structural damage to homes and other buildings located within FEMA 100-year floodplain within the Village of Lake in the Hills.	Flood proof individual structures; increase floodplain storage capabilities upstream; implement impervious reduction stormwater measures as new development occurs

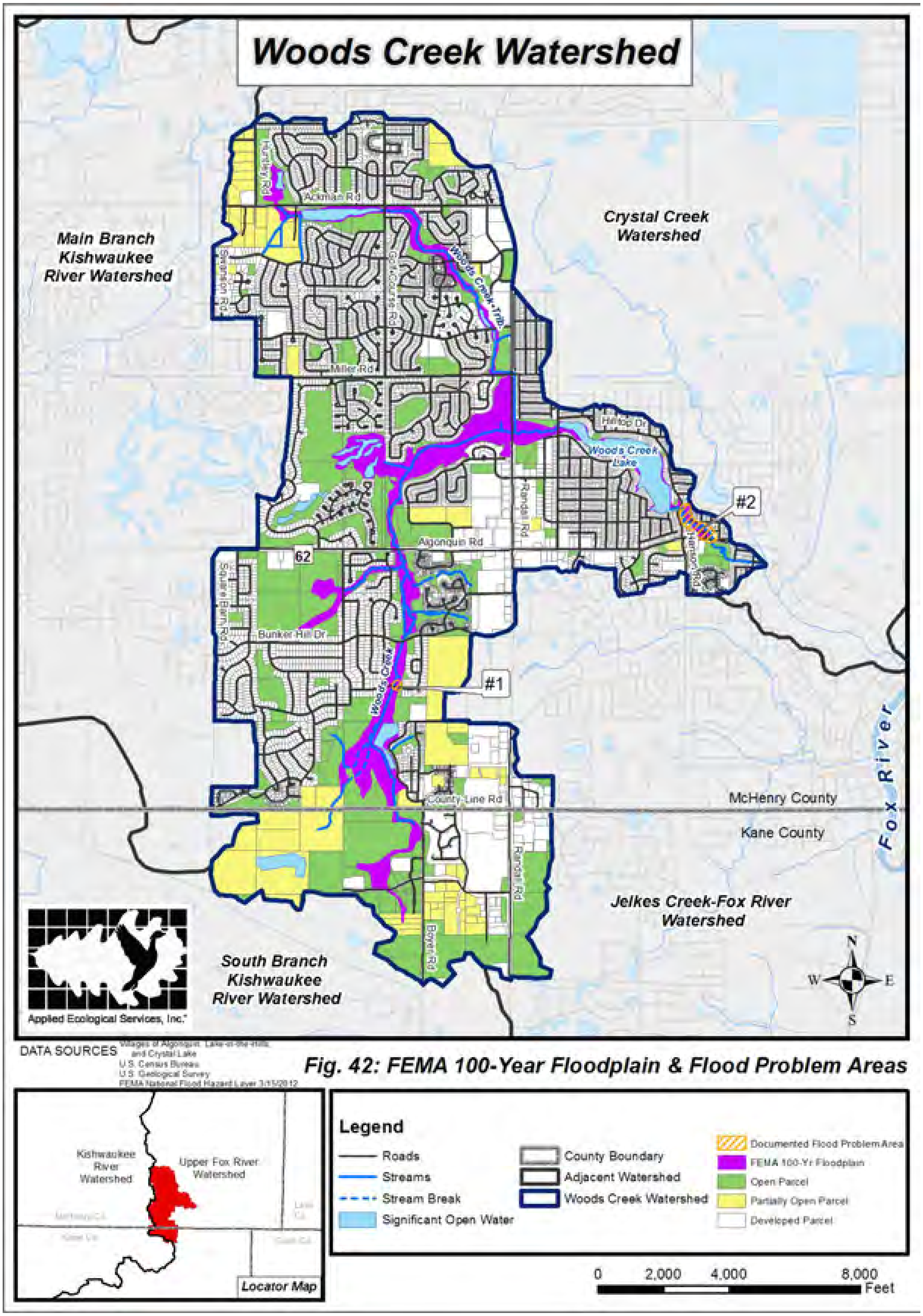


Fig. 42: FEMA 100-Year Floodplain & Flood Problem Areas

3.12 Groundwater Aquifer Recharge & Public Water Supply

Groundwater is water that saturates small spaces between sand, gravel, silt, clay particles or crevices in underground rocks.Groundwater is an essential resource to most of McHenry County and Kane County as underlying aquifers provide all of the drinking water supply for people and support many ecosystems by providing base flow for streams and contributing water to ponds, lakes, and wetlands. Two groundwater pumping wells are located with Woods Creek watershed. Both are located in the Village of Lake in the Hills (Water System Number IL1110400). Lake in the Hills also operates a station just outside the watershed north of Woods Creek Lake. In addition, the Village of Algonquin operates a groundwater well just outside the southwest portion of the watershed on the west side of Square Barn Road (Water System Number IL1110500).

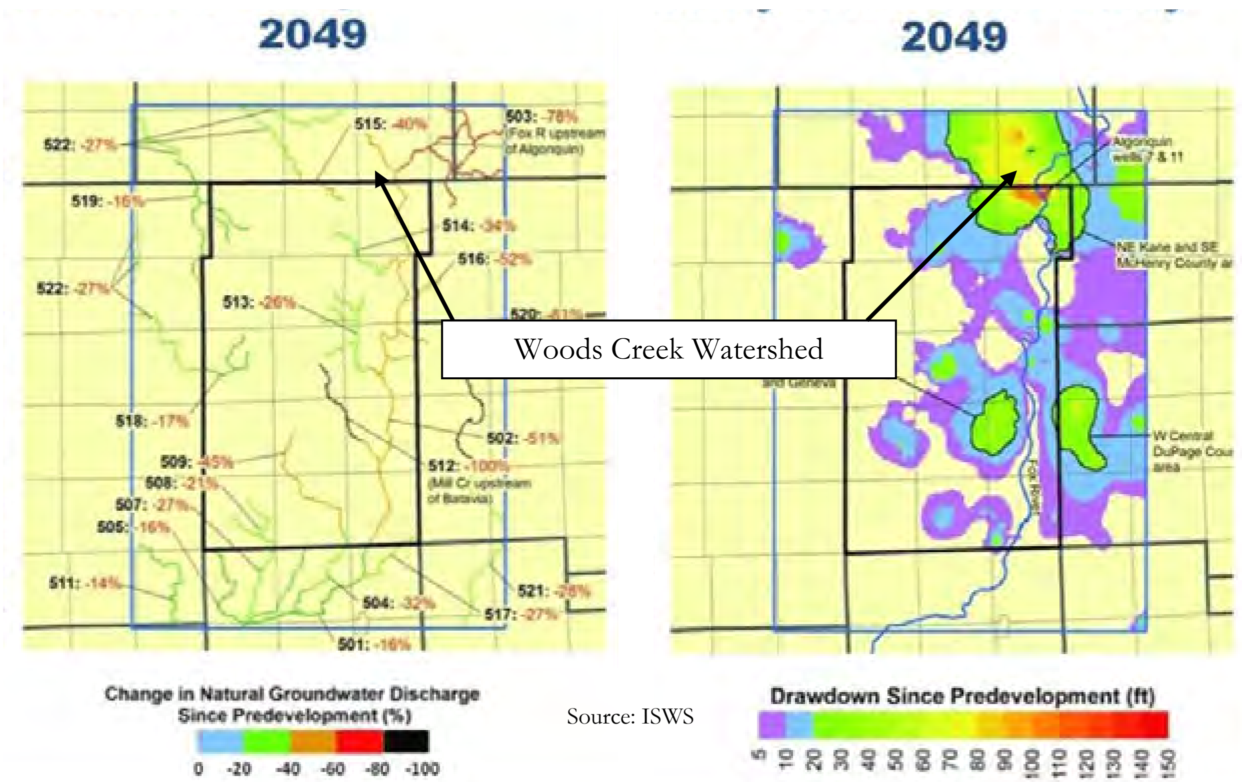
Groundwater is found in aquifers or underground formations that provide readily available quantities of water to wells, springs, or streams. Aquifers can be *Confined aquifers* where groundwater is confined between layers of clay, silts, dense rock or other materials or *Unconsolidated shallow aquifers* which are not confined by impermeable layers. Unconfined sand and gravel aquifers generally extend from just below the ground surface to depths of several hundred feet. These shallow aquifers are easily tapped and used by residences, farms, or entire communities.

Four major aquifer systems supply Northern Illinois communities that rely on groundwater. Those aquifers include the unconsolidated sand and gravels, the shallow Silurian dolomite bedrock, the deep Cambrian-Ordovician sandstone bedrock, and the very deep Elmhurst-Mount Simon sandstone bedrock. All but the Elmhurst-Mount Simon aquifer are utilized in the surrounding study area (Baxter & Woodman 2006).

Groundwater studies conducted for the 11-county Northeastern Illinois Regional Water Supply Planning area by the Illinois State Water Survey (ISWS) suggests that drawdown currently exceeds 5 feet in shallow unconsolidated aquifers in much of southeastern McHenry County, and that these areas will expand significantly by 2050, possibly affecting groundwater availability (Meyer et al., 2009). The studies also suggests that reductions in groundwater discharge to streams currently exceeds 10 percent in some southeastern McHenry County streams, and that the number of streams affected to this degree will increase greatly by 2050. Land cover changes may also affect groundwater quality, as ISWS studies have demonstrated elsewhere in northeastern Illinois (Kelly and Wilson 2008).

Groundwater aquifer recharge is the process by which precipitation reaches and re-supplies the groundwater aquifers. Conversely, groundwater discharge occurs when groundwater water seeps out though permeable soils to low areas such as stream channels and other wetlands. Woods Creek watershed is located in an area highly affected by future recharge and discharge issues. Figure 43 illustrates ISWS modeling that shows significantly lower levels of groundwater discharge (-40% to -60%) and significant shallow bedrock aquifer drawdown (70 to 100 feet) by 2049 compared to predevelopment conditions.

Figure 43. Modeled groundwater discharge and aquifer drawdown since predevelopment.



Sensitive Aquifer Recharge Areas (SARA) are generally defined as areas where the surface of the aquifer is close to the ground surface with highly permeable sand and gravel. In these areas, contaminants from the surface can move rapidly through the sand and gravel deposits to wells and groundwater fed streams. Figures 44 and 45 show the distribution of aquifer recharge sensitivity in Woods Creek watershed. The watershed is approximately 5,508 acres of which 4,535 acres (82%) exhibit "Low to Moderate" sensitivity, 520 acres (10%) are "Moderately High", and 453 acres (8%) are "Highly" sensitive. Less than 20% of the watershed is comprised of SARAs.

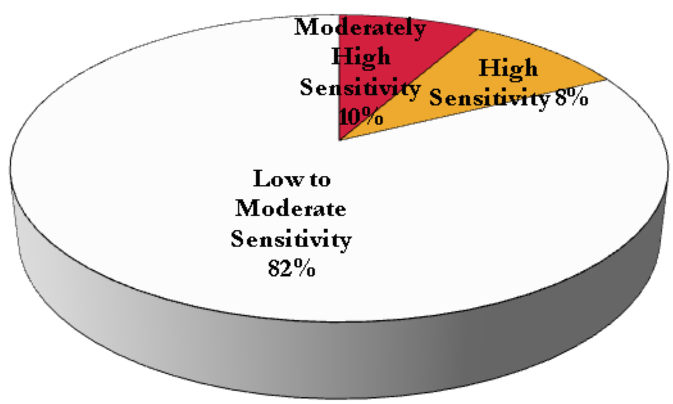


Figure 44. Distribution of aquifer recharge sensitivity.

McHenry County and Kane County are focusing on future groundwater issues. McHenry County's Groundwater Protection Action Plan (McHenry County 2009) and the Water Resources Section of Kane County's 2040 Plan (Kane County Draft 2012) address groundwater issues by presenting model policies that all local government can consider and modify to address their individual needs. In McHenry County, a Sensitive Aquifer Recharge Areas (SARA) map was developed to delineate Moderately High and High potential for aquifer recharge/contamination areas. A similar map is also available for Kane County called Aquifer Sensitivity to Contamination. Figure 45 shows the distribution of Sensitive Aquifer Recharge Areas in Woods Creek watershed. The policy recommendations focus on future groundwater withdrawals, land use and zoning, stormwater management, National Pollution Discharge Elimination Systems (NPDES), open space/natural areas, mining operations, wastewater reuse and septic systems, abandoned wells, storage tanks, and salvage yards.

Based on SARA mapping in Woods Creek watershed, future groundwater policy issues may present themselves related to the gravel quarry operation in the southwest corner of the watershed and southern tip of the watershed where future commercial/retail and industrial development is predicted to replace agricultural land. Most of the remaining Sensitive Aquifer Recharge Areas in the watershed are currently developed.

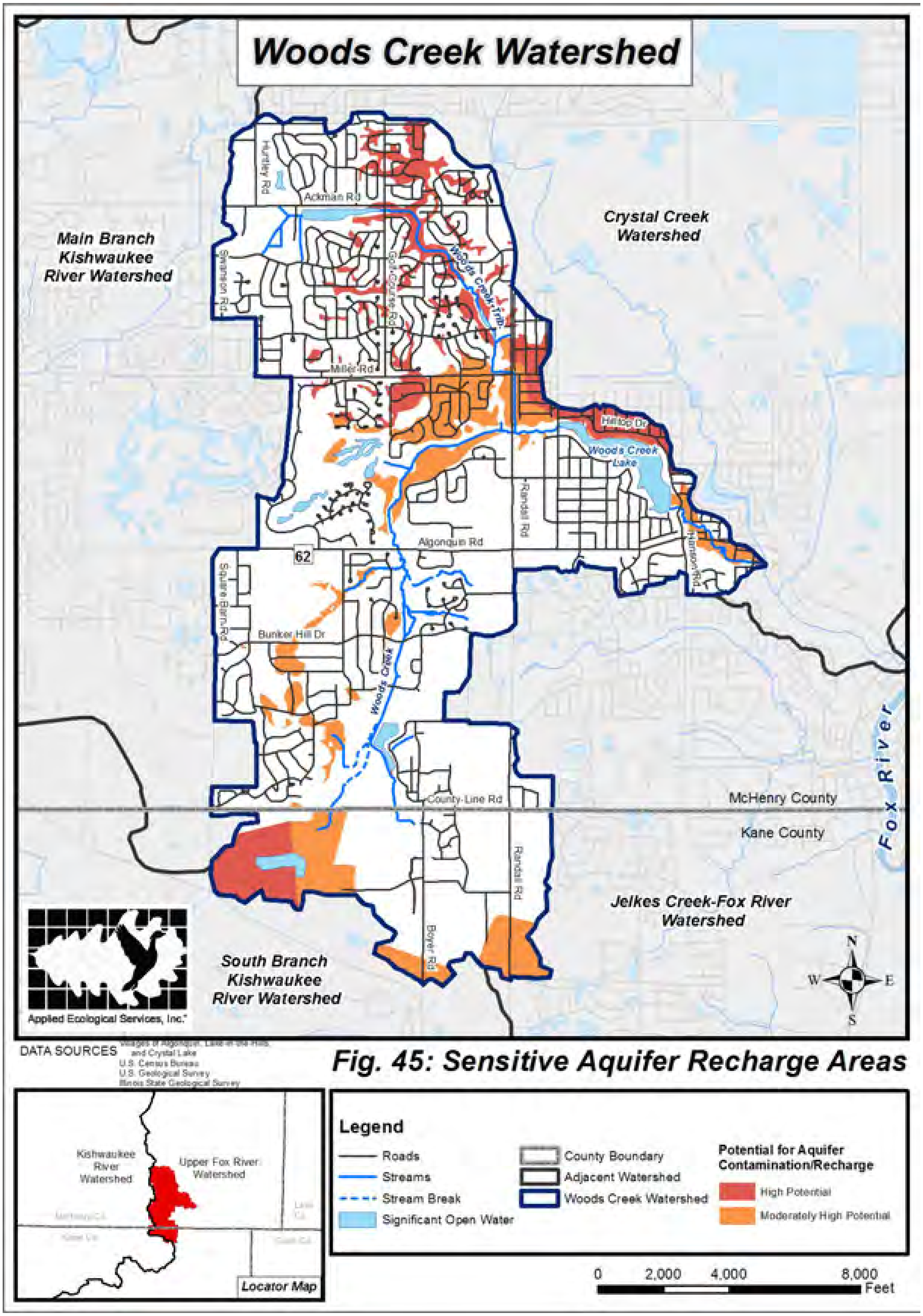


Fig. 45: Sensitive Aquifer Recharge Areas

3.13 Water Quality Assessment

Woods Creek and Woods Creek Tributary are the two primary streams in Woods Creek watershed. Woods Creek begins in the southern portion of the watershed and generally flows north for approximately 3.5 miles before joining Woods Creek Tributary just east of Randall Road. Woods Creek Tributary begins in the northwest portion of the watershed and generally flows southeast for about 2 miles before joining Woods Creek. After joining Woods Creek Tributary, Woods Creek flows east for about 0.5 miles to Woods Creek Lake, a 52 acre impoundment that was formed by creating a dam on Woods Creek. Woods Creek continues flowing east after exiting the spillway on the east side of Woods Creek Lake and flows southeast for about 1 mile prior to joining Crystal Creek. Crystal Creek flows southeast for just over 1 mile to the Fox River. In addition, 10 tributaries flow to Woods Creek and Woods Creek Tributary accounting for 3 tributary miles.

Water quality is generally fair within Woods Creek watershed according to available data. There are no wastewater treatment plant NPDES outfalls in the watershed and municipalities discharging to Woods Creek and tributaries are regulated by EPA's NPDES Phase II Stormwater Permit Program. Many stormwater discharges are located along Woods Creek and Woods Creek Tributary. However, the location of each discharge is not available for this study. Table 20 lists all known water quality and biological data collected in the watershed within the past 10-15 years while Figure 46 displays the location of each sample site where the data was collected. In general, the most recent data is analyzed so that recommendations and management strategies are based on the most current depiction of the water quality and biological conditions.

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 303d List.* These reports must also describe how Illinois assessed water quality and whether assessed waters meet or do not meet water quality standards specific to each "Designated Use" of a stream or lake 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.

Illinois EPA developed seven general Designated Uses for Illinois surface waters. No Designated Uses are assigned to Woods Creek specifically. However, Woods Creek watershed is a subwatershed to Crystal Creek watershed, also known as Crystal Lake Outlet (HUC 07120061201; Illinois EPA #IL DTZR 01). Crystal Creek watershed is approximately 20 square miles in size and abuts Woods Creek watershed to the north and east. Crystal Creek flows to a segment of the Fox River monitored by the Illinois EPA at site IL DT-06. It is reasonable to assume the same five Designated Uses for Woods Creek that Illinois EPA assigned to Crystal Creek and the Fox River segment downstream. Illinois EPA also assigned the same five Designated Uses to Woods Creek Lake (Illinois EPA #IL RTZZ 1W).

The five Designated Uses assigned to Crystal Creek and the Fox River by Illinois EPA include: *Aquatic Life, Fish Consumption, Primary Contact, Secondary Contact,* and *Aesthetic Quality*. Crystal Creek is not supporting for *Primary Contact* due to high Fecal Coliform levels originating from urban runoff. The Fox River is not supporting for *Aquatic Life* and *Fish Consumption*. *Aquatic Life* is impaired by various streamside and flow regime alterations, low dissolved oxygen levels, and aquatic algae caused by streambank modification and flow regulation/dam or impoundment. *Fish Consumption* is the Fox River segment is impaired by polychlorinated biphenyls from unknown sources. Table 19 includes a summary of Designated Uses and impairments for Crystal Creek and the immediate downstream segment of the Fox River.

Table 19. Illinois EPA Designated Uses and impairments for Crystal Creek and Fox River segment downstream from Woods Creek.

Designated Use	Use Attainment	Impaired?	Cause of Impairment	Source of Impairment
Crystal Creek (Crystal Lake Outlet): ILDTZR01				
Aquatic Life	Not Assessed	-	-	-
Fish Consumption	Not Assessed	-	-	-
Primary Contact	Not Supporting	Yes	Fecal Coliform	Urban runoff/stormsewers
Secondary Contact	Not Assessed	-	-	-
Aesthetic Quality	Not Assessed	-	-	-
Fox River: ILDT-06				
Aquatic Life	Not Supporting	Yes	Alteration in stream-side or littoral vegetative covers, other flow regime alterations, dissolved oxygen, aquatic algae	Streambank modification/destabilization, impacts from hydrostructure flow regulation/modification, dam or impoundment
Fish Consumption	Not Supporting	Yes	Polychlorinated biphenyls	Source unknown
Primary Contact	Fully Supporting	No	-	-
Secondary Contact	Fully Supporting	No		
Aesthetic Quality	Not Assessed	-	-	-

Source: Draft 2012 Illinois EPA 303(d) list

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 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 has been proposed by USEPA for nutrients based on a reference stream method for the Corn Belt and Northern Great Plains Ecoregion (Ecoregion VI) which includes Woods Creek watershed. The USGS has published a document outlining recommended *numeric* criteria for sediment in streams for Ecoregion VI. These criteria are used in this report to assess the quality of Woods 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 Woods Creek watershed.

This Page Intentionally Left Blank

Table 20. List of recent chemical (H2O) and biological (BIO) water quality sample sites.

Sample Location/ Code	Location(s)	Sampling Entity(s)	Date(s)	Purpose	Water Quality and other Parameters	Data Availability
Algonquin (H2O1-7)	Woods Creek and tributaries @ multiple locations (H2O1-H2O7)	Village of Algonquin with assistance from Applied Ecological Services; labs by Village of Algonquin.	1/12/11, 4/16/12	Baseline and post storm event physical and chemical water quality sampling	Temp, pH, N, Tot. P, TDS, TSS, Cond, Turb, DO, BOD, Discharge	Available
FOFR (H2O8)	Woods Creek @ Randall Road; FORF #30 (H2O8)	Friends of Fox River (FOFR)	10/16/02, 10/12/03/, 5/19/05	Stream assessment study	Temp, pH, N, Tot. P, Turb. DO, Fecal Coliform, BOD, Substrate, Water Dimensions, Macroinvertebrates	Not Available-records are incomplete
LITH (H2O9-11)	Woods Creek Lake Outlet, Woods Creek Lake Inlet, Woods Creek Tributary (H2O9-H2O11)	Village of LITH via Phase I Diagnostic-Feasibility Study	5/15/97 to 5/30/98	Stream chemical water quality data to supplement Phase I Diagnostic-Feasibility Study of Woods Creek Lake (LITH 2000)	Temp, DO, pH, TP, N, NH3, NO3, TKN, TSS, VSS, Turb, Cond, Alkalinity, Discharge	Available
LITH (H2O12)	Woods Creek Lake (3 sites on lake) (H2O12)	Village of LITH via Phase I Diagnostic-Feasibility Study	5/15/97 to 5/30/98	Lake chemical water quality and other data to supplement Phase I Diagnostic-Feasibility Study of Woods Creek Lake	Lake Sediment, Temp, DO, pH, Secchi, Turb, TP, N, Turb, Cond, Alkalinity, TSS, Fecal Coliform, Algae, Aquatic Plants, Fish	Available
VLMP (H2O13)	Woods Creek Lake (Illinois EPA # IL RTZZ 1w) (2 sites on lake) (H2O13)	Illinois EPA Volunteer Lakes Monitoring Program (VLMP)	2000-2011	Water quality sampling program	TSS, VSS, N, NH3, NO3, TKN, TP, Algae, Temp, Secchi, Alkalinity, Chloride	Available
ALMP (H2O14)	Woods Creek Lake (3 sites on lake) (H2O14)	Illinois EPA Ambient Lakes Monitoring Program (ALMP)	2007	Water quality sampling program	Algae, N, NH3, NO3, TKN, TP, VSS, TSS, Temp, DO, Sediment, Alkalinity, pH, Cond, Turb, Metals	Available
Jacobs HS (BIO1)	Woods Creek @ Bunker Hill Road (BIO1)	Jacobs High School Biology Department	Not known	Aquatic Macroinvertebrate Survey	Water quality using Macroinvertebrate Biotic Index (MBI)	Not Available-electronic records were cleared
IDNR (BIO2)	Woods Creek Lake (BIO2)	Illinois Department of Natural Resources (IDNR)	3/12/2009	Fish Survey	Lake morphology, Temp, pH, Cond, Secchi, Alkalinity, aquatic vegetation, fish community	Available
KEY:		NH3 = ammonia nitrogen	TDS = total dissolved solids			
DO = dissolved oxygen		NO3 = nitrate nitrogen	Turb = turbidity			
Tot. P = total phosphorus		TKN = kjeldahl nitrogen	TSS = total suspended solids			
IBI = Index of Biotic Integrity		Cond.= conductivity	pH=acid/base scale			
MBI = Macroinvertebrate Biotic Index		BOD = biological oxygen demand	VSS=volotile suspended solids			

Note: Illinois EPA does not monitor to the level of detail included in this plan. The local community conducted additional monitoring and developed a localized waterbody code system. Therefore, the codes used in this plan are not found in the Illinois EPA's *Illinois Integrated Water Quality Report and Section 303d List*.

Table 21. Baseflow (Dec. 1, 2011) and storm event (Apr. 16, 2012) water quality sample results for Sites H2O1-H2O7.

Parameter	Statistical, Numerical, or General Use Guidelines	Date Collected	Site H2O 1	Site H2O 2	Site H2O 3	Site H2O 4	Site H2O 5	Site H2O 6	Site H2O 7
Dissolved Oxygen (DO)	>5.0 mg/l*	12/1/2011	12.6	13.6	11.9	11.2	12.0	11.6	11.7
		4/16/2012	8.9	8.2	8.4	8.5	8.7	13.4	8.32
pH	>6.5 or <9.0*	12/1/2011	6.7	6.8	6.8	6.9	6.9	6.9	6.9
		4/16/2012	8.0	8.2	8.1	8.4	8.5	8.9	8.3
Temp (F)	<90 F*	12/1/2011	40.0	38.9	37.9	38.8	41.4	36.5	40.1
		4/16/2012	58.5	59.0	56.6	57.9	56.2	56.1	57.0
Total Phosphorus (TP)	<0.0725 mg/l***	12/1/2011	0.04	0.05	0.02	0.05	0.05	0.04	0.04
		4/16/2012	0.07	0.10	0.10	0.06	0.12	0.07	0.12
Nitrate-N (N)	<1.798 mg/l***	12/1/2011	1.7	1.5	1.3	1.3	2.0	1.7	1.2
		4/16/2012	1.5	1.7	1.5	1.5	1.1	1.3	1.0
Total Dissolved Solids (TDS)	<1,000 mg/l**	12/1/2011	300	224	440	318	260	566	474
		4/16/2012	676	342	500	536	332	384	740
Total Suspended Solids (TSS)	<19 mg/l****	12/1/2011	2.0	1.0	1.0	1.0	1.0	8.0	4.0
		4/16/2012	13.0	10.0	23.0	8.0	20.0	5.0	30.0
Turbidity	<14 NTU***	12/1/2011	<10	<10	<10	<10	<10	<10	<10
		4/16/2012	<10	<10	13	<10	10	<10	25
Biological Oxygen Demand (BOD)	<5.0 mg/l	12/1/2011	2.23	1.46	1.50	1.94	1.47	1.49	1.53
		4/16/2012	2.45	3.66	3.60	3.14	4.6	2.52	3.63
Conductivity	<1,667 µmhos/cm**	12/1/2011	773	845	923	742	672	897	1009
		4/16/2012	1168	853	1150	1135	750	774	1500

-An Illinois EPA approved quality assurance program plan was not prepared for this data collection
-Cells highlighted in red exceed recommended statistical, numerical, or General Use guidelines
* Illinois EPA General Use Standard
**2006 and/or 2010 Illinois EPA Integrated Water Quality Report (Illinois EPA 2006 & 2010)
*** 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)

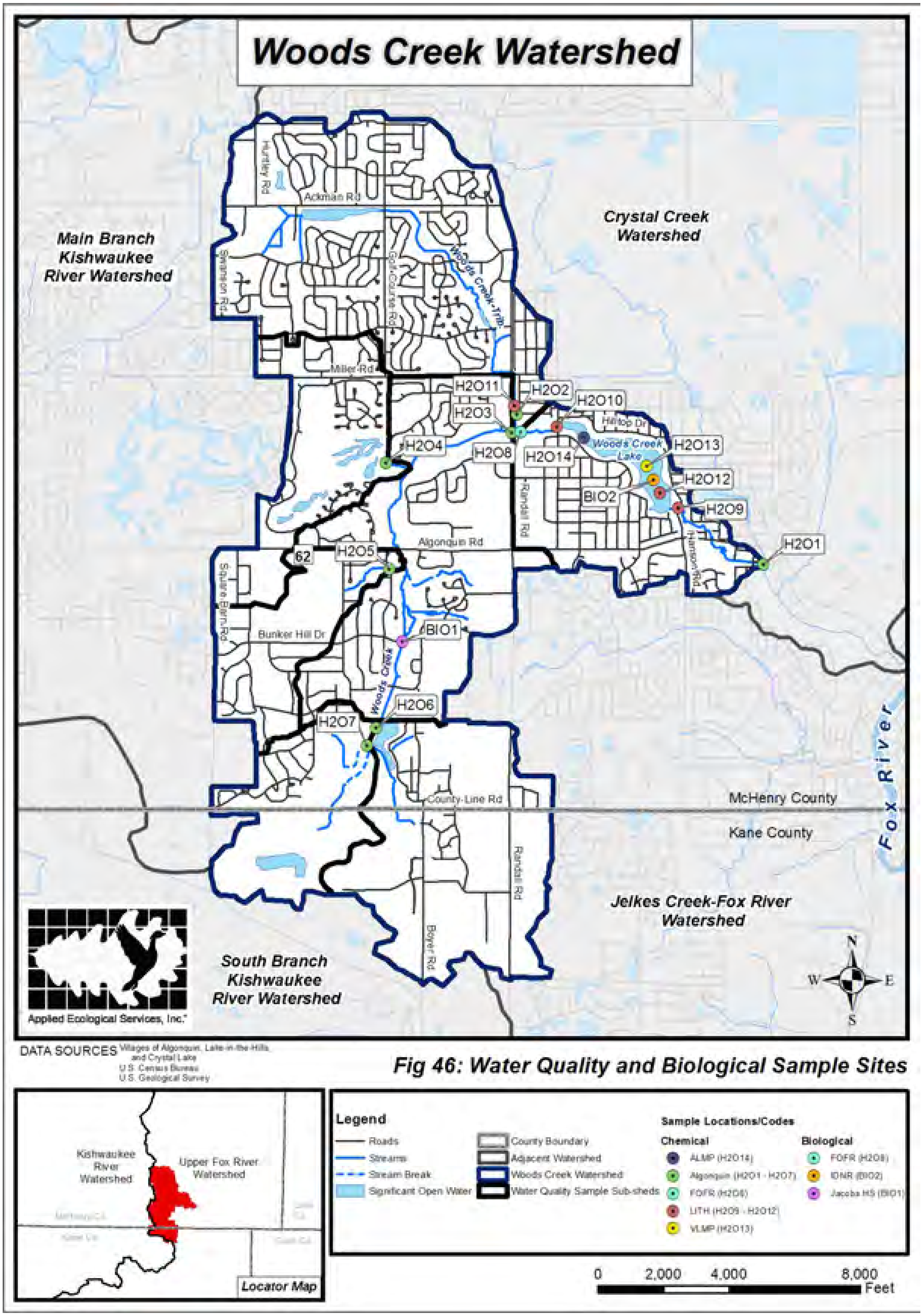


Fig 46: Water Quality and Biological Sample Sites

Water Chemistry Monitoring

The Illinois EPA does not list Woods Creek as being impaired for any Designated Uses because it is not monitored by Illinois EPA prior to joining Crystal Creek. Therefore, there is insufficient available data and/or information to make a formal Designated Use Support Determination (Illinois EPA Category 3). Available water quality and habitat data for Woods Creek and its tributaries indicates moderate overall impairment. Total phosphorus (TP), turbidity/total suspended solids (TSS: sediment), and habitat alteration (channelization) are the primary *Aquatic Life* Designated Use impairments for Woods Creek and tributaries. Illinois EPA data for Crystal Creek does not show similar impairments; Crystal Creek's is only impaired for *Primary Contact* due to elevated Fecal Coliform levels. In addition, impaired water quality in Woods Creek appears to cause phosphorus and sediment impairments in Woods Creek Lake.

Elevated phosphorus levels are a problem in watersheds under the right conditions and can lead to a chain of undesirable events in streams and lakes such as accelerated plant growth, algae blooms, low dissolved oxygen, and death of some aquatic organisms. 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.

Woods Creek & Tributaries

It became clear after initial examination of available water quality data that additional updated data needed to be collected for Woods Creek and its tributaries. Hence, the Village of Algonquin agreed to provide in-kind time and use of their wastewater treatment plant facilities to analyze water samples. AES worked with the Village to locate seven water quality sample sites (Sites H2O1-H2O7 on Figure 46). A closer look at Figure 46 shows how each sample site was strategically located to capture multiple "Water Quality Sub-sheds". Each of these sub-sheds includes one or more Subwatershed Management Units (SMUs) defined in Section 3.3 of this report.

Algonquin staff collecting water quality samples at Site H2O7 on Woods Creek.

Sample Site H2O1 was established to capture water quality data near the point where water leaves the watershed via Woods Creek. Data at this site provides a snapshot of water quality for the entire watershed. Site H2O2 provides data for all of Woods Creek Tributary prior to joining Woods Creek just east of Randall Road and Site H2O3 captures information about Woods Creek prior to joining Woods Creek Tributary. Sites H2O2 & 3 are just upstream from Woods Creek Lake and therefore provide information about water quality entering the lake. Sites H2O4-H2O7 are strategically located to capture water quality data at multiple smaller tributaries draining golf courses, gravel operations, and heavily developed areas.

Timeframe and budget allowed for one base flow grab sampling at each of the seven locations on December 1, 2011 and a second grab sample following a 2 inch storm event on April 16, 2012. The rationale behind this sampling is to capture a snapshot of water quality conditions when minimal land use activity is occurring in fall/early winter and a second snapshot of water quality conditions following a significant rain event when land is actively being used and managed in spring.

Physical water quality data for dissolved oxygen (DO), pH, temperature, conductivity, and turbidity was sampled in the field with a datasonde and turbidity tube. Water chemistry samples for total phosphorus (TP), nitrate nitrogen (N), total dissolved solids (TDS), total suspended solids (TSS), and biological oxygen demand (BOD) were analyzed by the Village of Algonquin via their wastewater treatment facility. December 1, 2011 baseflow and April 16, 2012 post storm event data is summarized in Table 21. 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. Load estimates using this data were not calculated for this study.

None of the water quality parameters sampled during December 1, 2011 base flow conditions exceeded recommended *statistical, numerical,* or Illinois EPA General Use guidelines (Table 21). An important finding is that total phosphorus (TP) and turbidity/total suspended solids (TSS), which are Illinois EPA documented problems in Woods Creek Lake, are not problematic in Woods Creek during base flow conditions. This evidence suggests high pollutant loads in Woods Creek following storm events is causing water quality problems in Woods Creek Lake.

As expected, post storm event data collected on April 16, 2012 revealed elevated levels of total phosphorus (TP) and turbidity/total suspended solids (TSS) compared to base flow conditions (Table 21). Total phosphorus (TP) levels at Sites H2O2, H2O3, H2O5, & H2O7 exceeded the recommended USEPA Ecoregion VI guideline of 0.0725 mg/l. A closer look at the data collected at Sites H2O 5 & H2O7 shows elevated total phosphorus (TP) levels of 0.12 mg/l originating from Terrace Hill Golf Course and the southeast portion of the watershed that encompasses the Commons Shopping Center along Randall Road.

Data collected at Sites H2O2 & H2O3 also have high total phosphorus (TP) levels (0.10 mg/l). This is a significant finding since water quality at these two sites reflects the quality of water entering Woods Creek Lake just downstream. It is important to note that total phosphorus (TP) does not exceed recommended levels at Site H2O1 just downstream of Woods Creek Lake. This provides evidence that Woods Creek Lake absorbs much of the phosphorus load from Woods Creek watershed upstream and does not contribute problems to Crystal Creek or the Fox River downstream.

Turbidity/total suspended solids (TSS) levels collected during the April 16, 2012 post storm event at Sites H2O3, H2O5, & H2O7 exceed the recommended USGS Ecoregion VI guideline and generally coincide with high total phosphorus (TP) levels. This is likely because phosphorus binds to sediment as it is transported downstream. And, suspended sediment data recorded at Site H201 downstream from Woods Creek Lake does not exceed recommended levels. This once again provides evidence that Woods Creek Lake absorbs much of the sediment load from the entire Woods Creek watershed upstream. The source of this sediment appears to originate from highly eroding streambanks along Woods Creek between Algonquin and Randall Roads and south of Woods Creek Lane.

To summarize, a 27.5% decrease in total phosphorus (TP) and 17% decrease in turbidity/total suspended solids (TSS) following storm events is needed upstream of Woods Creek Lake to reach target levels based on recommended *numeric* criteria proposed by USEPA (USEPA 2000) and USGS (USGS 2006). No total phosphorus (TP) or turbidity/total suspended solid (TSS) reduction is needed downstream of Woods Creek Lake before Woods Creek joins Crystal Creek. Section 4.0 of this report includes detailed information related to developing pollutant load reduction/ impairment targets just upstream from Woods Creek Lake and addressing "Critical Areas" to reach these targets.

Woods Creek Lake

Illinois EPA determined that the 52 acre Woods Creek Lake is impaired for not meeting all of its Designated Uses according to the Draft 2012 *Illinois Integrated Water Quality Report and Section 303d List* (Draft Illinois EPA 2012). Table 22 includes a summary of Illinois EPA Designated Uses and impairments for Woods Creek Lake. Woods Creek Lake is not supporting for *Fish Consumption* because of high mercury levels and *Aesthetic Quality* due to high total suspended solids (TSS) (sediment), high total phosphorus (TP), and overabundance of aquatic plants. In general, Woods Creek Lake is classified as eutrophic or rich in nutrients and capable of supporting large populations of aquatic organisms.

Table 22. Illinois EPA Designated Uses and impairments for Woods Creek Lake.

Designated Use	Use Attainment	Impaired?	Cause of Impairment	Source of Impairment
Aquatic Life	Fully Supporting	No	-	-
Fish Consumption	Not Supporting	Yes	Mercury	Atmospheric deposition
Primary Contact	Not Assessed	-	-	-
Secondary Contact	Not Assessed	-	-	-
Aesthetic Quality	Not Supporting	Yes	Total Suspended Solids (TSS), Total Phosphorus (TP), Aquatic plants	Hydrostructure flow modification, dam or impoundment, waterfowl, unspecified urban stormwater, urban runoff/stormsewers, runoff from forest/grassland/parkland

Source: Draft 2012 *Illinois Integrated Water Quality Report and Section 303d List.*

Illinois EPA lists atmospheric deposition (likely from global coal combustion) as the source of mercury in Woods Creek Lake. Other sources may include annual drawdown and reflooding and historic discharges although no such historic or current discharges were or are known to occur.

Jody Kubitz, Ph.D., Senior Consultant with Cardo ENTRIX and watershed resident analyzed the mercury issue in detail and found that mercury levels collected under the Illinois Fish Contaminant Monitoring Program found concentrations in largemouth bass that exceeded recommended levels and led to establishment of special mercury advisories:

- One meal per week advisory for largemouth bass >15 inches long (men >15 years and women past child-bearing age)
- One meal per month advisory for largemouth bass >15 inches long (children <15 years and women of child-bearing age)

These advisories are meant to encourage people to consume fish as a source of lean protein (as long as it is safe to do so) and protect the most susceptible individuals (babies) from potential mercury poisoning. Largemouth bass in Woods Creek Lake are not a serious threat, but future management of Woods Creek Lake should consider options to lower mercury levels. The most feasible option is to hire a professional consultant to evaluate the annual drawdown and flow regime to determine if maintaining a stable water level and/or releasing water at a different location along the dam would decrease mercury levels over time.

Illinois EPA lists total suspended solids (TSS), total phosphorus (TP) and aquatic plants as the causes of impairment to the *Aesthetic Quality* Designated Use for Woods Creek Lake. Illinois EPA lists sources of impairment from hydrostructure flow modification, dam or impoundment, waterfowl, unspecified urban stormwater, urban runoff/stormsewers, and runoff from forest/grassland/parkland. Extensive water quality sampling data has been conducted at Woods Creek Lake via Illinois EPA's Ambient Lake Monitoring Program (ALMP) and Volunteer Lake Monitoring Program (VLMP). ALMP collected multiple samples at 3 sites from May-November, 2007. VLMP collected multiple samples at 2 sites from May-October, 2000-2011. Additional data was collected between May 1997 and May 1998 at three locations during a study conducted by the Village of Lake in the Hills entitled "Clean Lakes Program Phase I Diagnostic-Feasibility Study of Woods Creek Lake" (LITH 2000). Data was obtained from all three monitoring programs and averages for each water quality parameter are included in Table 23.

Total phosphorus (TP) is on average higher than the 0.05 mg/l Illinois General Use standard according to data collected by Illinois EPA. A detailed analysis of Illinois EPA's raw data for total phosphorus (TP) reveals levels at or below the standard from May-August with moderate elevation spikes occurring in September and October as the lake experiences "turn over". This internal phosphorus cycling during turn over is normal as stratified lakes generally exhibit between 10-30% of phosphorus loading from internal sources (Wetzel 1983).

ALMP, VLMP, and LITH data for total suspended solids (TSS) is not problematic as referenced in Illinois EPA's most recent Draft 2012 *Illinois Integrated Water Quality Report and Section 303d List.* An average of samples collected by ALMP in 2007, VLMP from 2000-2011, and LITH from 1997-1998 show TSS levels below the 12 mg/l Illinois EPA standard. However, it is likely that suspended solids are elevated near Wood Creek's inlet to Woods Creek Lake following storm events as sediment is transported from upstream sources.

Table 23. Illinois EPA: ALMP (2007) & VLMP (2011) water quality results for Woods Creek Lake.

Parameter	Statistical, Numerical, or General Use Guideline	IEPA ALMP (2007 ave.)	IEPA VLMP (2000-2011 ave.)	LITH Phase I (1997-1998 ave.)
Chloride	<500 mg/l**	185.2	141.2	-
Nitrate-Nitrite Nitrogen (N)	<15.0 mg/l*	0.705	0.48	1.84
Total Phosphorus (TP)	<0.05 mg/l*	0.064	0.057	0.037
Total Suspended Solids (TSS)	<12 mg/l**	10.8	10.4	8.3
Turbidity	<20 NTU	18.2	-	5.0
Conductivity	<1,667 µmhos/cm***	1,182.2	-	648.3
Temperature (F)	<90 F*	35.8	36.9	64.0
pH	>6.5 or <9.0*	8.34	-	8.57
Secchi	>18 in. (eutrophic status)	-	49.8	57.0
Dissolved Oxygen	>5.0 mg/l*	6.0	-	10.8

Cells highlighted in red exceed recommended statistical, numerical, or General Use guideline
Statistical Guidelines obtained from IEPA Integrated Water Quality Reports & conversations with IEPA staff and other sources.
* IEPA General Use Standard; **2010 IEPA Integrated Water Quality Report; ***2006 IEPA Integrated Water Quality Report

One final note must be made regarding Illinois EPA's designation of Woods Creek Lake as not supporting for *Aesthetic Quality* related to aquatic plant coverage. Illinois EPA states in its 2010 *Illinois Integrated Water Quality Report and Section 303d List* that aquatic plant coverage greater than 40% from June-August is problematic and forms the basis for listing lakes as impaired for *Aesthetic Quality*. The study entitled "Clean Lakes Program Phase I Diagnostic-Feasibility Study of Woods Creek Lake" (LITH 2000) indicates that the western third of the lake is relatively shallow where Woods Creek enters and deposits sediment. Here, aquatic plants growth is heavy transitioning to moderate growth then light growth moving east toward the dam. An aquatic plant survey conducted in 1997 found 8% of the lake with slight plant coverage, 10% with medium coverage, and 36% with high coverage. Total plant cover was estimated at 54%, 10% higher than the recommended Illinois EPA standard.

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 303d List*. The 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 currently uses MBI and fIBI data to determine the Aquatic Life support status of streams as shown in Table 24.

Table 24. 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 < 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: Draft 2012 *Illinois Integrated Water Quality Report and Section 303d List*

No biological data exists for use in examining *Aquatic Life* support in Woods Creek. The Illinois EPA has determined however that Woods Creek Lake fully supports *Aquatic Life*. This would indicate in part that water quality in Woods Creek is of sufficient quality to support aquatic life since the stream is the primary source of water supplying Woods Creek Lake. Future biological sampling in Woods Creek is needed to determine Wood Creek's ability to support aquatic life and should include aquatic macroinvertebrate and fish surveys. Macroinvertebrate samples should be limited to Woods Creek and Woods Creek Tributary. Fish surveys should only be conducted downstream from Woods Creek Lake dam because the dam inhibits fish migration throughout the watershed. Section 8.0 outlines a plan for incorporating biological sampling into a watershed monitoring program.

3.14 Pollutant Loading Analysis

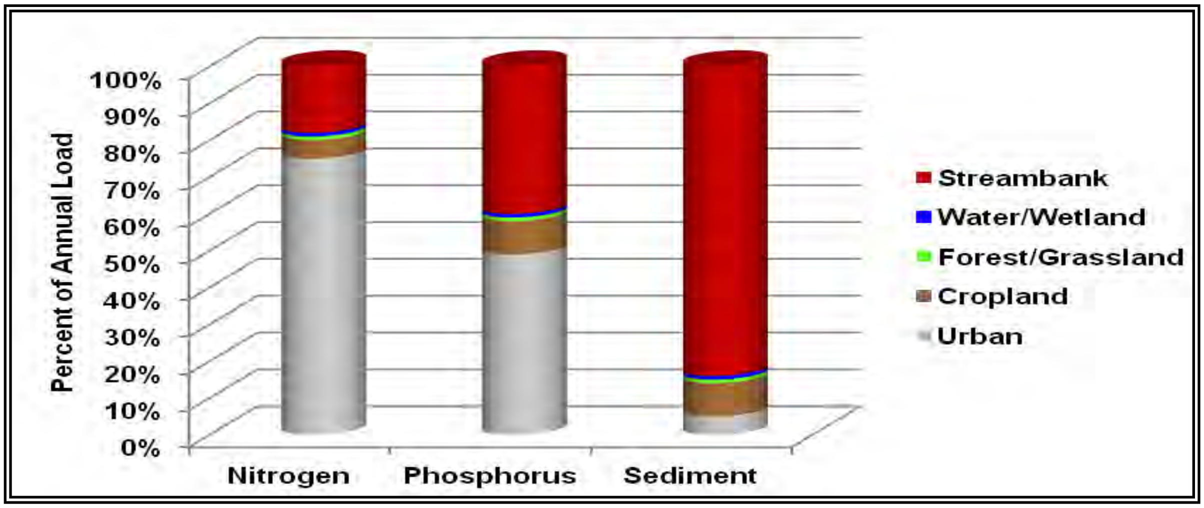
An EPA modeling tool called STEPL (Spreadsheet Tool to Estimate Pollutant Loads) was used to estimate the existing nonpoint source load of nutrients (nitrogen & phosphorus) and sediment from Woods Creek watershed in its entirety and by individual Subwatershed Management Unit (SMU). The model uses land use/cover category types, precipitation, management measures, and known water quality data input information. The model outputs average annual pollutant load for each of the land use/cover types. The results of this analysis were used to estimate the total watershed load for nitrogen, phosphorus, and sediment and to identify and map pollutant load "Hot Spot" SMU's. It is important to note that STEPL is not calibrated due to lack of sufficient water quality and stream flow data.

The results of the STEPL model run at the watershed scale indicate that existing land use/cover in Woods Creek watershed produces 17,549 lb/yr of nitrogen, 3,231 lb/yr of phosphorus, and 2,530 tons/yr of sediment (Table 25; Figure 47). Urban land uses contribute the highest load of nitrogen (12,179 lb/yr: 75%) and phosphorus (1,578 lb/yr: 66%). This result is expected since urban land uses cover more that 75% of the watershed. Streambanks contribute the highest sediment load (2,175 tons/yr: 86%). Streambanks also contribute the second highest load of nitrogen (3,341 lb/yr: 19%) and phosphorus (1,286 lb/yr: 40%). Cropland contributes less than 10% of total nitrogen, phosphorus, and sediment. Most of the cropland in the watershed is located in the southern portion of the watershed where topography is relatively flat and where most rainfall is infiltrated or directed to buffers and wetlands. Forest/grassland and water/wetland contribute very little to pollutant loading. Note: STEPL Model results can be found in Appendix C.

Table 25: Estimated existing (2012) annual pollutant load by source at the watershed scale.

Source	N Load (lb/yr)	% of Total Load	P Load (lb/yr)	% of Total Load	Sediment Load (tons/yr)	% of Total Load
Urban	13,179	75%	1,587	49%	131	5%
Cropland	897	5%	294	9%	217	9%
Forest & Grassland	50	<1%	23	1%	7	<1%
Water/Wetland	82	<1%	41	<1%	<1	<1%
Streambank	3,341	19%	1,286	40%	2,175	86%
Total	**17,549**	**100%**	**3,231**	**100%**	**2,530**	**100%**

Figure 47. Estimated contributions to existing (2012) pollutant load by source.



The results of the STEPL model were also analyzed at the Subwatershed Management Unit (SMU) scale. This allows for a more refined breakdown of 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 were calculated resulting in the pollutant load Hot Spot SMUs. Table 26 and Figure 48 summarize and depict the results of the SMU scale pollutant loading analysis. Five of the 17 SMUs comprising Woods Creek watershed are considered pollutant load Hot Spots based on STEPL modeling:

- SMU 1 comprises 215 acres on the far east side of the watershed just prior to water in Woods Creek leaving the watershed. Pollutants in this SMU originate from various urban land uses that dominate the SMU and from streambanks that are moderately eroded. It is important to note base flow and storm event water quality data collected by Algonquin at a point on Woods Creek just prior to Crystal Creek do not show any nitrogen, phosphorus, or sediment problems.
- Pollutants coming from SMUs 6 and 8 are primarily from highly eroded streambanks.
- SMU 14 is relatively small (129 acres) compared to other SMUs in the watershed but contributes pollutants at relatively high concentrations from commercial/retail and residential land uses as well as from highly eroded streambanks along Woods Creek.
- SMU 16 is the largest SMU (798 acres) located in the far southeast corner of the watershed. It is dominated by agricultural, commercial/retail, multifamily residential, and industrial land uses. SMU 16 also contains headwater reaches of Woods Creek with highly eroded streambanks.

Table 26: Pollutant load "Hot Spot" SMUs.

Hot Spot SMU*	Size (acres)	N Load (lb/yr)	N Load (lb/yr)/ Acre	P Load (lb/yr)	P Load (lb/yr)/ Acre	Sediment Load (t/yr)	Sediment Load (t/yr)/ Acre
SMU 1	215	981	4.57	202	0.94	185	0.86
SMU 6	373	1,411	3.78	336	0.90	388	1.04
SMU 8	208	8,001	3.86	174	0.84	159	0.77
SMU 14	129	530	4.10	95	0.74	119	0.92
SMU 16	798	3,174	3.98	627	0.79	558	0.70
Total	**1,723**	**14,097**	**4.06**	**1,434**	**0.84**	**1,409**	**0.86**

*Hot Spot SMUs exceed the 75% quartile: N=3.78, P=0.74, Sediment= 0.70

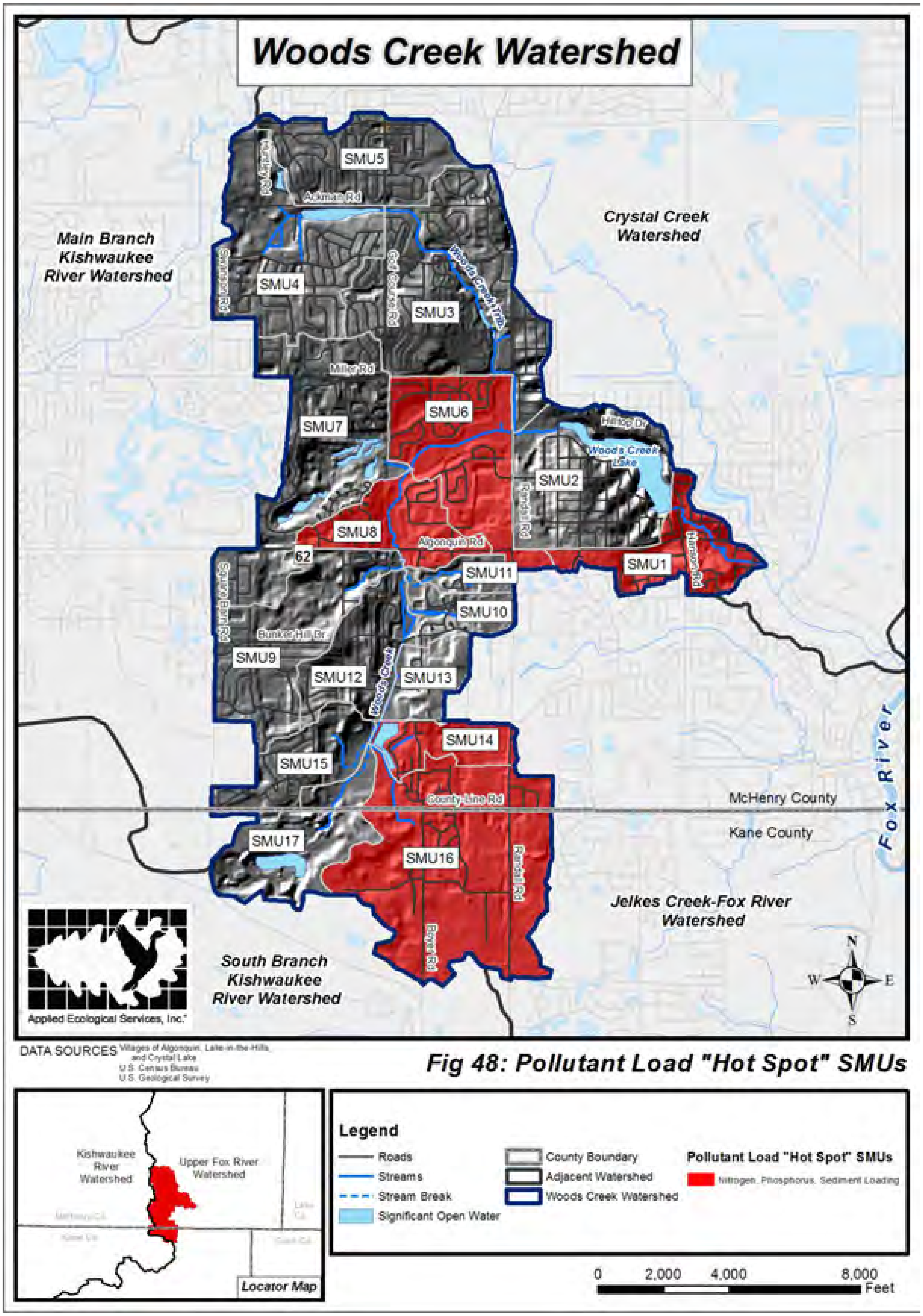


Fig 48: Pollutant Load "Hot Spot" SMUs

4.0 CAUSES AND SOURCES OF WATERSHED IMPAIRMENT

4.1 Causes & Sources of Impairment

The Illinois EPA does not list Woods Creek as being impaired for any "Designated Uses" because it is not sampled by Illinois EPA prior to joining Crystal Creek. Recent water quality data collected by Algonquin and Lake in the Hills and habitat data collected by Applied Ecological Services, Inc. for Woods Creek and its tributaries indicates moderate overall impairment. Illinois EPA determined that Woods Creek Lake is impaired for not meeting *Fish Consumption* and *Aesthetic Quality* Designated Uses based on Illinois EPA's Volunteer Lake Monitoring Program and Ambient Lake Monitoring Program data.

Causes and sources of impairment are based on Illinois EPA 303(d) impaired waters information for Woods Creek Lake (Illinois EPA code: RTZZ), items identified during the watershed characteristics inventory, and input from Woods Creek Watershed Committee (WCWC) stakeholders who met one time during the planning process to discuss the topic. Table 27 includes a summary of the known or potential causes and sources of watershed impairment.

Table 27. Known and potential causes and sources of watershed impairment.

Impairment	Cause of Impairment	Known or Potential Source of Impairment
Woods Creek and Tributaries		
Water Quality/Aquatic Life	Nutrients: (phosphorus and nitrogen)	Streambank and lake shoreline erosion Residential and commercial lawn fertilizer
Water Quality/Aquatic Life	Total Suspended Solids: ((TSS)/turbidity/sediment)	Streambank and lake shoreline erosion Construction sites Existing & future urban runoff Online lake/impoundment/dam at Woods Creek lake
Water Quality/Aquatic Life	Low dissolved oxygen	Heated stormwater runoff from urban areas Lack of natural riffles in channelized stream reaches
Water Quality/Aquatic Life	Chlorides (salinity)	Deicing operations on roads & other pavement
Water Quality/Aquatic Life	Petroleum hydrocarbons (oil & grease)	Trucking cargo spills along major roads General gas station, urban, and highway runoff Illicit dumping
Habitat Degradation	Invasive and/or non-native plant species	Spread from existing and introduced populations
Habitat Degradation	Lack of habitat characteristics	Stream channelization Streambank modification Inappropriate land management Loss of natural management mechanisms (i.e. fire) Wetland loss
Hydrologic and Flow Changes	Impervious cover	Existing & future urban runoff Wetland loss
Reduced Groundwater Discharge to Streams	Shallow aquifer drawdown	Human use Existing and future urban impervious surfaces
Structural Flood Damage	Encroachment in 100-year floodplain	Existing and future urban impervious surfaces Channelized streams Wetland loss
Woods Creek Lake		
Fish Consumption	Mercury	Atmospheric deposition

Impairment	Cause of Impairment	Known or Potential Source of Impairment
Aesthetic Quality	Total Suspended Solids (TSS), Total Phosphorus (TP), Aquatic Plants	Hydrostructure flow modification Dam or impoundment Waterfowl Unspecified urban stormwater Urban runoff/stormsewers Runoff from forest/grassland/parkland
Primary & Secondary Contact	E. coli	Waterfowl

4.2 Critical Areas, Management Measures & Estimated Impairment Reductions

For this watershed plan a "Critical Area" is best described as a particular place or area of the watershed where causes/sources of impairment or function are relatively worse than other areas of the watershed. Critical Areas also include open space parcels within the Green Infrastructure Network that, if protected and restored to natural conditions or developed using Conservation Design standards, would greatly reduce impairments compared to existing land use conditions or development using typical standards. Six Critical Area types were identified in Woods Creek watershed and are described below. Table 28 includes descriptions of each individual Critical Area (by type) as well as recommended Management Measures and their estimated nutrient and sediment load reduction efficiency. The list of Critical Areas is derived from a comprehensive list of measures found in the Action Plan section of this report. Figure 49 maps the location of each Critical Area.

Pollutant load reduction is 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 of sediment and nutrient load reductions from the implementation of *agricultural* Management Measures. Estimate of sediment and nutrient load reduction from implementation of *urban* Management Measures is based on efficiency calculations developed by Illinois EPA. Illinois EPA pollutant load reduction worksheets are located in Appendix C.

Critical Stream Reaches

Critical stream reaches are those with highly eroded streambanks or highly degraded channel conditions that are the likely source of high total suspended solids (sediment) carrying attached phosphorus that ends up in Woods Creek Lake downstream. Moderately eroded stream reaches that are known to contribute high total suspended solids based on water quality sampling are also Critical Areas. Several critical stream reaches are also moderately to highly channelized. Streambank stabilization and installation of artificial riffles in these reaches will greatly reduce sediment and phosphorus transport downstream while improving habitat and increasing oxygen levels. Six stream reaches (WCR1, WCR2, WCR3, WCR10, WCR11, and THD1) totaling 11,252 linear feet were identified as Critical Areas. Section 3.11 includes a complete summary of streams and tributaries in the watershed.

Critical Lake Shoreline Erosion

Critical lake shorelines include those along Woods Creek Lake identified by the Village of Lake in the Hills. These areas contribute to sedimentation and turbidity in the lake. A total of approximately 1,000 linear feet of shoreline at five Village owned parks is classified eroded. Section 3.11 includes a brief summary of shoreline erosion along Woods Creek Lake.

Critical Riparian Areas

An assessment was completed as part of this project that identifies the ecological quality of riparian areas (Appendix B). Critical riparian areas are select natural areas adjacent to stream reaches that are in poor ecological condition but have excellent ecological restoration and remediation potential to improve water quality and habitat conditions and reduce flooding downstream. Four separate riparian areas totaling 89.4 acres were identified as Critical Areas. Section 3.11 includes a summary of all the riparian areas in the watershed.

Critical Drained Wetlands

Five drained wetland areas totaling 50 acres are critical area wetland restoration sites based on their location, size, and restoration potential. A detailed summary of the extent of drained wetlands and potential wetland restoration opportunities in the watershed is included in Section 3.11.

Critical Detention Basins

A detention basin inventory was completed as part of this plan that identifies basins needing water quality improvement retrofits (Appendix B). Twelve (12) basins meet the criteria of a Critical Area based of their location, function, and size. Several critical area detention basins are located at the headwaters of Woods Creek in a multifamily subdivision in the early stages of construction but on hold as a result of the economic turndown. Other Critical Area basins include those that outlet to highly sensitive ecological areas such as Algonquin Hanging Fen and Winding Creek Fen or select basins located along a stream corridor that if retrofitted with natural vegetation, have the potential to improve water quality and extend the Green Infrastructure Network. A summary of the detention basins in the watershed is included in Section 3.11.

Critical Green Infrastructure Protection Areas

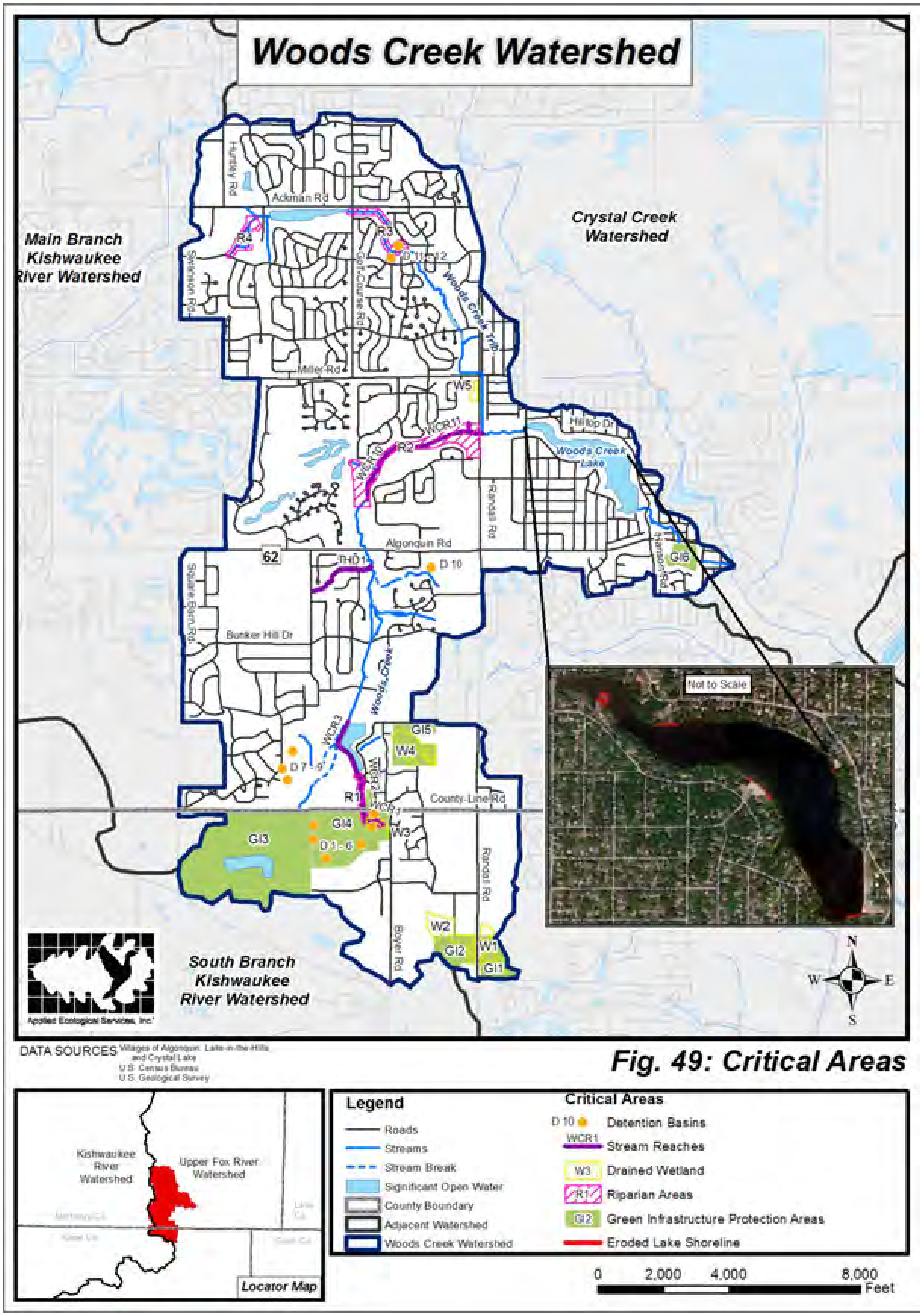
Information obtained from existing and predicted future land use data, sensitive aquifer recharge areas, and green infrastructure sections of this report led to identification of six green infrastructure priority protection areas totaling 412.5 acres. Green infrastructure protection areas 1 and 2 are situated at the southern tip of the watershed in the vicinity of sensitive aquifer recharge areas. These areas are currently under agricultural row crop production but slated for future commercial/retail development. Area 3 is currently a gravel quarry that is planned mixed commercial/retail in the future. Areas 4 and 5 are comprised of land in the very early stages of development to become multi-family residential but are currently on hold due to the economic turndown. Conservation Design standards are recommended for all green infrastructure protection areas 1-5 when and if they become developed.

Area 6 includes two private parcels recognized as Ecologically Significant Areas harboring the highest quality reach of Woods Creek (WCR14) that is adjacent to the only remaining remnant mesic woodland. The ability to develop these areas in the future is limited due to existing wetland and floodplain along Woods Creek and the steep mesic woodland slope. Therefore, acquisition and preservation as a dedicated natural area is recommended.

Table 28. Critical Areas, Management Measures, & estimated nutrient and sediment load reductions.

Critical Area	Existing Condition/Description	Recommended Critical Area Management Measure	Nutrient & Sediment Load Reduction
Stream Reaches			
Woods Creek Reach 1 (WCR1)	909 lf of stream on private land with highly eroded streambanks and moderate channelization	Restore streambanks using bioengineering techniques and improve channel using riffles; restore in conjunction with Critical wetland restoration W3 and Riparian Area R1	TN= 52 lbs/yr TP= 26 lbs/yr TSS= 26 tons/yr
Woods Creek Reach 2 (WCR2)	1,231 lf of stream on public land (Algonquin) with highly eroded streambanks and high channelization	Restore streambanks using bioengineering techniques and improve channel using riffles; restore in conjunction with Riparian Area R1	TN= 355 lbs/yr TP= 177 lbs/yr TSS= 177 tons/yr
Woods Creek Reach 3 (WCR3)	1,873 lf of stream on public land (Algonquin) with highly eroded streambanks and high channelization	Restore streambanks using bioengineering techniques and improve channel using riffles	TN= 252 lbs/yr TP= 126 lbs/yr TSS= 126 tons/yr
Woods Creek Reach 10 (WCR10)	1,817 lf of stream on public land (Lake in the Hills) with highly eroded streambanks and moderate channelization	Restore streambanks using bioengineering techniques and improve channel using riffles	TN= 556 lbs/yr TP= 278 lbs/yr TSS= 278 tons/yr
Woods Creek Reach 11 (WCR11)	3,129 lf of stream on public land (Lake in the Hills) with highly eroded streambanks and high channelization	Restore streambanks using bioengineering techniques and improve channel using riffles	TN= 957 lbs/yr TP= 479 lbs/yr TSS= 479 tons/yr
Terrace Hill Drain 1 (THD1)	2,292 lf of stream on public land (Algonquin) with moderately eroded streambanks; high TSS levels have been documented	Restore streambanks using bioengineering techniques and improve channel using riffles	TN= 91 lbs/yr TP= 46 lbs/yr TSS= 46 tons/yr
Lake Shoreline			
Woods Creek Lake	1,000 lf of eroded shoreline at five public parks owned by Lake in the Hills	Restore shoreline areas using bioengineering techniques	TN= 65 lbs/yr TP= 32.5 lbs/yr TSS= 32.5 tons/yr
Riparian Areas			
R1	9.7 degraded riparian acres on private & public (Algonquin) land along Woods Cr. Reaches 1 & 2 (WCR1 & 2)	Restore degraded riparian area using a natural ecological restoration approach; restore in conjunction with Critical wetland restoration W3 and Stream Reaches WCR1 & 2	TN= 267 lbs/yr TP= 40 lbs/yr TSS= 29 tons/yr
R2	52 degraded riparian acres on public land (Lake in the Hills) along Woods Creek Reaches 10 & 11 (WCR10 & 11)	Restore degraded riparian area using a natural ecological restoration approach	TN= 129 lbs/yr TP= 25 lbs/yr TSS= 6.5 tons/yr
R3	15 degraded riparian acres on public land (Crystal Lake PD) along Woods Creek Tributary Reach 2 (WCTR2)	Restore degraded riparian area using a natural ecological restoration approach; includes retrofitting two Critical detention basins D11-12	TN= 63 lbs/yr TP= 11 lbs/yr TSS= 3 tons/yr
R4	12.7 degraded riparian acres on private land along Unnamed Tributary A (TRA)	Modify ditch outlet to restore water level to surrounding wetland	TN= 189 lbs/yr TP= 56 lbs/yr TSS= 25 tons/yr
Drained Wetlands			
W1	12.1 acres of drained wetland on private land; area is important for groundwater/aquifer recharge	Incorporate wetland restoration into future development plans by using area as wetland detention	TN= 24 lbs/yr TP= 4 lbs/yr TSS= 3 tons/yr
W2	17.5 acres of drained wetland on private land; area is important for groundwater/aquifer recharge	Incorporate wetland restoration into future development plans by using area as wetland detention	TN= 52 lbs/yr TP= 11 lbs/yr TSS= 8 tons/yr

Critical Area	Existing Condition/Description	Recommended Critical Area Management Measure	Nutrient & Sediment Load Reduction
W3	3.1 acres of drained wetland on private land at headwaters of Woods Creek (WCR1)	Restore wetland along Woods Creek Reach 1 using a ecological restoration approach in conjunction with restoring Critical Area stream reach WCR1	TN= 34 lbs/yr TP= 10 lbs/yr TSS= 8 tons/yr
W4	14.9 acres of drained wetland on private land at headwaters of Grand Reserve Creek (GRCR1)	Incorporate wetland restoration into planned development as wetland detention and connect to existing green infrastructure in Grand Reserve Subdivision	TN= 60 lbs/yr TP= 17 lbs/yr TSS= 14 tons/yr
W5	2.5 acres of drained wetland on public land (Lake in the Hills: Sky Park) that occasionally floods	Create wetland using a ecological restoration approach	TN= 4 lbs/yr TP= 2 lbs/yr TSS= 1 tons/yr
Detention Basins			
D1-6	Six privately owned wet bottom basins located at headwaters of Woods Creek; basins are part of early development stage that is currently on hold	Regrade and plant basins to naturalized detention basin standards	TN= 198 lbs/yr TP= 55 lbs/yr TSS= 46 tons/yr
D7-9	Three HOA owned wet bottom/turf grass sideslope basins within the Coves Subdivision; water from basins outlets to Algonquin Hanging Fen	Retrofit with a native vegetation buffer on sideslopes and emergent plants along shoreline	TN= 138 lbs/yr TP= 41 lbs/yr TSS= 14 tons/yr
D10	One privately owned wet bottom/turf grass sideslope basin at Montessori School; water from basin outlets to Winding Creek Fen	Retrofit with a native vegetation buffer and emergent plants along the shoreline	TN= 4 lbs/yr TP= 1 lbs/yr TSS= 1 tons/yr
D11-12	Two dry bottom/turf grass basins abutting Wood Creek Tributary Reach 2 (WCRT2) on Crystal Lake Park District owned land	Retrofit with native vegetation and incorporate into Critical riparian area R3 project	TN= 148 lbs/yr TP= 18 lbs/yr TSS= 7 tons/yr
Green Infrastructure Protection Areas			
GI1	24.4 acres currently in private agriculture use in area that is important for groundwater/aquifer recharge and planned for commercial/retail development	Incorporate Conservation Design standards into future development plans with an emphasis on stormwater infiltration	Pollutant reduction cannot be assessed via modeling
GI2	24.5 acres currently in private agriculture use in area that is important for groundwater/aquifer recharge and planned for commercial/retail development	Incorporate Conservation Design standards into future development plans with an emphasis on stormwater infiltration	Pollutant reduction cannot be assessed via modeling
GI3	222.6 acres currently in private use as a gravel quarry; retail/commercial development in planned in future	Incorporate Conservation Design standards into future re-development plans	Pollutant reduction cannot be assessed via modeling
GI4	89.8 acres of private land currently in early stages of development at headwaters of Woods Creek; site includes Critical Area Detentions #1-6	Incorporate Conservation Design standards into future development plans	Pollutant reduction cannot be assessed via modeling
GI5	34.7 acres of private land in early stages of development at headwaters of Grand Reserve Creek	Incorporate Conservation Design standards into future development plans	Pollutant reduction cannot be assessed via modeling
GI6	16.5 acres of private land that includes a high quality reach of Woods Creek (WCR14) and adjacent remnant mesic woodland	Acquire and protect parcels as natural area	Not applicable


Woods Creek Watershed
Main Branch Kishwaukee River Watershed
Crystal Creek Watershed
South Branch Kishwaukee River Watershed
Ackman Rd
Miller Rd
Algonquin Rd
Bunker Hill Dr
County Line Rd
Randall Rd
Woods Creek Trib
Woods Creek
Woods Creek Lake
Hilltop Dr
Not to Scale
Applied Ecological Services, Inc.
DATA SOURCES Villages of Algonquin, Lake-in-the-Hills and Crystal Lake
U.S. Census Bureau
U.S. Geological Survey
Fig. 49: Critical Areas
Legend
Roads
Streams
Stream Break
Significant Open Water
County Boundary
Adjacent Watershed
Woods Creek Watershed
Critical Areas
Detention Basins
Stream Reaches
Drained Wetland
Riparian Areas
Green Infrastructure Protection Areas
Eroded Lake Shoreline
0 2,000 4,000 8,000 Feet
Kishwaukee River Watershed
Upper Fox River Watershed
Locator Map

4.3 Impairment Reduction Targets

Establishing "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. Table 29 summarizes the basis for *known* impairments and Reduction Targets in Woods Creek watershed as derived from Table 27. Reduction Targets listed in Table 29 are based on documented information, modeling results, best professional judgment, and/or 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 for phosphorus and sediment reduction targets the assumption is made that the percent decrease in sample concentration needed is approximately equal to the percent reduction in annual load needed. Table 29 also includes a column summarizing the overall impairment reduction expected after addressing Critical Areas. According to the pollutant reduction calculations, all Reduction Targets that can be measured would be attained by addressing Critical Areas alone.

Noteworthy- Water Quality Reduction Targets

Water quality impairment Reduction Targets for Woods Creek were established prior to water entering Woods Creek Lake and not for the water at the point just before it leaves the watershed and enters Crystal Creek. This approach was taken because water quality sampling conducted by local communities indicates that pollutant levels are elevated in Woods Creek prior to entering Woods Creek Lake and are below recommended standards and criteria downstream from the lake.

This Page Intentionally Left Blank

Table 29. Basis for known impairments, Reduction Targets, & impairment reduction from Critical Areas.

Impairment: Cause of Impairment	Basis for Impairment	Reduction Target	Reduction from Critical Area	Attainable?
Water Quality/Aquatic Life: phosphorus in Woods Creek prior to entering Woods Creek Lake	2,761 lb/yr of phosphorus loading based on STEPL model & 0.10 mg/l TP in water quality samples prior to Woods Creek Lake	>27.5% or 759 lb/yr reduction in phosphorus loading to achieve 0.0725 mg/l TP USEPA numeric criteria for streams in Ecoregion VI	1,131 lbs/yr or 41% phosphorus reduction from critical stream reaches	Yes
			132 lbs/yr or 5% phosphorus reduction from critical riparian areas	No
			44 lbs/yr or 1.5% reduction from critical drained wetlands	No
			115 lbs/yr or 4% reduction from critical detention basins	No
TOTAL			**1,422 lbs/yr or 51.5% TP reduction of from all Critical Areas combined**	**Yes**
Water Quality/Aquatic Life: turbidity/total suspended sediment in Woods Creek prior to entering Woods Creek Lake	2,531 tons/yr of sediment loading prior to Woods Creek Lake based on STEPL model; 8,960 linear feet of highly eroded streambank contributing 2,175 tons/yr of sediment loading based on STEPL model; 269 riparian acres are currently in poor ecological condition; 1,056 acres (71%) of wetlands lost since pre-settlement; 91 of 134 (91%) detention basins are in poor condition	>17% or 430 tons/yr reduction in sediment loading to achieve 19 mg/l TSS based on USGS numeric criteria in Great Lakes Region	1,131 tons/yr or 45% sediment reduction from critical stream reaches	Yes
			63.5 tons/yr or 2.5% sediment reduction from critical riparian areas	No
			34 tons/yr or 1.5% sediment reduction from critical drained wetlands	No
			68 tons/yr or 3% sediment reduction from critical detention basins	No
TOTAL			**1,296.5 tons/yr or 51% sediment reduction from all Critical Areas combined**	**Yes**
Habitat Degradation: lack of habitat in streams	24,160 lf of stream length is highly channelized	>50% or 12,080 linear feet of highly channelized stream length enhanced	67% or 8,049 linear feet of channelized stream enhanced via improvements to critical stream reaches	Yes
Habitat Degradation: invasive and/or non-native plant species in riparian areas	269 riparian acres are currently in poor ecological condition	25% or 67 acres of poor quality riparian areas ecologically restored	89.4 or 33% areas restored addressing critical riparian areas	Yes
Habitat Degradation: hydrologic and flow changes	1,056 acres (71%) of wetlands lost since pre-settlement.	5 critical drained wetlands restored accounting for 50 acres	50 critical wetland acres restored	Yes
Fish Consumption: mercury levels in largemouth bass >15 inches in Woods Creek Lake	Mercury in largemouth bass >15 inches ranges from 0.118 to 0.730 mg/kg	< 0.22 mg/kg in largemouth bass >15 inches	Not Applicable*	Not Applicable

Impairment: Cause of Impairment	Basis for Impairment	Reduction Target	Reduction from Critical Area	Attainable?
Aesthetic Quality: aquatic plants in Woods Creek Lake	54% total aquatic plant cover in Woods Creek Lake according to IDNR in 2009	>14% decrease in total aquatic plant cover to reach 40% IEPA recommendation	Not Applicable*	Not Applicable**
Structural Flood Damage: structures in 100-year floodplain	2 structural flood problem areas	100% or 2 structural flood problem areas addressed	Not Applicable*	Not Applicable
Reduced Groundwater Discharge to Streams: shallow aquifer drawdown	>40% reduction in groundwater discharge and >60 foot drawdown of aquifer by 2049	>50% preservation of open space in Sensitive Aquifer Recharge Areas (SARS) for all future development	>50% preservation of Sensitive Aquifer Recharge Areas (SARS) if developed using Conservation Design	Yes**

* Addressed in Action Plan section of report
**Target will be met if Action Plan recommendations are implemented

5.0 MANAGEMENT MEASURES ACTION PLAN

Earlier sections of this plan summarized Woods 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 objectives related to each plan goal at general and site specific scales. The Action Plan is divided into two subsections:

- *Programmatic Measures* : general remedial, preventive, and regulatory 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 aquatic and terrestrial habitat.

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 30. Detailed descriptions and responsibilities of each stakeholder is found in Appendix D.

Table 30. Key Woods Creek watershed stakeholders/partners.

Watershed Stakeholder/Partner	Acronym/Abbreviation
Businesses	Business
City of Crystal Lake	Crystal Lake
Crystal Lake Park District	CLPD
Developers	Developer
Ecological Consultants	Consultant
Fox River Ecosystem Partnership	FREP
Golf Courses	GC
Illinois, McHenry, and Kane County Dept. of Transportation	DOTs
Illinois Environmental Protection Agency	IEPA
Kane County Development Department	KCDD
McHenry County Planning and Development Department	MCPDD
Residents or Owners	Resident/Owner
School Districts	School
The Land Conservancy of McHenry County	TLC
Townships (Algonquin, Dundee, Grafton, Rutland)	TWP
USDA Natural Resources Conservation Service (Kane and McHenry County)	USDA
US Army Corps of Engineers-Chicago Region	USACE
US Fish & Wildlife Service	USFWS
Village of Algonquin	Algonquin
Village of Lake in the Hills	LITH
Village of Lakewood	Lakewood
Woods Creek Watershed Committee	WCWC

5.1 Programmatic Management Measures Action Plan

Numerous types of programmatic Management Measures are recommended to address watershed objectives for each plan goal. Table 31 includes recommended measures that are applicable throughout the watershed and information needed to facilitate implementation of specific actions. This information includes the "Priority", "Objective Addressed", "Responsible Stakeholder(s)", and the recommended "Technical Support" that will likely be responsible for issuing appropriate permits or providing technical, regulatory, or funding assistance. Note: estimated costs and pollutant load reductions are not included for programmatic measures due to the general nature of the recommendations.

Priority is assigned to each action item and classified as "High", "Medium", or "Low" based on several factors such as importance, ownership type, potential cost, technical assistance and financial needs, and potential shortcomings. High priority recommendations deserve immediate attention and should be ongoing or addressed in the short term (1-5 years) whereas medium and low priority recommendations are not as urgent and should be addressed in the long term (5-10+ years). Medium and low priority recommendations should not be written off as less important. In many cases, funding availability, technical assistance needs, or shortcomings may be responsible for a recommendation being designated as medium or low priority.

Noteworthy- Programmatic Management Measure Categories

Non-Structural: Broad group of practices that prevent impairment through maintenance and management of Management Measures or performance of stewardship tasks that are ongoing in nature and designed to control pollutants at their source.

Educational: Outreach to educate the public related to environmental impacts of daily activities and to build support for watershed planning and projects. Topics typically addressed include land management, pet waste management, lawn fertilizer use, good housekeeping, etc.

Policy: Local, state, and federal government can help prevent watershed impairments in various ways through policy but specifically related to controlling pollutants and reducing stormwater runoff from new developments and protecting floodplain and natural resources.

Project Coordination: Successful watershed plan implementation depends on coordination and cooperation between the Woods Creek Watershed Committee and all other pertinent stakeholders.

Structural: Watershed impairments and pollutant load reduction targets may not be met with recommended site specific Management Measures and therefore will require a more comprehensive use of other structural measures such as agricultural measures, filtering and infiltration practices, erosion control practices, etc.

Table 31: Programmatic Management Measures to address objectives for plan goals A-H.

Goal A: Identify, protect, and manage the Green Infrastructure Network.

	Management Measures	Priority	Primary Objective	Responsible Stakeholder(s)	Technical Assistance
1	Identify and designate a lead Woods Creek watershed stakeholder to serve as a "coordinator" and meet with other stakeholders to plan for future green infrastructure. See Section 3.9 for a summary and map of the Green Infrastructure Network.	High	A1	WCWC	All Stakeholders
2	Each municipality incorporate the identified Green Infrastructure Network (see Section 3.9) into comprehensive plans and development review maps.	High	A1	All Municipalities	Consultant
3	Create zoning overlay and update development ordinances to require Conservation Development design standards on all Green Infrastructure Network parcels (see Section 3.9) where development is planned.	High	A2	All Municipalities; TWP	KCDD; MCPDD
4	Leverage mitigation dollars from the proposed Randall Road expansion project to help implement and manage projects on Green Infrastructure Network parcels (see Section 3.9).	High	A4	WCWC; TLC All Municipalities	McDOT; Consultant
5	Require Development Impact Fees and/or Special Service Area taxes for all new development and redevelopment to help fund future management of green infrastructure.	High	A4	All Municipalities; TWP	-
6	Identify and protect green infrastructure parcels harboring high quality natural areas or T&E species that are currently not protected.	Medium	A3	TLC	All Municipalities; CLPD; TWP
7	Private land owners with parcels in the Green Infrastructure Network (see Section 3.9) along Woods Creek Lake and stream/tributary corridors manage their land for green infrastructure benefits.	Medium	A4	Resident; Owner	FREP; USDA; Consultant; WCWC
8	Use Green Infrastructure Network (see Section 3.9) to identify and create new trails and trail connections between communities.	Medium	A1	All Municipalities; CLPD; TWP	WCWC
9	Prepare and implement short and long term management plans for all publically owned natural area Green Infrastructure Network parcels (see Section 3.9).	Medium	A4	All Municipalities; CLPD; TWP	Consultant
10	Identify opportunities for agencies to provide economic incentives to developers that encourage the preservation of green infrastructure in developments.	Low	A2	All Municipalities; TWP	KCDD; MCPDD; USACE; USFWS
11	Limit subdivision of large Green Infrastructure Network parcels.	Low	A2	All Municipalities; TWP	-

Goal B: Create policy to protect watershed resources from the impacts of future development.

	Management Measures	Priority	Primary Objective	Responsible Stakeholder(s)	Technical Assistance
1	Watershed Partners adopt the Woods Creek Watershed-Based Plan and incorporate plan goals, objectives, and recommended actions into comprehensive plans and ordinances.	High	B1	Algonquin; LITH; Crystal Lake; CLPD	WCWC
2	Identify "Champions" to assemble at future Woods Creek Watershed Committee (WCWC) meetings to actively implement the Watershed-Based Plan and conduct progress evaluations.	High	B1	WCWC	Consultant
3	Amend municipal comprehensive plans and zoning ordinances to include a Woods Creek Watershed Protection Overlay that requires Conservation Design standards for all development located on identified Green Infrastructure Network parcels (see Section 3.9) using the "McHenry County Subdivision Ordinance-Conservation and Design Standards and Procedures" adopted February 19, 2008 as a minimum standard/guideline.	High	B2	All Municipalities	WCWC; KCDD; MCPDD
4	Require Watershed Protection Fees in the form of Development Impact Fees and/or Special Service Area (SSA) taxes for all new development to help fund management of the Green Infrastructure Network.	High	B4	All Municipalities; TWP	WCWC; KCDD; MCPDD
5	Train local government planners and engineers on how to use and implement the Woods Creek Watershed-Based Plan.	Medium	B1	WCWC	Consultant
6	Kane and McHenry "Certified Community" staff assist developers with proper Management Measures selection and siting.	Medium	B2	All Certified Municipalities	KCDD; MCPDD
7	Require developers to protect sensitive natural areas, restore degraded natural areas and streams, then donate all natural areas and naturalized stormwater management systems to a public agency or conservation organization for long term management with dedicated funding.	Medium	B3	Developer	All Municipalities; TWP
8	Require reduced or no phosphorus use based on soil testing recommendations and Illinois Phosphorus Law.	Medium	B5	All Municipalities; TWP	-
9	Provide incentives or priority review status for developers who are required to implement Conservation Design standards on Green Infrastructure Network parcels. Incentives might include reduced fees for reducing impervious surface, reduced detention requirements for using permeable surfaces, preservation of existing natural areas, or reduced landscape requirements when using native vegetation.	Medium	B2	All Municipalities; TWP	KCDD; MCPDD
10	Require mitigation for all wetland losses to occur within Woods Creek watershed.	Medium	B2	All Municipalities; TWP	KCDD; MCPDD; USACE

Goal C: Restore and manage aquatic and terrestrial habitat.

	Management Measures	Priority	Primary Objective	Responsible Stakeholder(s)	Technical Assistance
1	Watershed Partners prepare annual budgets for restoring and managing habitat.	High	C1-7	All Municipalities; CLPD	Consultant
2	Prepare and implement Natural Resource Inventory (NRI)/management plans for all publically owned natural area parcels within the Green Infrastructure Network.	High	C1	All Municipalities, TLC; CLPD	Consultant
3	Follow standard short term and long term maintenance recommendations for naturalized detention basins (see Section 3.11).	High	C5	All Municipalities; CLPD; HOA	Consultant
4	Leverage mitigation dollars from the proposed Randall Road expansion project to help restore and manage aquatic and terrestrial habitat.	High	C1	WCWC; TLC All Municipalities	McDOT; Consultant
5	Reintroduce fire as a management tool into natural areas where feasible via controlled burns.	High	C3,4,5	All Municipalities; TWP; CLPD	Consultant
6	Control existing populations and prevent the spread of non-native/invasive plant species within natural areas and replace with native vegetation.	High	C3	All Stakeholders	Consultant
7	Apply natural pool/riffle habitat and bank stabilization designs to all stream restoration projects.	High	C2	Developer; All Municipalities; TWP; CLPD	USACE; Consultant
8	Plant native oak (*Quercus*) trees at all applicable restoration and management sites in support of TLC's Project Quercus.	High	C1	Developer; CLPD Municipalities;	TLC
9	Restore wetlands using an ecological restoration approach.	Medium	C3,4	All Municipalities; Owner	Consultant
10	Restore stream and terrestrial habitat in conjunction with construction of road and bridge crossings.	Medium	C2,3	DOT	USACE
11	Restore stream reaches within all new and redevelopment to add wildlife habitat and aesthetic value.	Medium	C2,3	Developer	USACE; Consultant
12	Require developers to protect sensitive natural areas, restore degraded natural areas and streams, then donate all natural areas and naturalized stormwater management systems to a public agency or conservation organization for long term management with dedicated funding.	Medium	C3	Developer	All Municipalities; TWP
13	Golf Courses enroll in Audubon Cooperative Sanctuary Program (ACSP) then naturalize ponds/buffers and rough areas.	Low	C3,5	Golf	Consultant
14	Conduct annual aquatic plant (macrophyte) surveys in Woods Creek Lake to evaluate overall plant cover as it relates to aquatic plant management based on IEPA/IDNR recommendations.	Low	C7	LITH	Consultant

Goal D: Provide watershed educational opportunities.

	Management Measures	Priority	Primary Objective	Responsible Stakeholder(s)	Technical Assistance
1	Inform stakeholders that a Watershed-Based Plan has been developed for Woods Creek Watershed then educate stakeholders on the beneficial uses of the plan.	High	D1	Algonquin; LITH; Crystal Lake; CLPD	WCWC
2	Watershed Partners prepare annual budgets to hold educational workshops and other events recommended in the Education Plan (see Section 6.0).	High	B1	Algonquin; LITH; Crystal Lake; CLPD	-
3	Implement the Education Plan section of the Watershed-Based Plan (see Section 6.0). The Plan includes the following key topics and events: • Target property owners to help them understand the link between their land management choices and its impact on the watershed resources. • Educate the general public about the benefits of ecological/natural area restoration and management. • Educate private land owners along Woods Creek Lake and miscellaneous stream/tributary corridors about the importance of proper land management to benefit the Green Infrastructure Network. • Role of the Green Infrastructure Network for public and school outdoor education. • Alternatives or management of phosphorus and road salt use. • Flood proofing structural flood problem areas. • Annual tour of watershed by elected officials and others that are interested to see the progress on restoration, areas that need improvement, or failed projects. • Offer outdoor "Volunteer Days" to get the general public to experience the watershed. • Student projects for high schools or college, boy scouts/girl scouts top service project, etc. • Implement demonstration projects, or highlight existing case studies within the watershed that promote the benefits of watershed protection and best management practices.	High	D2	Algonquin; LITH; Crystal Lake; CLPD; School	Consultant; USFWS; TLC; FREP; USDA; WCWC
4	Recruit volunteers and stewards interested in restoring and monitoring natural areas in the watershed.	Medium	D1	Algonquin; LITH; Crystal Lake; CLPD	TLC

Goal E: Improve and monitor surface water quality.

	Management Measures	Priority	Primary Objective	Responsible Stakeholder(s)	Technical Assistance
1	Watershed Partners prepare annual budgets to implement and monitor recommended water quality Management Measures.	High	E1-9	Algonquin; LITH; Crystal Lake; CLPD	-
2	Identify "Champions" to pursue implementation of recommended site specific water quality improvement Management Measures.	High	E1-9	WCWC	Consultant
3	Leverage mitigation dollars from the proposed Randall Road expansion project to help improve water quality by funding recommended projects.	High	E1-5,8	WCWC; TLC All Municipalities	McDOT; Consultant
4	Apply natural pool/riffle habitat and/or bank stabilization designs to stream restoration projects rather than using a hard armoring approach.	High	E1	Developer; All Municipalities; TWP; CLPD	USACE; Consultant
5	Apply natural stabilization designs to all pond, lake, and detention basin shoreline/sideslope restoration projects.	High	E2,8	Developer; All Municipalities; TWP; CLPD	USACE; Consultant
6	Use best management practices when applying road salt during winter months.	High	E6	All Municipalities; TWP, DOT	IEPA; County
7	Develop a plan and implement weekly street cleaning and stormsewer cleaning as needed.	High	E9	All Municipalities; TWP; DOT	-
8	Install and maintain stormwater treatment units (stormceptors) on appropriate new or repaved road construction projects.	High	E9	All Municipalities; TWP; DOT	-
9	Implement the Water Quality Monitoring Plan section of the Woods Creek Watershed-Based Plan.	High	E9	IEPA; Algonquin, LITH; Crystal Lake; CLPD; IDNR; School	Consultant; Riverwatch
10	Reduce fertilizer use on large retail/commercial, municipal/park district parks, and large residential lawns based on results of soil testing and consider using organic fertilizer.	Medium	E7	All Municipalities; CLPD; TWP; Resident; Business	USDA; Consultant
12	Install rain gardens to capture, clean, and infiltrate rooftop and sump pump runoff.	Low	-	Resident; Business; All Municipalities	Consultant; USDA
13	Install a stream gage on Woods Creek to monitor flow/discharge and assist with scheduling storm event water quality monitoring.	Low	E9	USGS	-
14	Implement stream maintenance programs to identify and remove problematic debris jams from culverts, road crossing, etc. and fix problematic discharge/hydraulic structures.	Low	E1	All Municipalities; CLPD	Consultant; USDA; USACE

Goal F: Improve groundwater recharge.

	Management Measures	Priority	Primary Objective	Responsible Stakeholder(s)	Technical Assistance
1	Maintain open space in Sensitive Aquifer Recharge Areas (SARA) per county "Groundwater Protection Action Plans" requirements.	High	F1	All Municipalities; TWP	KCDD; MCPDD
2	Leverage mitigation dollars from the proposed Randall Road expansion project to help fund groundwater recharge Management Measures related to the project.	High	E1-5,8	WCWC; TLC All Municipalities	McDOT; Consultant
3	Encourage limitations in impervious surface coverage at the Subwatershed Management Unit (SMU) scale based on "Future Land Use Vulnerability" results (see Section 3.6).	High	F1	All Municipalities; TWP	KCDD; MCPDD
4	Restore wetlands within Sensitive Aquifer Recharge Areas (SARA) to promote infiltration of stormwater (see Section 3.12).	Medium	F1	All Municipalities; developer; Owner	Consultant
5	Install infiltration detention basins to capture, clean, and infiltrate stormwater.	Medium	F1	All Municipalities; developer; Owner	Consultant; County
6	Install rain gardens to capture, clean, and infiltrate rooftop runoff.	Low	F1	Resident; All Municipalities	Consultant
7	Conduct investigation of any remaining drain tiles in the watershed and the impacts on groundwater recharge.	Low	F1	Consultant	IEPA
8	Identify shallow aquifer monitoring sites and implement a monitoring plan.	Low	F1	KCDD; MCPDD	IEPA

Goal G: Increase and/or improve recreational opportunities.

	Management Measures	Priority	Primary Objective	Responsible Stakeholder(s)	Technical Assistance
1	Incorporate green infrastructure amenities such as trails, fishing access, interpretive signage, wildlife habitat, and other features when creating new recreational areas or enhancing existing areas.	High	G3	All Municipalities; CLPD	Consultant
2	Create bike path/trail connections to existing networks.	Medium	G1,3	Algonquin; LITH; Crystal Lake, CLPD, DOT	-
3	Create fishing opportunities by providing access on appropriate publically owned detention basins and stream reaches.	Medium	G2,3	All Municipalities; CLPD	-
4	Watershed Partners prepare annual budgets to implement recreational opportunities.	Medium	G1	Algonquin; LITH; Crystal Lake; CLPD	-

Goal H: Mitigate for existing structural flood problems

	Management Measures	Priority	Primary Objective	Responsible Stakeholder(s)	Technical Assistance
1	Continue to inspect the integrity of the dam on Woods Creek Lake annually.	High	H1	LITH	USACE
2	Coordinate and implement stormsewer cleaning as needed.	High	-	All Municipalities; TWP; DOT	-
3	Mitigate for all identified structural flood problem areas identified in Section 3.11.	Medium	H4	All Municipalities; Owner	FEMA; USACE
4	Restore historical floodplain function by breaking or removing spoil piles along channelized stream reaches.	Medium	H2	Owner	FEMA; USACE; USDA
5	Assess all dams, weirs, online impoundments, and streamside floodplains for potential increased stormwater storage.	Medium	-	Municipalities	Consultant
6	Implement impervious reduction stormwater measures as development occurs within Subwatershed Management Units 14, 16, and 17 that are ranked as "Highly Vulnerable" to future development and associated impervious cover (see Section 3.6).	Medium	H3	All Municipalities; Twp	KCDD; MCPDD; USACE
7	Assess storage capacity for older, sediment laden detention basins and consider dredging those with storage deficiencies or retrofitting the basin bottom with features that extend the length of time water is stored in the basin.	Medium	-	Owner	Municipalities; Consultant
8	Restore wetlands to promote storage and infiltration of stormwater (see Section 3.11).	Medium	-	All Municipalities; developer; Owner	Consultant
9	Implement detention basin outlet monitoring to remove trash and other debris.	Medium	-	All Municipalities; TWP; DOT	-
10	Install rain gardens to capture, clean, and infiltrate rooftop runoff.	Low	-	Resident; All Municipalities	Consultant
11	Require mitigation for all wetland losses to occur within Woods Creek watershed.	Low	-	All Municipalities; TWP	KCDD; MCPDD; USACE
12	Implement stream maintenance programs to identify and remove debris jams that lead to flooding.	Low	E1	All Municipalities; CLPD	Consultant; USDA; USACE

This Page Intentionally Left Blank

5.2 Site Specific Management Measures Action Plan

Site Specific Management Measure (Best Management Practices [BMPs]) recommendations made in this section of the report are backed by findings from the watershed field inventory, overall watershed characteristics assessment, and input from watershed 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 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 jurisdictions and are included in the Action Plan:

- *Algonquin*
- *Algonquin Township*
- *Crystal Lake*
- *Crystal Lake Park District*
- *Dundee Township*
- *Grafton Township*
- *Lake in the Hills*
- *Rutland Township*

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

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

Descriptions and location maps for each Management Measure category follow. Table 36 includes useful project details such as site ID#, Location, Units (size/length), Owner, Existing Condition, Management Measure Recommendation, Pollutant Load Reduction Efficiency, Priority, Responsible Entity, Sources of Technical Assistance, Cost Estimate, and Implementation Schedule.

Many facets such as importance, technical and financial needs, cost, feasibility, and ownership type were taken into consideration when prioritizing and scheduling Management Measures for implementation. Critical Area, High Priority, Medium Priority, or Low Priority was assigned to each recommendation. Critical Areas are the highest priority and are discussed in Section 4.0 and highlighted in red on project category maps and the Action Plan table. Implementation schedule varies greatly with each project but is generally based on the short term (1-5 years) for Critical Area projects, 1-10 years for High Priority projects, and 10-20+ years for medium and low priority projects. In addition, many projects such as maintenance 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 jurisdiction (listed alphabetically in Table 36) then identify the Management Measure category of interest. A site ID# can be found in the first column under each recommendation that corresponds to the site ID# on a map associated with each category.

Method 2: The user should go to the page(s) summarizing the appropriate Management Measure category of interest then locate the corresponding map and ID# of the site specific recommendations for that category. Next, the user should go to Table 36 and locate the jurisdiction, project category, and 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* Management Measures. Estimate of sediment and nutrient load reduction from implementation of *urban* Management 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 Critical Area and High Priority projects where calculation of such data is applicable. In summary, pollutant reductions were calculated for 5 detention basin retrofit & maintenance projects, 5 wetland restoration projects, 10 streambank & channel restoration projects, 4 riparian area restoration & maintenance projects, 5 combined lake shoreline restoration projects, and 5 project types included under other measures. Spreadsheets used to determine pollutant load reductions can be found in Appendix C.

Estimated *percent* removal of Total Suspended Solids, Nitrogen, and Phosphorus is included in the Action Plan table for most medium and low priority projects and those projects where calculation of pollutant weight reduction is beyond the scope of this project. The percent removal efficiencies were based on various Management Measures included in the Region 5 Model as shown in Table 32.

Table 32. Region 5 Model percent pollutant removal efficiencies for various Management Measures.

Management Measures	TSS	TN	TP
Vegetated Filter Strips	73%	40%	45%
Extended Wet Detention	86%	55%	68.5%
Wetland Detention	77.5%	20%	44%
Streambank Stabilization	90%	90%	90%
Lake Shoreline Stabilization	90%	90%	90%
Gully Stabilization	90%	90%	90%

Note: Streambank, lake/pond shoreline, and gully stabilization pollutant removal is based on bank height and lateral recession rates.

Summary of Watershed-Wide Action Recommendations

All Site Specific Management Measures and Education Plan (Section 6.0) recommendation information is condensed by Management Measure Category in Table 33. 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 Site Specific Management Measures Action Plan and Education Plan are implemented. Key points include:

- 1,416.5 acres of restoration (detention basins, wetlands, riparian areas, green infrastructure, bioswales, parks, and prairie) with a total cost of $4,750,000.
- 312.5 acres comprising detention basins needing yearly maintenance costing $188,000/year.
- 37,833 linear feet of stream, gully, and swale needing stabilization costing $2,697,000.
- 1,746.25 tons/year of Total Suspended Solids (TSS) would potentially be reduced each year, exceeding the 430 tons/year Reduction Target identified in Section 4.0.
- 5,234 pounds/year of Nitrogen (TN) would potentially be reduced each year.
- 1,789 pounds/year of Phosphorus (TP) would potentially be reduced each year, exceeding the 759 pounds/year Reduction Target indentified in Section 4.0.
- Education programs will cost $31,000 to meet objectives (see Section 4.0).

Table 33. Watershed-wide summary of Management Measures recommended for implementation.

Management Measure Category	Total Units (size/length)	Total Cost	Estimated Load Reduction TSS (t/yr)	Estimated Load Reduction TN (lbs/yr)	Estimated Load Reduction TP (lbs/yr)
Detention Basin Retrofits & Maintenance*					
Retrofits (prairie buffers, plantings, etc.)	168.25 acres	$1,014,500	119	1,424	278
Maintenance (burning, invasive control, brushing, etc.)	312.5 acres	$188,000/yr	n/a	n/a	n/a
Wetland Restoration*	55.5 acres	$820,500	34	174	44
Streambank & Channel Restoration	36,558 lf	$2,507,000	1,446	2,797	1,222
Riparian Area Restoration & Maintenance*	448.3 acres	$2,553,000	63.5	648	132
Lake Shoreline Restoration	1,000 lf	$150,000	32.5	65	32.5
Priority Green Infrastructure Protection Areas**	412.5 acres	n/a	n/a	n/a	n/a
Other Management Measures					
Gully Stabilization	275 lf	$40,000	41	69	35
*Rain Gardens***	2,000 sq. ft.	$12,000	n/a	n/a	n/a
Park Retrofit	30 acres	$80,000	1.25	12	5
Bioswale/Wetland Retrofit	6 acres	$50,000	5.3	7	11.1
Upland Prairie/Buffer Restoration	140 acres	$220,000	3.7	38	29
Aquatic Plant Management-Woods Creek Lake	52 acres	$30,000	n/a	n/a	n/a
Mercury Study-Woods Creek Lake	52 acres	$6,000	n/a	n/a	n/a
Dam Inspection-Woods Creek Lake Dam/Spillway	n/a	$0	n/a	n/a	n/a
Sediment Removal Study-Woods Creek Lake	52 acres	$25,000	n/a	n/a	n/a
Bike Path/Trail Connection	500 lf	$50,000	n/a	n/a	n/a
Information/Education	n/a	$31,000	n/a	n/a	n/a
TOTALS	**1,416.5 acres**	**$4,750,000**	**1,746.25 tons/yr**	**5,234 lbs/yr**	**1,789 lbs/yr**
	312.5 acres maintenance	**$188,000/yr**			
	37,833 lf	**$2,697,000**			
	Other	**$86,000**			
	Education	**$31,000**			

* Pollutant load reduction calculated for applicable Critical Areas and High Priority projects only.
* * Pollutant load reductions could not be calculated using STEPL model.

5.2.1 Detention Basin Retrofits & Maintenance

Applied Ecological Services, Inc. (AES) conducted an inventory of 134 detention basins in fall of 2011. The results of the detention basin inventory are summarized in Section 3.11; detailed field investigation datasheets can be found in Appendix B. The benefits of storing stormwater runoff in detention basins and releasing water slowly are well documented. More recently, the benefits of proper slope and depth design and introducing native vegetation to improve water quality and provide wildlife habitat is becoming the new standard and is required in some local ordinances.

The condition of detention basins in the watershed varies. Twenty nine (29) dry bottom turf grass, 28 wet or wetland bottom w/turf grass slopes, 10 naturalized dry bottom, and 67 naturalized wet or wetland bottom basins were assessed. Of the 134 basins, only 9 (7%) provide "Good" ecological and water quality benefits while 34 (26%) basins provide "Fair" benefits. The majority of the basins (91 (68%) are "Poor" at providing ecological and water quality benefits.

The majority of dry bottom detention basins are located north of Algonquin Road within residential areas in the Village of Lake in the Hills, City of Crystal Lake, and within parks owned by Crystal Lake Park District. Many of the dry bottom basins that are not heavily used for recreation present excellent retrofit opportunities to naturalizing with native vegetation. When naturalized, basins do a better job of cleaning stormwater, provide wildlife habitat, and add to green infrastructure. Wet and wetland bottom detention basins are the most common in the watershed. Those with turf grass on the side slopes present excellent naturalization opportunities.

All recommended detention basin retrofits and/or maintenance projects are shown by site ID# and priority on Figure 51. Details about each recommendation can be found in the Action Plan Table (Table 36) within the appropriate jurisdiction. Critical Area basins are the highest priority. Most publicly owned basins and other private basins with significant problems or opportunities are assigned High or Medium priority for retrofits because funding and implementation are usually easier on public land or where major problems/opportunities exist. In some cases, basins are assigned higher priority based on location and/or ability to treat polluted stormwater runoff in a sensitive or pollutant load hotspot. Medium priority is given to most basins where native vegetation has been established but requires ongoing maintenance to prevent degradation. Low priority is generally assigned to small private basins and those with few problems. Recommendations are not made for ten basins where future retrofits are not practical or feasible.

Critical Area detention basin retrofit opportunity at Coves Subdivision

High priority maintenance opportunity around detention basin at Woodscreek Park

Naturalized Wetland Detention Basin Design, Establishment, & Maintenance Recommendations

Future wetland 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. Native vegetation planted in a properly designed basin provides excellent water quality benefits through nutrient uptake, filtering, and by gravitational settling. Recommendations below include schematics and seed/plant lists for the design of naturalized wetland detention basins (Figure 50). These recommendations do not necessarily apply to dry bottom basins. Note: all local and county ordinance requirements will also apply.

Properly designed wet bottom naturalized detention

Location & Siting Recommendations

- Naturalized detention basins should be restricted to natural depressions or drained hydric soil areas and adjacent to other existing natural 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.

General 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.*) should be the only tree species planted on the side slopes.
- A 5-foot wide (at a minimum) shelf planted to native wet prairie and stabilized with erosion control blanket should be constructed above the normal water level. This area should be designed to inundate after every 0.5 inch rain event or greater.
- A 10-foot wide (at a minimum) shelf planted with native emergent plugs should extend from the normal water level to 2 feet below normal water level.
- Permanent pools should be at least 4 feet deep.
- Irregular islands and peninsulas should be constructed 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 should be constructed at the inlet(s) to capture sediment; a 4-6 foot deep micropool should be constructed at the outlet to prevent clogging.

Short Term (3 Years) Establishment Recommendations

The developer in new developments should be responsible for implementing short term management of detention basins and other natural areas to meet performance standards. Generally speaking, three years of management is needed to establish native plant communities. Measures needed include mowing during the first two growing seasons following seeding to reduce annual and biennial weeds. Spot herbiciding is also required to eliminate problematic non-native/invasive species such as thistle, reed canary grass, common reed, cattail, 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 34 includes a three year schedule appropriate to establish native plantings around naturalized detention basins.

Table 34. Three-year establishment schedule for naturalized detention basins.

Year 1 Establishment Recommendations
Mow mesic prairie buffer and wet prairie shelf to a height of 6-12 inches in late June, August, & September.
Spot herbicide non-native/invasive species throughout site in early June and again in August/September. Target thistle, reed canary grass, common reed, purple loosestrife, cattail, and all emerging woody saplings.
Check for clogging and erosion control at inlet and outlet structures during every site visit.
Year 2 Establishment Recommendations
Mow mesic prairie buffer and wet prairie shelf when dry to a height of 12 inches in late June and early August.
Spot herbicide non-native/invasive species throughout site in early June and again in August/September. Target thistle, reed canary grass, common reed, purple loosestrife, cattail, and all 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 every site visit.
Year 3 Establishment Recommendations
Spot herbicide non-native/invasive species throughout site in early June and again in August/September. Target thistle, reed canary grass, common reed, purple loosestrife, cattail, and all emerging woody saplings.
Check for clogging and erosion control at inlet and outlet structures during every site visit.

Long Term (3 Years +) Maintenance Recommendations

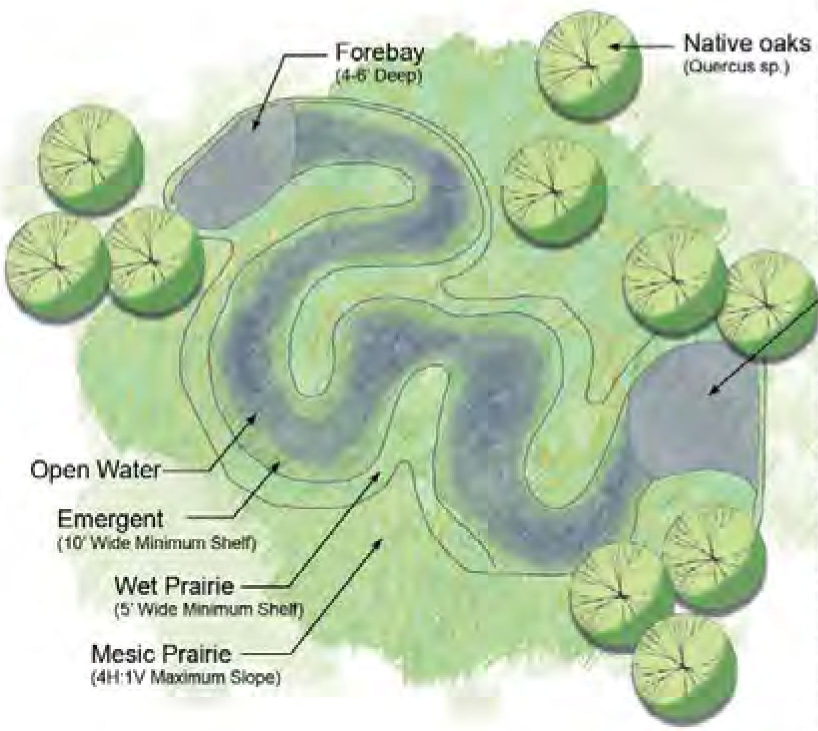
Long term management of most detention basins and other natural areas associated with development is the responsibility of the homeowner or business association or local municipality. Often, these groups lack the knowledge and funding to implement long term management of natural areas resulting in the 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 or other means such as a watershed protection fee. Table 35 includes a cyclical long term schedule appropriate to maintain native vegetation around detention basins and other natural areas.

Table 35. 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, cattail, and emerging woody saplings such as willow, cottonwood, buckthorn, and box elder.
Check for clogging and erosion control at inlet and outlet structures during every site visit.
Year 2 of 3 Year Maintenance Cycle
Spot herbicide problematic non-native/invasive species throughout site in August. Specifically target thistle, reed canary grass, common reed, cattail, and emerging woody saplings such as willow, cottonwood, buckthorn, and box elder.
Mow mesic prairie buffer and wet prairie shelf to a height of 6-12 inches in November.
Check for clogging and erosion control at inlet and outlet structures during every site visit.
Year 3 of 3 Year 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 every site visit.

Figure 50. Naturalized Detention Basin Design Recommendations.

Naturalized Detention Basin Design Recommendations



MESIC PRAIRIE

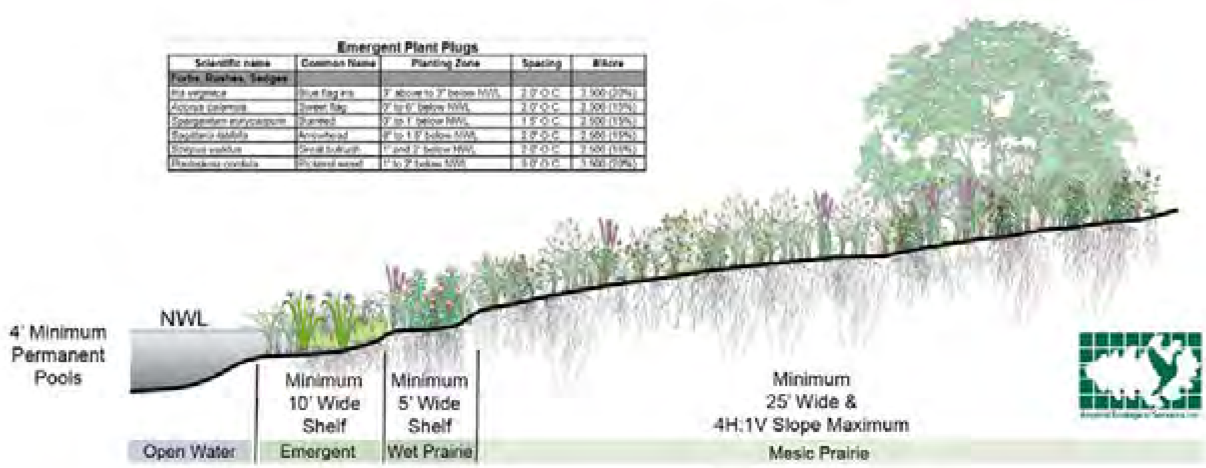
Scientific name	Common Name	Oz./Acre	lbs./Acre
Grasses			
Andropogon gerardii	Big bluestem	12.0	
Andropogon scoparius	Little bluestem	65.1	
Bouteloua curtipendula	Side oats gramma	20.7	
Elymus canadensis	Canada wild rye	24.5	
Sorghastrum nutans	Indian grass	12.7	
Total Grasses		135.0	9.7
Forbs			
Aster laevis	Smooth blue aster	1.1	
Asclepias tuberosa	Butterfly milkweed	7.3	
Coreopsis lanceolata	Sand coreopsis	2.2	
Echinacea pallida	Pale purple coneflower	16.0	
Eryngium yuccifolium	Rattlesnake master	9.3	
Liatris pycnostachya	Prairie blazing star	7.5	
Monarda fistulosa	Wild bergamot	0.4	
Penstemon digitalis	Foxglove beard tongue	0.2	
Petalostemum purpureum	Purple prairie clover	3.5	
Ratibida pinnata	Yellow coneflower	1.4	
Rudbeckia hirta	Black eyed Susan	0.9	
Silphium integrifolium	Rosinweed	4.4	
Solidago rigida	Stiff goldenrod	1.1	
Zizia aurea	Golden Alexanders	3.2	
Total Forbs		60.3	3.8
Total Grasses and Forbs		215.4	13.5
Temporary Cover Crop			
Avena sativa	Common oats	320.0	20.0

WET PRAIRIE

Scientific name	Common Name	Oz./Acre	lbs./Acre
Grasses, Sedges, Rushes			
Carex scoparia	Pointed broom sedge	1.1	
Carex vulpinoidea	Brown fox sedge	1.0	
Carex comosa	Bristly sedge	0.8	
Juncus dudleyi	Dudley's rush	0.1	
Juncus torreyi	Torrey's rush	0.1	
Leersia oryzoides	Rice cut grass	2.3	
Panicum virgatum	Switch grass	27.7	
Scirpus atrovirens	Dark green rush	0.7	
Total Grasses		34.8	2.2
Forbs			
Asclepias incarnata	Swamp milkweed	17.3	
Bidens cernua	Swamp bur marigold	3.6	
Eryngium yuccifolium	Rattlesnake master	10.5	
Helenium autumnale	Sneezeweed	0.7	
Liatris spicata	Marsh blazing star	14.2	
Lobelia cardinalis	Cardinal flower	0.3	
Lobelia siphilitica	Great blue lobelia	0.3	
Physostegia virginiana	False dragonhead	3.1	
Pycnanthemum virginianum	Common mountain mint	0.2	
Rudbeckia subtomentosa	Sweet black eyed Susan	2.5	
Solidago riddellii	Riddell's goldenrod	1.4	
Zizia aurea	Golden Alexanders	1.1	
Total Forbs		61.6	3.8
Total Grasses and Forbs		96.4	6.0
Temporary Cover Crop			
Elymus virginicus	Virginia wild rye	80.0	5.0

Emergent Plant Plugs

Scientific name	Common Name	Planting Zone	Spacing	#/Acre
Forbs, Rushes, Sedges				
Iris virginica	Blue flag iris	3" above to 3" below NWL	2.0' O.C.	2,500 (20%)
Acorus calamus	Sweet flag	3" to 6" below NWL	2.0' O.C.	2,500 (15%)
Sparganium eurycarpum	Burreed	3" to 1' below NWL	1.5' O.C.	2,500 (15%)
Sagittaria latifolia	Arrowhead	6" to 1.5' below NWL	2.0' O.C.	2,500 (15%)
Scirpus validus	Great bulrush	1' and 2' below NWL	2.0' O.C.	2,500 (15%)
Pontederia cordata	Pickerel weed	1' to 2' below NWL	3.0' O.C.	2,500 (20%)



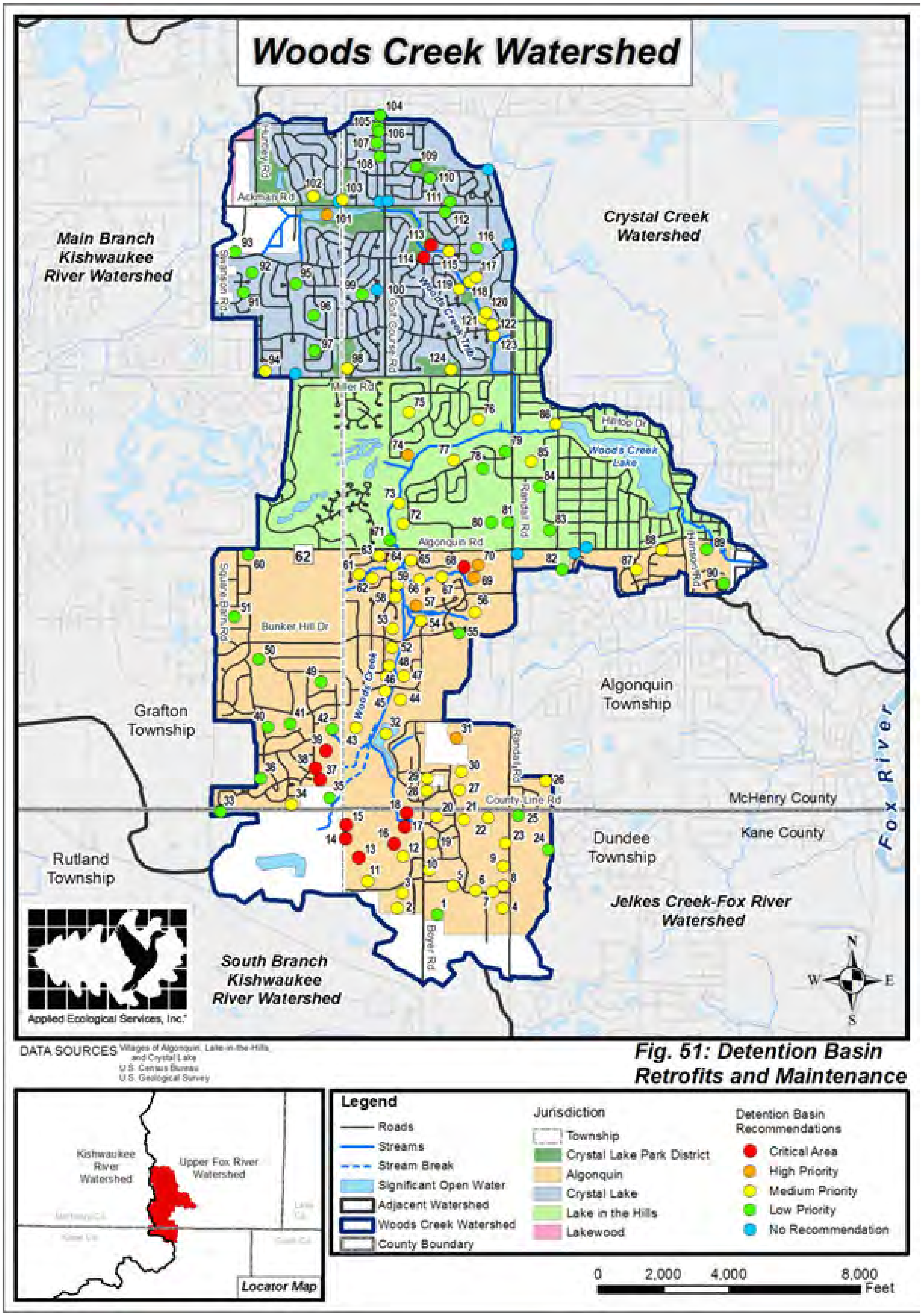


Fig. 51: Detention Basin Retrofits and Maintenance

5.2.2 Wetland Restoration

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 hydrology and vegetation. Seeding and plugging with native plant species is the next step followed by short and long term maintenance and monitoring to ensure establishment.

Critical Area wetland restoration opportunity at headwaters of Woods Creek

Wetland restoration sites were identified in Section 3.11 using GIS data and specific criteria determined to be essential for restoration of a functional and beneficial wetland. The initial analysis resulted in 32 sites meeting these criteria. However, only 16 of these sites were determined to be "potentially feasible" or have at least "limited feasibility" based on careful review of each site using 2011 aerial photography, open space inventory results, existing (2012) land use, and field visits where appropriate.

Figure 52 includes the location of all "potentially feasible" wetland restoration sites by site ID# and priority while wetland restoration sites that were determined to have only "limited feasibility" are not included in the Action Plan. Table 36 includes action related information for each recommendation listed within the appropriate jurisdiction. In general, large sites on agricultural land, sites on public land, and sites within the identified Green Infrastructure Network are Critical Areas or High priority. Smaller sites and those on private land are assigned medium or low priority for implementation.

Example wetland restoration at nearby wetland mitigation site

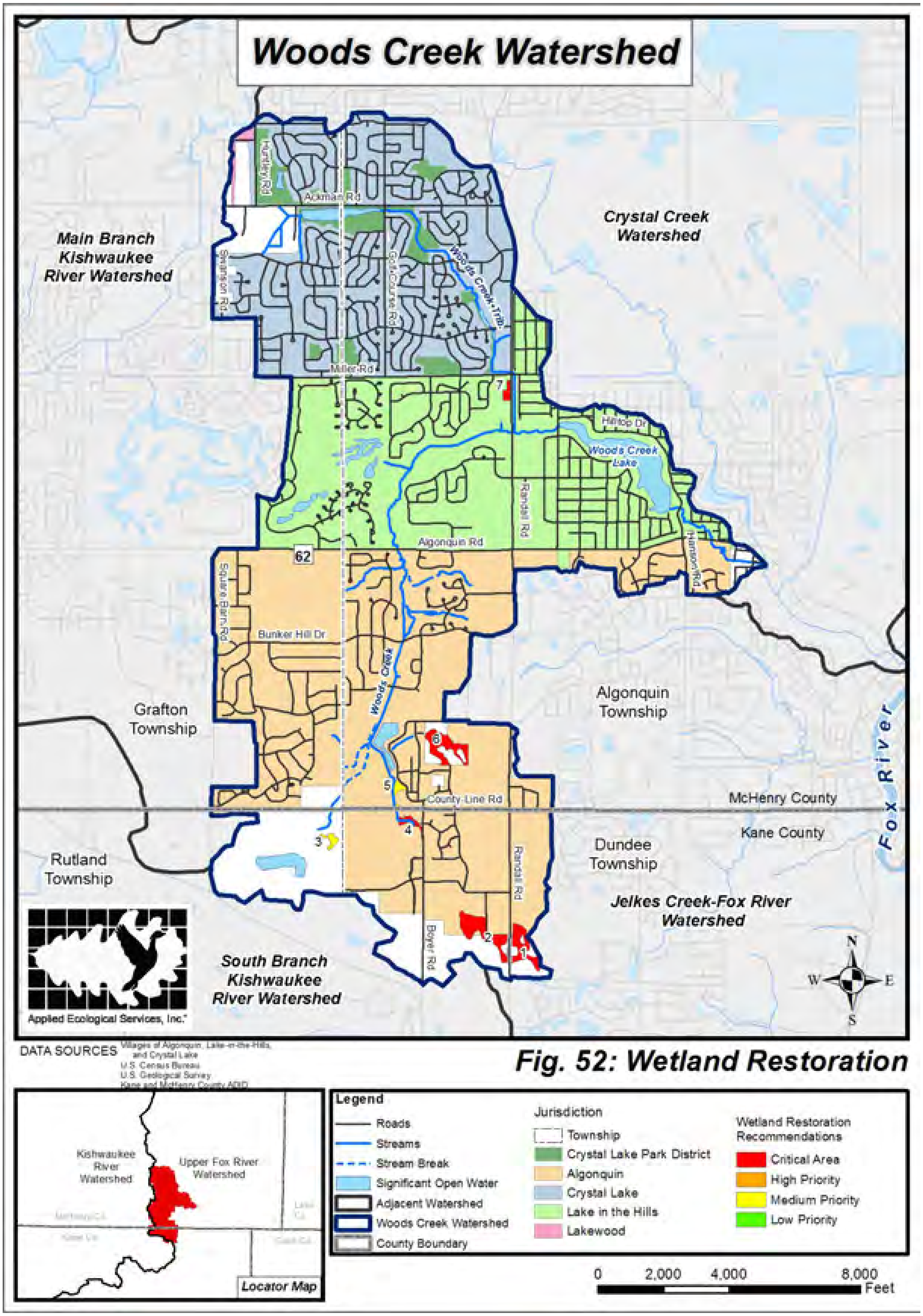


Fig. 52: Wetland Restoration

5.2.3 Streambank and Channel Restoration

Applied Ecological Services, Inc. (AES) completed a general inventory of Woods Creek and its tributaries in fall of 2011. All streams and tributaries were assessed based on divisions into "Stream Reaches". Thirty (30) stream reaches were assessed accounting for 49,424 linear feet or 9.4 linear miles. Detailed notes were recorded for each stream reach related to potential Management Measure recommendations such as improving streambank and channel conditions and maintaining long term. Site specific maintenance for culverts, road crossing, etc. is not included in this section but is a recommended action in the Programmatic Action Plan. The results of the stream inventory are summarized in Section 3.11; detailed field investigation datasheets can be found in Appendix B.

Example of stream restoration project at nearby Dixie Creek

The condition of stream reaches in the watershed varies. According to the stream inventory, 36% of stream and tributary length is naturally meandering; 15% is moderately channelized; 49% is highly channelized. Approximately 38% of stream and tributary length exhibits no or minimal bank erosion; moderate erosion is occurring along 44% of streambanks; 18% of streambanks are highly eroded.

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 streambanks and immediate buffer followed by; 2) stabilized streambanks using bioengineering, regraded banks, and installation of native vegetation; and 3) restored riffles/grade controls in the stream channel to simulate conditions found in naturally meandering streams.

Figure 53 shows the location of all potential streambank/channel restoration projects by reach ID# and priority while Table 36 lists project details about each recommendation within the appropriate jurisdiction. Potential streambank and channel restoration projects on public land and reaches exhibiting severe problems on private land are generally assigned as higher priority for implementation. Medium and Low priority was generally assigned to stream reaches exhibiting only minor problems. Recommendations are not made for stream reaches where restoration is not needed.

Critical Area stream/channel restoration opportunity along Woods Creek (WCR10)

Channel improvement opportunity using artificial riffles along Woods Creek Reach 4 (WCR4)

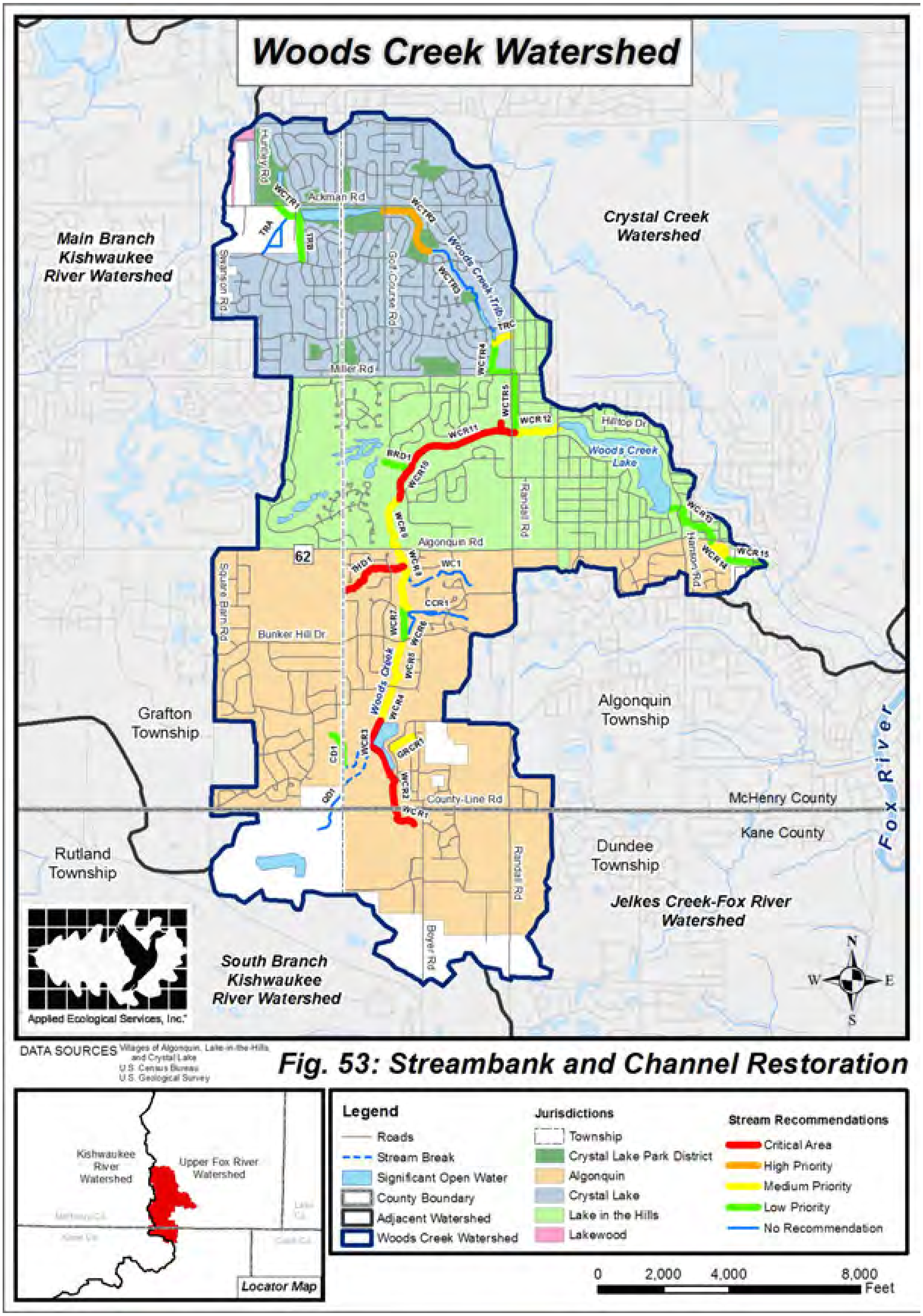


Fig. 53: Streambank and Channel Restoration

5.2.4 Riparian Area Restoration & Maintenance

Applied Ecological Services, Inc. (AES) completed a general inventory of the riparian areas along the stream reaches comprising Woods Creek and its tributaries in fall of 2011. Riparian areas were assessed by noting the "Condition" as it relates to riparian area function and quality of ecological communities present. Field notes also included potential recommendations such as need for management plans, ecological restoration, and general maintenance needs such as controlled burning. The results of the inventory are summarized in Section 3.11; detailed field investigation datasheets can be found in Appendix B.

Average quality riparian corridor along Woods Creek Tributary 3 (WCTR3) in Crystal Lake

Approximately 474 riparian area acres were assessed along the streams and tributaries in the watershed. Of this, 269 acres (57%) is considered to be "Poor" ecological quality, 104 acres (22%) is "Average" ecological quality, and the remaining 101 acres (21%) is "Good" ecological quality. The majority of poor quality areas are located at the headwaters of Woods Creek, between Algonquin Road and Woods Creek Lake, and at the headwaters and narrow buffers along Woods Creek Tributary. Riparian areas in average to good condition are located primarily south of Algonquin Road where high quality remnant ecological communities persist or where ecological restoration and management has occurred.

Riparian area restoration and/or maintenance projects generally focus on converting degraded ecological communities into higher quality communities that function to store and filter stormwater while also providing excellent wildlife habitat. First, it is recommended that a management plan be in place for larger riparian areas. The restoration process usually includes removal of invasive trees, shrubs, and herbaceous vegetation followed by seeding in areas where the native seed bank has been lost. Short and long term maintenance then follows and is critically important to maintain restored conditions. The most common maintenance tasks include ongoing removal of invasive species and controlled burning.

Riparian area restoration work completed by Algonquin along Woods Creek Reach 5 (WCR5)

Figure 54 shows the location of all recommended riparian area restoration and maintenance projects by ID# and priority while Table 36 lists project details related to each recommendation within the appropriate jurisdiction. Larger riparian area projects located on public land are generally assigned as higher priority for implementation whereas smaller privately owned areas are Medium and Low priority.

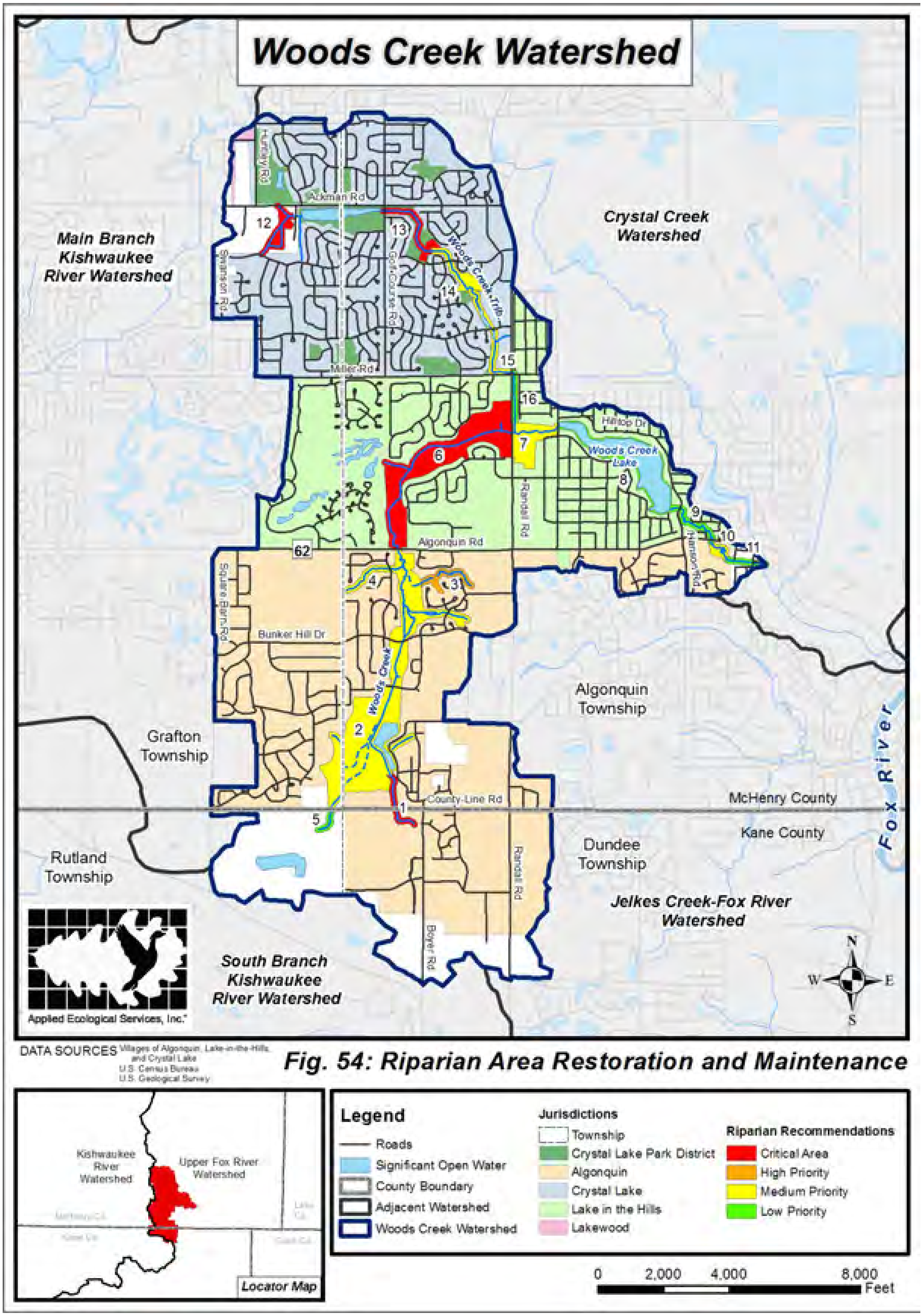


Fig. 54: Riparian Area Restoration and Maintenance

5.2.5 Lake Shoreline Restoration

Woods Creek Lake is the only true lake in the watershed and is the only lake where recommendations are made related to repairing shoreline erosion by implementing shoreline restoration projects. The Village of Lake in the Hills (LITH) was able to provide information about the degree of shoreline erosion at five Village owned parks: Indian Trail Beach, Hilltop Beach, Nockels Park, Turtle Island Park, and Echo Hill Park. Information related to erosion along the remainder of the lake was collected in the late 1990s but this information was unable to be located or obtained and therefore is not included in plan recommendations. A summary of Wood Creek Lake including shoreline erosion can be found in Section 3.11.

Erosion along shoreline at Nockels Park

Figure 55 shows the location of all shorelines within LITH owned parks where shoreline restoration projects and long term maintenance are recommended. Table 36 lists project details related to each recommendation. All recommendations are considered high priority "Critical Areas" for implementation and long term maintenance.

Figure 55. Lake shoreline restoration opportunities at Woods Creek Lake.

5.2.6 Priority Green Infrastructure Protection Areas

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 where acquiring, protecting, and restoring or developing in keeping with Conservation Design standards would best benefit watershed conditions. Six areas totaling approximately 400 acres were identified in the watershed based on information obtained from existing and predicted future land use data (Section 3.6), sensitive aquifer recharge areas (Section 3.12), and green infrastructure (Section 3.9) sections of this report.

Aerial view of Priority Green Infrastructure Protection Areas 1 & 2 along Randall Road

Figure 56 shows the location of all six Priority Green Infrastructure Protection Areas by site ID# while Table 36 includes action recommendations for each. All six sites are considered "Critical Areas". Cost estimates and schedules for implementing recommendations for these areas is not included due to the difficulty in determining how or if each site will be acquired or developed. In addition, pollutant reduction estimates cannot be determined for these areas.

Aerial view of Priority Green Infrastructure Protection Areas 3 & 4

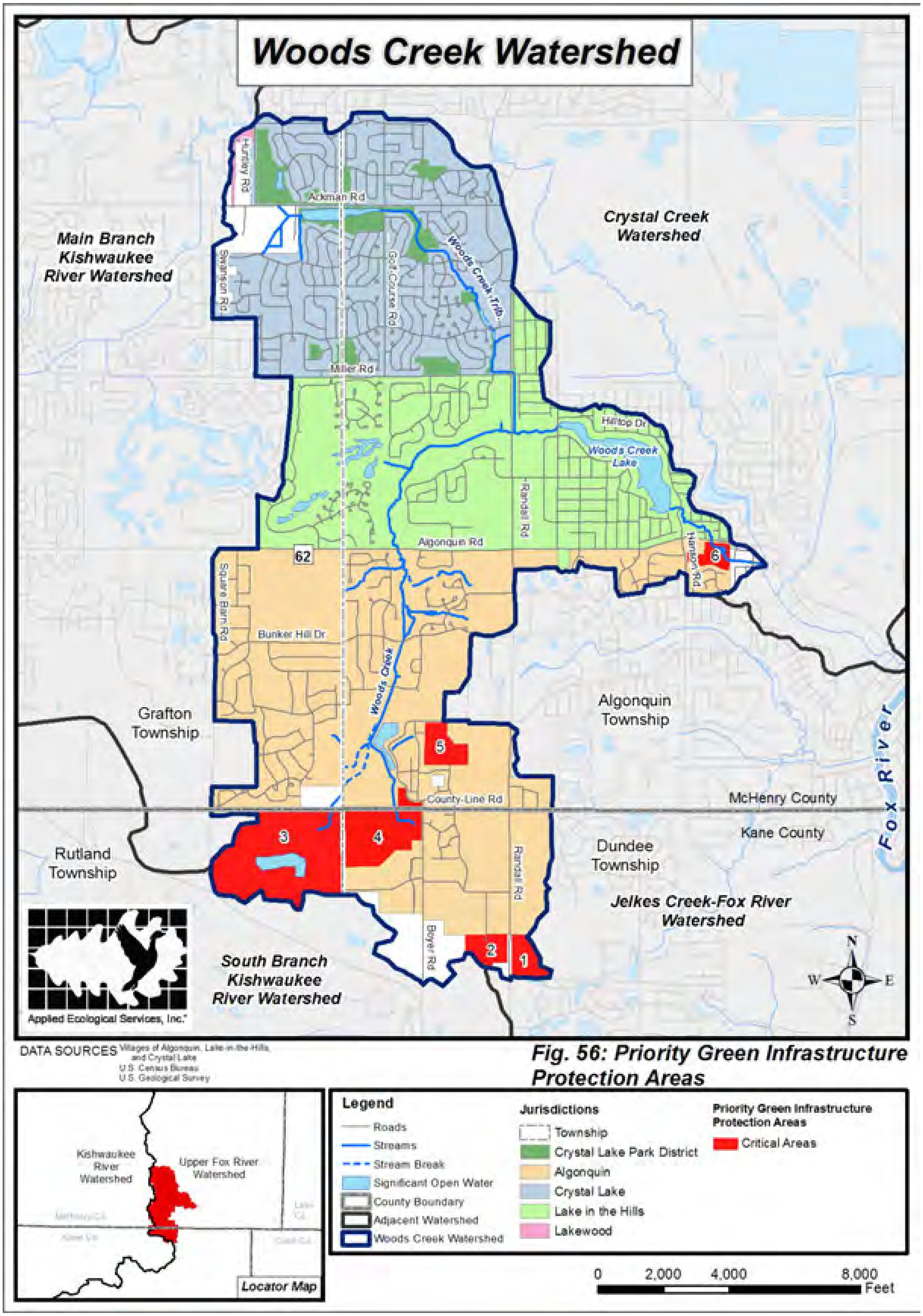


Fig. 56: Priority Green Infrastructure Protection Areas

5.2.7 Other Management Measures

While completing the general inventory of Woods Creek watershed, Applied Ecological Services, Inc. (AES) noted potential Management Measure projects that fit under miscellaneous categories including:

- 1 gully stabilization site on private land
- 2 rain gardens sites at Algonquin Public Library
- 1 CLPD park retrofit at Willow's Edge Park
- 2 bioswale retrofit sites at Terrace Hill Golf Course and LITH Village Hall
- 3 prairie restorations at Terrace Hill Golf Course, Boulder Ridge Country Club, and Spella Sled Hill.
- Aquatic plant management for Woods Creek Lake
- Mercury study for Woods Creek Lake
- Dam inspection at Woods Creek Lake
- Sediment removal study -Woods Creek Lake
- 1 bike path/trail connection

Potential bioswale project at Terrace Hill GC

The location of other stormwater practices such as green roofs, permeable pavement, decreased road widths, curb cuts, etc. are not included in this section but are recommended in the Programmatic Action Plan and are required or recommended under various local ordinances.

Potential rain garden site at Algonquin Public Library

Figure 57 shows the location of all "Other Management Measures" by ID# while Table 36 lists details about each recommendation within the appropriate jurisdiction.

Potential bioswale project at LITH Village Hall

Aerial view of Willow's Edge Park

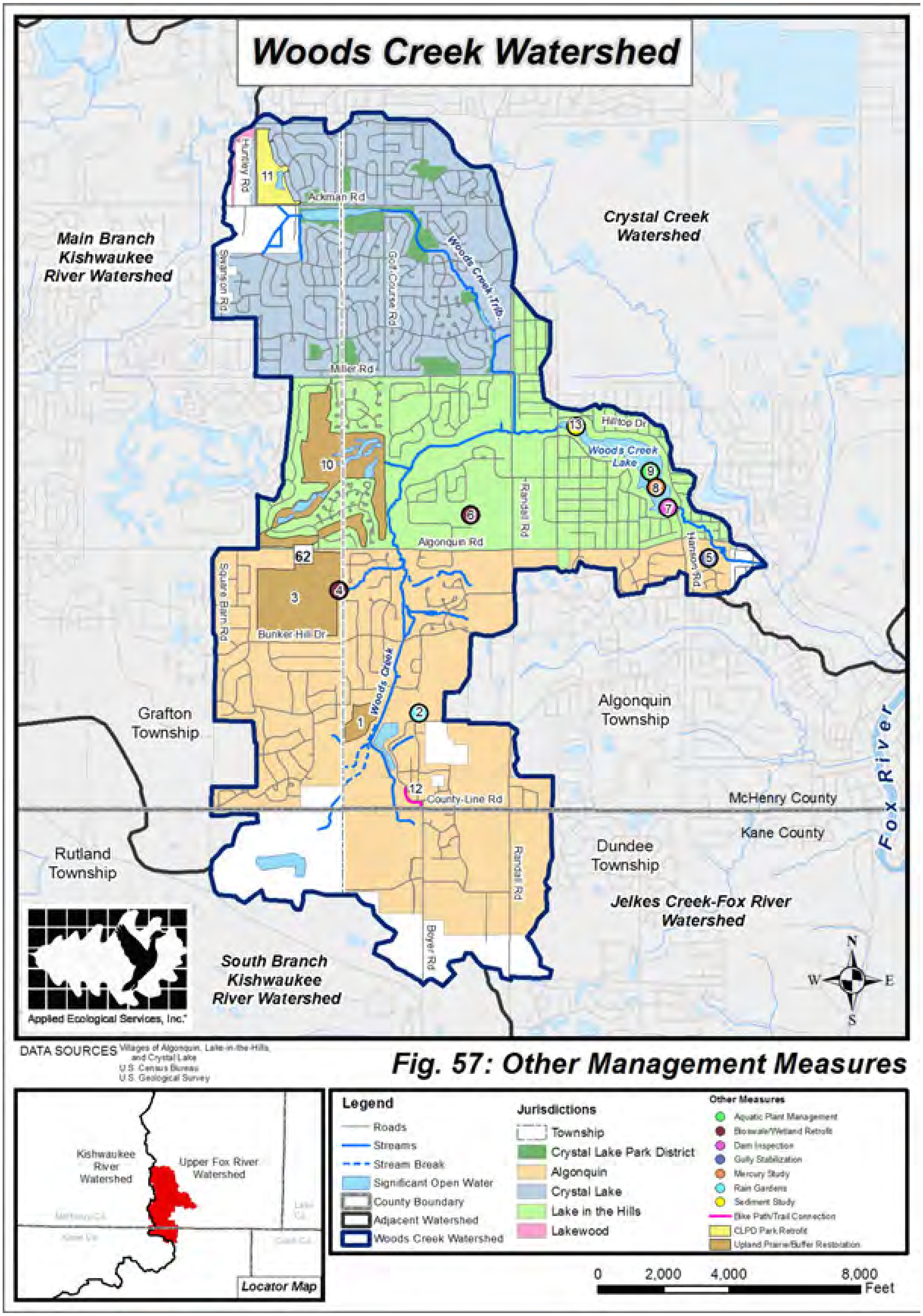


Fig. 57: Other Management Measures

This Page Intentionally Left Blank

Table 36. Site Specific Management Measures Action Plan.

ALGONQUIN

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
DETENTION BASIN RETROFITS & MAINTENANCE (See Figure 51)											
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 require the greatest assistance.											
1	Esplanade/ Algonquin Corp. Campus Unit 1	2.75 acres	Business (Private)	Existing naturalized wet bottom detention basin with poor quality buffer and emergent zone within defunct industrial development.	Design and implement project to install a native prairie vegetation buffer, install native emergent plants along shoreline, and maintain indefinitely when development resumes.	Extended Wet Detention: TSS= 86% TN= 55% TP= 68.5%	Low	Developer	Ecological Consultant/ Contractor	$27,500 to design & install prairie buffer & emergent plants; $2,000/year maintenance	When development resumes
2, 3, 11, 12	Algonquin Corporate Campus Unit 3	9.0 acres	Business (Private)	Four existing naturalized wet bottom detention basins within industrial development that are in relatively good condition.	Implement maintenance program to preserve good condition of naturalized basins.	Not Applicable	Medium	Business Association	Ecological Consultant/ Contractor	$5,000/year maintenance	Ongoing
4	Hobby Lobby on Randall Rd.	1.5 acres	Business (Private)	Existing naturalized wet bottom detention basin servicing Hobby Lobby. Basin is in good condition and under a maintenance program through 2014.	Implement long term maintenance program following 2014 growing season to preserve good condition of naturalized basin.	Not Applicable	Medium	Business Association	Ecological Consultant/ Contractor	$2,000/year maintenance	Ongoing
5, 10	Corporate Parkway E. of Boyer Rd.	4.0 acres	Business (Private)	Two existing naturalized wet bottom detention basins within industrial development that are in fair condition.	Implement maintenance program to enhance condition of naturalized basins.	Not Applicable	Medium	Business Association	Ecological Consultant/ Contractor	$3,000/year maintenance	Ongoing
13, 14, 15, 16, 17, 18	Parkview Villas Subdivision	25.0 acres	Developer (Private)	Six existing wet bottom detention basins at the headwaters of Woods Creek within defunct residential development. No stormsewer is currently connected to detentions. Note: basins are considered "Critical Areas."	Redesign basins to be wet/wetland bottom with recommended emergent and wet prairie shelves and mesic prairie buffer when development resumes then maintain indefinitely.	Wetland Detention: TSS= 46 tons/yr; TN= 198 lbs/yr; TP= 55 lbs/yr	Critical Area	Developer	Ecological Consultant/ Contractor; Algonquin	$200,000 to redesign & install prairie buffer & emergent plants; $10,000/year maintenance	When development resumes
6, 7, 8, 9, 21, 22, 23	Algonquin Commons on Randall Rd.	6.5 acres	Business (Private)	Seven naturalized wet bottom detention basins servicing Algonquin Commons that are generally in fair condition but not managed ecologically.	Implement an "ecological" maintenance program that includes controlled burning to preserve & enhance condition of naturalized basins.	Not Applicable	Medium	Business Association	Ecological Consultant/ Contractor	$8,000/year maintenance	Ongoing
19, 20	Canterburry Subdivision	6.0 acres	Residential HOA (Private)	Two existing naturalized wet bottom detention basins within a residential development that are in fair to poor condition.	Implement maintenance program to enhance condition of naturalized basins.	Not Applicable	Medium	Residential HOA	Ecological Consultant/ Contractor	$3,000/year maintenance	Ongoing
24, 25	The Galleria Center on Randall Rd.	3.5 acres	Business (Private)	Two existing naturalized wet bottom detention basins servicing The Galleria Center that are in poor condition.	Implement maintenance program to enhance condition of naturalized basins.	Not Applicable	Low	Business Association	Ecological Consultant/ Contractor	$5,000/year maintenance	Ongoing
26	Briarwood Center	5.0 acres	Business (Private)	Existing partially naturalized wet bottom detention basin in fair condition.	Expand and naturalize existing basin to accommodate future development planned north of the site.	Not Applicable	Medium	Developer	Village of Algonquin	Not Applicable	As new development occurs
27	Wal-Mart Detention	7.0 acres	Business (Private)	Existing naturalized wet bottom detention basin servicing Wal-Mart that is in good condition.	Implement maintenance program to preserve condition of naturalized basin.	Not Applicable	Medium	Business Association	Ecological Consultant/ Contractor	$4,000/year maintenance	Ongoing
28, 29, 30	Millbrook Subdivision	6.0 acres	Residential HOA (Private)	Three existing naturalized wet bottom detention basins within Millbrook Subdivision that are in fair condition.	Implement maintenance program to enhance condition of naturalized basins.	Not Applicable	Medium	Residential HOA	Ecological Consultant/ Contractor	$5,000/year maintenance	Ongoing
31	Oakridge Ct.	5.0 acres	Business (Private)	Existing wet bottom detention basin servicing retail/commercial development to east. Basin is headwaters to Grand Reserve Creek. Basin is partially naturalized but in poor condition.	Replant buffer and emergent zones with native vegetation.	Wetland Detention: TSS= 18 tons/yr; TN= 168 lbs/yr; TP= 23 lbs/yr	High	Developer	Ecological Consultant/ Contractor; Village of Algonquin	$50,000 to install prairie buffer & emergent plants; $3,000/year maintenance	1-10 Years (2013-2022)

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
33, 36	The Coves Subdivision	5.0 acres	Residential HOA (Private)	Two existing wet bottom detention basins with mown turf grass slopes within subdivision.	Design and implement project to install a native prairie vegetation buffer, install native emergent plants along shoreline, and maintain indefinitely.	Extended Wet Detention: TSS= 86% TN= 55% TP= 68.5%	Low	Residential HOA	Ecological Consultant/ Contractor	$50,000 to design & install prairie buffer & emergent plants; $3,000/year maintenance	10-20+ Years (2023-2032+)
34	The Coves Subdivision	1.5 acres	Residential HOA (Private)	Existing naturalized wet bottom detention basin in undeveloped portion of subdivision that is in fair condition.	Implement maintenance program to enhance & preserve condition of naturalized basin.	Not Applicable	Medium	Residential HOA	Ecological Consultant/ Contractor	$1,000/year maintenance	Ongoing
35	Common Wealth Edison	1.0 acre	Business (Private)	Existing naturalized wetland bottom basin servicing Common Wealth Edison facility. Basin is dominated by invasive common reed.	Implement maintenance program to control invasive common reed and other invasive species.	Not Applicable	Low	Common Wealth Edison	none	$500/year maintenance	Ongoing
37, 38, 39	The Coves Subdivision	7.0 acres	Residential HOA (Private)	Three existing wet bottom detention basins with mown turf grass side slopes. Algae is abundant in summer months indicating nutrient problem. Basins drain to Algonquin Hanging Fen making them "Critical Areas."	Design and implement project to remove turf grass side slopes and install native prairie vegetation, install native emergent plants along shoreline, and maintain indefinitely. Also, install up to five aerators.	Wetland Detention: TSS= 14 tons/yr TN= 138 lbs/yr TP= 41 lbs/yr	Critical Area	Residential HOA	Ecological Consultant/ Contractor	$70,000 to design & install prairie buffer & emergent plants; $10,000 for aerators; $3,000/year maintenance	1-5 Years (2013-2017)
40, 41	Terrace Lakes Subdivision	3.0 acres	Residential HOA (Private)	Two existing wet/wetland bottom detention basins in poor condition dominated by invasive species.	Implement maintenance program to remove invasive species.	Not Applicable	Low	Residential HOA	Ecological Consultant/ Contractor	$2,000/year maintenance	Ongoing
42, 49	Terrace Lakes Subdivision	5.5 acres	Residential HOA (Private)	Two existing dry bottom detention basins with mown turf grass and concrete channels running between inlets and outlets.	Design and implement project to break concrete channels to create wetland bottom, install native vegetation throughout, then maintain indefinitely.	Wetland Det.: TSS= 77.5% TN= 20% TP= 44%	Low	Residential HOA	Ecological Consultant/ Contractor	$65,000 to design & install; $3,000/year maintenance	10-20+Years (2023-2032+)
50	Terrace Lakes Subdivision- Wood Park	5.0 acres	Algonquin (Public)	Existing wet bottom detention basin within James B. Wood Park owned by Algonquin. Basin buffer and shoreline is naturalized but in poor condition.	Redesign and implement project to replant entire buffer with native prairie vegetation, reinstall native emergent plants along shoreline, and maintain indefinitely.	Extended Wet Detention: TSS= 86% TN= 55% TP= 68.5%	Low	Algonquin	Ecological Consultant/ Contractor	$50,000 to design & install prairie buffer & emergent plants; $3,000/year maintenance	10-20+Years (2023-2032+)
51	Prestwicke Subdivision	4.0 acres	Residential HOA (Private)	Existing dry bottom detention basin with mown turf grass within subdivision.	Design and implement project to remove turf grass and revegetate with native prairie vegetation then maintain indefinitely.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Low	Residential HOA	Ecological Consultant/ Contractor	$18,000 to design & install prairie vegetation; $1,500/year maintenance	10-20+Years (2023-2032+)
55	Jacobs High School	1.0 acres	School (Public)	Existing naturalized dry bottom detention basins in poor condition dominated by invasive species.	Implement maintenance program to enhance condition of naturalized basin.	Not Applicable	Low	Jacobs High School	Ecological Consultant/ Contractor	$1,500/year maintenance	Ongoing
56	Meijer No. 206	4.5 acres	Business (Private)	Existing naturalized wetland bottom detention basin in poor condition dominated by invasive species. Basin is headwaters to Creekside Creek.	Implement maintenance program to enhance condition of naturalized basin.	Not Applicable	Medium	Business Association	Ecological Consultant/ Contractor	$4,000/year maintenance	Ongoing
57	Woods Creek Riparian Corridor	4.0 acres	Algonquin (Public)	Existing naturalized wet bottom detention basin in poor condition that drains to portion of Winding Creek Fen.	Plug existing basin outlet at northeast corner and reinstall new outlet on west side of basin that drains to Woods Creek.	Not Applicable	High	Algonquin	None: Algonquin complete in-house	$8,000 total	1-10 Years (2013-2022)
60	Prestwicke Subdivision	4.0 acres	Residential HOA (Private)	Existing wet bottom detention basin with mown turf grass slopes within subdivision.	Design and implement project to replant buffer with native prairie vegetation, install native emergent plants along shoreline, and maintain indefinitely.	Extended Wet Detention: TSS= 86% TN= 55% TP= 68.5%	Low	Residential HOA	Ecological Consultant/ Contractor	$40,000 to design & install prairie buffer & emergent plants; $3,000/year maintenance	10-20+ Years (2023-2032+)

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
61, 62, 63	Fairview View Estates	5.0 acres	Residential HOA (Private)	Three existing naturalized wet bottom detention basins in fair condition within subdivision.	Implement maintenance program to enhance condition of naturalized basins.	Not Applicable	Medium	Residential HOA	Ecological Consultant/ Contractor	$3,000/year maintenance	Ongoing
32, 43, 44, 46, 47, 48, 52, 53, 54, 57, 58, 59, 64, 65, 66	Woods Creek Riparian Corridor	Approx. 32 acres	Algonquin (Public)	Sixteen (16) existing naturalized wet, wetland, and dry bottom detention basins created during adjacent residential development along Woods Creek corridor from headwaters north to Algonquin Rd. Basins vary in condition but all were planted with native vegetation. All basins are managed by Algonquin.	Implement maintenance program to enhance condition of naturalized basins. Detailed recommendations for the majority of these basins are included in the "Woods Creek Riparian Area Corridor Natural Resource Inventory & Management Plan" dated Feb. 2, 2011 prepared for Algonquin by AES.	Not Applicable	Medium	Algonquin	Ecological Consultant/ Contractor	$15,000/year maintenance	Ongoing
67	Winding Creek Subdivision	1.5 acres	Residential HOA (Private)	Existing wet bottom detention basin dominated by invasive species. Note: basin is adjacent to and drains to Winding Creek Fen.	Implement maintenance program to enhance condition of naturalized basin.	Not Applicable	Medium	Residential HOA; Algonquin	Ecological Consultant/ Contractor	$1,500/year maintenance	Ongoing
68	Montessori School	1.5 acres	Montessori School (Private)	Existing wet bottom detention basin at Montessori School with mown turf grass side slopes; invasive plant species are abundant. Basin is at headwaters of Winding Creek Fen. Note: Basin is considered a "Critical Area".	Design and implement project to remove turf grass from side slopes and install native prairie vegetation, install native emergent plants along shoreline, and maintain indefinitely.	Wetland Detention: TSS= 1 tons/yr TN= 4 lbs/yr TP= 1 lbs/yr	Critical Area	Montessori School	Ecological Consultant/ Contractor	$15,000 to design & install prairie buffer & emergent plants; $1,500/year maintenance	1-5 Years (2013-2017)
69, 70	Winding Creek Center (Home Depot Detention)	3.5 acres	Business (Private)	Two existing naturalized wetland bottom detention basins servicing Winding Creek Center. Basins are in poor condition and dominated by invasive species. Basins are also adjacent/drain to Winding Creek Fen.	Implement maintenance program to enhance condition of naturalized basin by removing invasive species.	Not Applicable	High	Business Association	Algonquin; Ecological Consultant/ Contractor	$3,000/year maintenance	Ongoing
82	Oakridge Business Center	0.75 acre	Business (Private)	Existing dry bottom detention basin servicing Oakridge Business Center in poor condition dominated by invasive plant species. Note: site is adjacent to Algonquin owned natural area (Arbor Hills)	Design and implement project to replant entire basin with native prairie vegetation and maintain indefinitely.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Low	Business Association	Ecological Consultant/ Contractor	$8,000 to design & install native vegetation; $1,000/year maintenance	10-20+Years (2013-2032+)
87	Lake Drive South	3.5 acres	Algonquin (Public)	Existing naturalized wet bottom detention basin in good condition and owned by Algonquin.	Continue maintenance program to preserve condition of naturalized basin.	Not Applicable	Medium	Algonquin	Ecological Consultant/ Contractor	$2,000/year maintenance	Ongoing
88	Arquilla Drive	1.5 acres	Algonquin (Public)	Existing naturalized dry bottom detention basin in good condition and owned by Algonquin.	Continue maintenance program to preserve condition of naturalized basin.	Not Applicable	Medium	Algonquin	Ecological Consultant/ Contractor	$2,000/year maintenance	Ongoing
89	Woods Creek Commercial Park	1.0 acre	Business (Private)	Existing wetland bottom detention basin servicing Woods Creek Commercial Park in poor condition dominated by invasive common reed.	Implement maintenance program to control invasive common reed.	Not Applicable	Low	Business Association	Ecological Consultant/ Contractor	$500/year maintenance	Ongoing
90	Highland Glen Estates	1.0 acre	Residential HOA (Private)	Existing wetland bottom detention basin servicing Highland Glen Estates in poor condition dominated by invasive species.	Design and implement project to replant entire basin with native prairie vegetation and maintain indefinitely.	Wetland Det. TSS= 77.5% TN= 20% TP= 44%	Low	Business Association	Ecological Consultant/ Contractor	$10,000 to design & install native vegetation; $1,500/year maintenance	10-20+Years (2013-2032+)
WETLAND RESTORATION (See Figure 52)											
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.											
1	Northeast corner of Randall & Longmeadow Pkw. (see Figure 52)	12.1 acres	Private agricultural land	Potentially feasible wetland restoration site located on private agricultural land that is a planned future annexation/development area for Algonquin. Site is located within the Green Infrastructure Network in an area important for groundwater/aquifer recharge. Note: site is considered a "Critical Area".	Incorporate wetland restoration into future development plans by using area as wetland detention. Implementation: 1) determine feasibility, 2) design and permit; 3) construct and plant; and 4) conduct short and long term maintenance and monitoring to ensure establishment.	Wetland Detention: TSS=3 tons/yr; TN=24 lbs/yr; TP=4 lbs/yr	Critical Area	Future developer; Algonquin	Ecological Consultant/ Contractor; USACE; NRCS/ SWCD; IEPA	$181,500 to design/permit/install/ maintain wetland	As new development occurs

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
2	Southern tip of watershed west of Randall (see Figure 52)	17.5 acres	Private agricultural land	Potentially feasible wetland restoration site located on private agricultural land that is a planned future annexation area for Algonquin. Site is located within the Green Infrastructure Network in an area important for groundwater/aquifer recharge. Note: site is considered a "Critical Area".	Incorporate wetland restoration into future development plans by using area as wetland detention. Implementation: 1) determine feasibility, 2) design and permit; 3) construct and plant; and 4) conduct short and long term maintenance and monitoring to ensure establishment.	Wetland Detention: TSS=8 tons/yr; TN=52 lbs/yr; TP=11 lbs/yr	Critical Area	Future developer; Algonquin	Ecological Consultant/ Contractor; USACE; NRCS/ SWCD; IEPA	$262,500 to design/permit/install/ maintain wetland	As new development occurs
3	Southwest corner of watershed (see Figure 52)	2.5 acres	Private agricultural land	Potentially feasible wetland restoration site located on private agricultural land adjacent to an existing wetland; land is future annexation/industrial development area for Algonquin. Site is located within the Green Infrastructure Network in an area important for groundwater/aquifer recharge.	Incorporate wetland restoration into future development plans by using area as wetland detention. Implementation: 1) determine feasibility, 2) design and permit; 3) construct and plant; and 4) conduct short and long term maintenance and monitoring to ensure establishment.	Extended Wet Detention: TSS= 86% TN= 55% TP= 68.5%	Medium	Future developer; Algonquin	Ecological Consultant/ Contractor; USACE; NRCS/ SWCD; IEPA	$50,000 to design/permit/install/ maintain wetland	As new development occurs
4	Headwaters of Woods Creek (see Figure 52)	3.1 acres	Private agricultural land	Potentially feasible wetland restoration site located at headwaters of Woods Creek along Reach 1 (WCR1) in private agricultural area that is planned for multifamily residential. Note: site is considered a "Critical Area".	Incorporate wetland restoration into future development plans. Implementation: 1) determine feasibility, 2) design and permit; 3) construct and plant; and 4) conduct short and long term maintenance and monitoring to ensure establishment. Restoration should occur in conjunction with restoring Critical stream reach WCR1.	Wetland Detention: TSS=8 tons/yr; TN=34 lbs/yr; TP=10 lbs/yr	Critical Area	Future developer; Algonquin	Ecological Consultant/ Contractor; USACE; NRCS/ SWCD; IEPA	$62,000 to design/permit/install/ maintain wetland	As new development occurs
5	Headwaters of Woods Creek @ Spella Park (see Figure 52)	2.9 acres	Algonquin: Spella Park (Public)	Potentially feasible wetland restoration site located along the east side of Woods Creek Reach 2 (WCR2).	Restore wetland by removing existing non-native and invasive vegetation then establish native wetland vegetation.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Medium	Algonquin	Ecological Consultant/ Contractor	$6,000 to establish native vegetation	1-10 Years (2013-2022)
6	Headwaters of Grand Reserve Creek (see Figure 52)	14.9 acres	Private Parcel	Potentially feasible wetland restoration site located on vacant parcel that is planned multifamily residential at the headwaters of Grand Reserve Creek (GRCR1). Note: site is considered a "Critical Area".	Incorporate wetland restoration into future development plans by using area as wetland detention. Implementation: 1) determine feasibility, 2) design and permit; 3) construct and plant; and 4) conduct short and long term maintenance and monitoring to ensure establishment.	Wetland Detention: TSS=14 tons/yr; TN=60 lbs/yr; TP=17 lbs/yr	Critical Area	Future developer; Algonquin	Ecological Consultant/ Contractor; USACE; NRCS/ SWCD; IEPA	$223,500 to design/permit/install/ maintain wetland	As new development occurs

STREAMBANK & CHANNEL RESTORATION (See Figure 53)

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.

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
WCR1: Woods Creek Reach 1	Boyer Rd to County Line	909 linear feet	Private agricultural land	909 lf of stream at headwaters of Woods Creek and located on private land where future development is planned. The streambanks are highly eroded while channelization is moderate. Note: site is considered a "Critical Area".	Design, permit, and implement project to restore eroded streambanks using bioengineering techniques, improve channel bottom with artificial riffles, and restore immediate buffer by planting native vegetation. Restoration should occur in conjunction with restoring Critical Wetland Restoration 4 and restoring Riparian Area 1.	Bank Stabilization: TSS=26 tons/yr TN=52 lbs/yr TP=26 lbs/yr	Critical Area	Future developer; Algonquin	Ecological Consultant/ Contractor; USACE; IDNR; NRCS	$27,000 design/permit; $136,000 install	As new development occurs
WCR2: Woods Creek Reach 2	North of County Line	1,231 linear feet	Algonquin: Spella Park (Public)	1,231 lf of stream on public land (Algonquin: Spella Park) with highly eroded streambanks and high channelization. Note: site is considered a "Critical Area"	Design, permit, and implement project to restore eroded streambanks using bioengineering techniques, improve channel bottom with artificial riffles, and restore immediate buffer by planting native vegetation.	Bank Stabilization: TSS=177 tons/yr TN=355 lbs/yr TP=177 lbs/yr	Critical Area	Algonquin	Ecological Consultant/ Contractor; USACE; IDNR; NRCS	$40,000 design/permit; $200,000 install	1-5 Years (2013-2017)

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
WCR3: Woods Creek Reach 3	South of pedestrian bridge at Spella Park	1,873 linear feet	Algonquin: Spella Park (Public)	1,873 lf of stream on public land (Algonquin: Spella Park) with highly eroded streambanks and high channelization. Note: site is considered a "Critical Area"	Design, permit, and implement project to restore eroded streambanks using bioengineering techniques, improve channel bottom with artificial riffles, and restore immediate buffer by planting native vegetation.	Bank Stabilization: TSS=126 tons/yr TN=252 lbs/yr TP=126 lbs/yr	Critical Area	Algonquin	Ecological Consultant/ Contractor; USACE; IDNR; NRCS	$50,000 design/permit; $250,000 install	1-5 Years (2013-2017)
WCR4: Woods Creek Reach 4	Between Spella Park pedestrian bridge & Woods Creek Ln.	1,077 linear feet	Algonquin (Public)	1,077 lf of stream on public land (Algonquin) that was part of past wetland mitigation for adjacent residential development. The stream reach remains highly channelized.	Design and install up to three artificial riffles within the stream channel.	Not applicable	Medium	Algonquin	Ecological Consultant/ Contractor	$10,000 to design and install 3 artificial riffles	1-10 Years (2013-2023)
WCR5: Woods Creek Reach 5	Between Woods Creek Ln. and Bunker Hill Dr.	1,630 linear feet	Algonquin (Public)	1,630 lf of stream on public land (Algonquin) that is highly channelized within adjacent spoil piles/berms.	Design, permit, and construct breaks in adjacent spoil pile berms to allow for additional flood storage and water quality filtering in adjacent floodplain.	Not applicable	Medium	Algonquin	Ecological Consultant/ Contractor, USACE, FEMA	$30,000 to design and create breaks in berms	10-20+ Years (2023-2032+)
WCR7: Woods Creek Reach 7	N. of Bunker Hill Dr. & W. of Reach 6	1,037 linear feet	Algonquin (Public)	1,037 lf drainage ditch on public land (Algonquin) that is highly channelized with moderately eroded streambanks. Channel was created as a drainage ditch west of naturally meandering Reach 6.	Design, permit, and implement project to fill entire channel with adjacent spoil pile material then restore native vegetation.	Bank Stabilization: TSS=168 tons/yr TN=286 lbs/yr TP=143 lbs/yr	Low	Algonquin	Ecological Consultant/ Contractor, USACE	$30,000 to design, permit, and implement	10-20+ Years (2023-2032+)
WCR8: Woods Creek Reach 8	South of Algonquin Rd.	2,384 linear feet	Algonquin (Public)	2,384 lf of stream in good overall condition. A beaver dam is located just south of the pedestrian bridge near Algonquin Rd. that is causing natural backwater flooding.	Conduct inspections of the beaver dam and backwater flooding to ensure that adjacent structures are not being flooding and that flooding is not encroaching on high quality fen and sedge meadow communities.	Not applicable	Medium	Algonquin	Ecological Consultant/ Contractor; IDNR; USACE	No cost if done in-house by Algonquin	Twice Annually
WCR14: Woods Creek Reach 14	South of Algonquin Road	1,133 linear feet	Private owner	1,133 linear feet of naturally meandering stream with moderately eroded streambanks in isolated locations. Invasive trees and shrubs dominate the banks throughout. This is the highest quality stream reach in the watershed.	Remove invasive trees and shrubs from the streambanks and immediate buffer area and replace with native vegetation.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Medium	Owner or Future Owner	Ecological Consultant/ Contractor	$15,000 to remove invasive trees and shrubs; $10,000 to establish native vegetation	When/if parcel is preserved as open space
WCR15: Woods Creek Reach 15	W. of Dennis Ave. to Crystal Creek	1,177 linear feet	Private owners	1,177 lf of highly channelized and moderately eroded stream in residential area. Invasive trees and shrubs dominate the banks in some locations.	Remove invasive trees and shrubs from the streambanks and immediate buffer area and replace with native vegetation.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Low	Owners	Ecological Consultant/ Contractor	$15,000 to remove invasive trees and shrubs; $10,000 to establish native vegetation	10-20+ Years (2023-2032+)
GRCR1: Grand Reserve Creek	Eineke Blvd. to Harnish Dr.	736 linear feet	Algonquin (Public)	736 lf of stream that was stabilized by Algonquin in 2011.	Conduct long term maintenance to preserve stabilized condition of stream.	Not applicable	Medium	Algonquin	Ecological Consultant/ Contractor	$1,000/year maintenance	Ongoing
CD1: Cove Drain	West end of Spella Park	1,070 linear feet	Algonquin: Spella Park (Public)	1,070 lf intermittent drainage ditch that is highly channelized with moderate erosion in the first 400 lf. The reach begins at a detention basin and flows to wetland restoration at Spella Park.	Reshape moderately eroded 400 lf section of channel and establish native vegetation along streambanks and channel bottom.	Bank Stabilization TSS=42 tons/yr TN=72 lbs/yr TP=36 lbs/yr	Low	Algonquin	Ecological Consultant/ Contractor; Algonquin	$10,000 to regrade & vegetate channel with native vegetation	10-20+ Years (2023-2032+) or during restoration of adjacent areas.
THD1: Terrace Hill Drain	Fairview Dr. to Woods Creek	2,292 linear feet	Algonquin (Public)	2,292 lf of stream on public land (Algonquin) with moderately eroded streambanks; high TSS levels have been documented. There is also heavy shading by invasive trees and shrubs. Note: site is considered a "Critical Area"	Design, permit, and implement project to restore eroded streambanks using bioengineering techniques, improve channel bottom with artificial riffles, and restore immediate buffer by removing invasive species and replanting with native vegetation.	Bank Stabilization: TSS=46 tons/yr TN=91 lbs/yr TP=46 lbs/yr	Critical Area	Algonquin	Ecological Consultant/ Contractor; USACE; IDNR; NRCS	$40,000 design/permit; $225,000 install	1-5 Years (2013-2017)

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
RIPARIAN AREA RESTORATION & MAINTENANCE (See Figure 54)											
Technical and Financial Assistance Needs: Technical assistance needed to implement riparian area restoration and maintenance is moderate at first because an environmental consultant is usually hired to complete a plan and implement the work. However, costs can be greatly reduced over time if municipal or park district staff complete some restoration and most of the long term maintenance in house. Private landowners will require the greatest assistance.											
1	Headwaters of Woods Creek at County Line	9.7 acres	Algonquin: Spella Park (Public) & Private	9.7 degraded riparian acres at the headwaters of Woods Creek (WCR1 & 2) on public land (Algonquin) and private land. Note: site is considered a "Critical Area".	Restore degraded riparian area using an ecological restoration approach. Implement by removing existing invasive vegetation followed by planting with native vegetation. Conduct short and long term maintenance to ensure establishment. Restoration should occur in conjunction with restoring Critical Wetland Restoration 4 and Critical Stream Reach WCR1 & 2.	Vegetated Filter Strips: TSS= 29 tons/yr TN= 267 lbs/yr TP= 40 lbs/yr	Critical Area	Algonquin; Future developer	Ecological Consultant/ Contractor	$30,000 to establish native vegetation; $2,000/year maintenance	1-5 Years (2013-2017) or as new development occurs
2	Woods Creek Riparian Corridor: County Line to Algonquin Rd.	≈ 185 acres	Primarily Algonquin (Public)	Approximately 200 undeveloped/protected public riparian acres along Woods Creek owned and managed by Algonquin. The corridor is comprised of high quality remnant, degraded remnant, and restored ecological communities. The "Woods Creek Riparian Area Corridor Natural Resource Inventory & Management Plan" dated Feb. 2, 2011 was prepared by AES for this area and is currently being implemented by Algonquin.	Restore and manage riparian area using an ecological approach by continuing to implement recommendations included in the "Woods Creek Riparian Area Corridor Natural Resource Inventory & Management Plan" dated Feb. 2, 2011.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Medium	Algonquin	Ecological Consultant/ Contractor	$6,000/acre for areas needing restoration; $1,000/acre for areas needing maintenance; $400,000 total	Ongoing
3	Winding Creek Riparian Corridor	11 acres	Algonquin (Public)	14 undeveloped/protected public riparian acres along Winding Creek owned and managed by Algonquin. The corridor harbors the highest quality fen wetlands in the watershed. The "Winding Creek Riparian Corridor Natural Resource Inventory & Management Plan" dated Aug. 15, 2008 was prepared by AES for this area and is currently being implemented by Algonquin.	Restore and manage riparian area using an ecological approach by continuing to implement recommendations included in the "Winding Creek Riparian Corridor Natural Resource Inventory & Management Plan" dated Aug. 15, 2008.	Filter Strip: TSS= 73% TN= 40% TP= 45%	High	Algonquin	Ecological Consultant/ Contractor	$8,000/acre for areas needing restoration; $1,000/acre for areas needing maintenance; $120,000 total	Ongoing
4	Terrace Hill Drain Riparian Area between Fairway View Dr. & Brookside Ave.	8 acres	Algonquin (Public)	8 acre degraded riparian area along Terrace Hill Drain (THD1) that is owned by Algonquin. The area is dominated by invasive trees and shrubs that severely shade the understory resulting in unstable streambank soils along Terrace Hill Drain.	Selectively remove invasive trees and shrubs from riparian area then establish native understory vegetation. Note: this work should be completed in conjunction with streambank/channel restoration work along Critical Stream Reach- Terrace Hill Drain (THD1).	Filter Strip: TSS= 73% TN= 40% TP= 45%	Medium	Algonquin	Ecological Consultant/ Contractor	$60,000 to remove invasive trees & shrubs then plant native vegetation	10-20+ Years (2023-2032+)
10	Woods Creek Riparian Corridor south of Algonquin Rd.	24.4 acres	Private Owner (Private)	24.4 riparian acres along a high quality reach of Woods Creek (WCR14) that is in average ecological condition although invasive trees and shrubs are abundant. Note: this area is a Priority Green Infrastructure Protection Area.	Restore the ecological condition of the riparian corridor by first developing a "Natural Resource Inventory & Management Plan" then implement recommendations.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Medium	Existing or future owner	Ecological Consultant/ Contractor; USACE; NRCS	$4,000 for NRI/Management Plan; $2,000/acre maint. $48,000 total	10-20+ Years (2023-2032+)
11	Woods Creek Corridor from Dennis Rd. to Crystal Creek	1,178 lf/ 6 acres	Private Owners (Private)	Narrow riparian buffer along Woods Creek (WCR15) from Dennis Rd. to Crystal Creek that is dominated by invasive trees and shrubs.	Restore the ecological condition of the riparian corridor by selectively removing invasive trees and shrubs.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Low	Owners	Tree Service Company	$15,000 to remove invasive trees and shrubs	10-20+ Years (2023-2032+)

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
PRIORITY GREEN INFRASTRUCTURE PROTECTION AREAS (See Figure 56)											
Technical and Financial Assistance Needs: Technical and financial assistance needed to acquire open space or implement conservation design is high because of land, design/permitting, and construction costs.											
1	Southeast tip of watershed; NE corner of Randall Rd. & Longmeadow (See Figure 56)	24.4 acres	Owner (Private)	24.4 acres currently in private agriculture use at NE corner of Randall and Longmeadow in area that is important for groundwater/aquifer recharge and area that is highly vulnerable to the impacts of future impervious cover resulting from development. The area is proposed to be annexed by Algonquin and developed to commercial/retail.	Incorporate Conservation Design standards into future development with an emphasis on promoting groundwater/aquifer recharge and reducing impervious surfaces.	Not Applicable	Critical Area	Future Developer; Algonquin	Ecological Consultant; USACE; NRCS/SWCD; IEPA; Kane County	Not Applicable	When development occurs
2	Southeast tip of watershed; W. of Randall Rd. (See Figure 56)	24.5 acres	Owner (Private)	24.4 acres currently in private agriculture use at NE corner of Randall and The area is proposed to be annexed by Algonquin and developed to light industrial.	Incorporate Conservation Design standards into future development with an emphasis on promoting groundwater/aquifer recharge and reducing impervious surfaces.	Not Applicable	Critical Area	Future Developer; Algonquin	Ecological Consultant; USACE; NRCS/SWCD; IEPA; Kane County	Not Applicable	When development occurs
3	Southwest corner of watershed (See Figure 56)	222.6 acres	Owner (Private)	226.6 acres currently in private use (Plote) as a gravel quarry. The area is important for groundwater/ aquifer recharge and is highly vulnerable to the impacts of future impervious cover resulting from development. The area is proposed to be annexed by Algonquin and developed to retail/commercial.	Incorporate Conservation Design standards into future development with an emphasis on promoting groundwater/aquifer recharge and reducing impervious surfaces.	Not Applicable	Critical Area	Future Developer; Algonquin	Ecological Consultant; USACE; NRCS/SWCD; IEPA; Kane County	Not Applicable	When development occurs
4	Southcentral portion of watershed S. of County Line (See Figure 56)	89.8 acres	Owner (Private)	89.8 acres of private land currently in early stages (but on hold) of development at headwaters of Woods Creek. The area is highly vulnerable to impacts of future impervious cover resulting from development. Note: site includes Critical Detentions #13-18.	Incorporate Conservation Design standards into future development with an emphasis on reducing impervious surfaces by setting aside open space.	Not Applicable	Critical Area	Developer; Algonquin	Ecological Consultant; USACE; NRCS/SWCD; IEPA; Kane County	Not Applicable	When development resumes
5	Between Randall Rd. and Grand Reserve Subdivision (See Figure 56)	34.7 acres	Owner (Private)	34.7 acres of private land in early stages of development (but on hold) at headwaters of Grand Reserve Creek. The area is highly vulnerable to impacts of future impervious cover resulting from development.	Incorporate Conservation Design standards into future development with an emphasis on reducing impervious surfaces by setting aside open space.	Not Applicable	Critical Area	Developer; Algonquin	Ecological Consultant; USACE; NRCS/SWCD; IEPA; Kane County	Not Applicable	When development resumes
6	Far eastern tip of watershed, S. of Algonquin Rd (See Figure 56)	16.5 acres	Owner; Residential HOA (Private)	16.5 acres of undeveloped private land that includes a high quality reach of Woods Creek (WCR14) and adjacent remnant mesic woodland. Future development is limited due to topography and wetland/floodplain issues.	Acquire and protect parcels as natural areas.	Not Applicable	Critical Area	Owners; Algonquin	TLC	Not Applicable	When parcel(s) become available for purchase
OTHER MANAGEMENT MEASURES (See Figure 57)											
Technical and Financial Assistance Needs: Technical and financial assistance needed to implement these projects varies depending on complexity.											
1	Spella Park Sled Hill	15 acres	Algonquin (Public)	Approximately 15 acres of old field vegetation along the riparian area near the headwaters of Woods Creek in Spella Park/Sled Hill.	Remove existing old field vegetation and establish upland (dry and mesic prairie) vegetation as a buffer to Woods Creek. Note: after restoration, area can be mowed or burned prior to winter to allow for sledding.	Vegetated Filter Strip: TSS= 0.5 tons/yr TN= 7 lbs/yr TP= 2 lbs/yr	Medium	Algonquin	Ecological Consultant/ Contractor	$20,000 to establish upland prairie buffer	1-5 Years (2013-2017)
2	Algonquin Area Library	2,000 square feet	Algonquin (Public)	Two depressional areas totaling about 2,000 square feet near the entrance of library where water drains from rooftop through gutters into stormsewer.	Design and install two demonstration rain gardens.	Wetland Det. TSS= 77.5% TN= 20% TP= 44%	Medium	Algonquin Area Library	Ecological Consultant or Landscape Architect	$6,000 each to design and install; $12,000 total	1-10 Years (2013-2022)

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
3	Terrace Hill Golf Course	150 acres	Golf Course (Private)	Approximately 150 acre golf course (Terrace Hill) with extensive mown turf grass rough areas and ponds with rip-rap edge/turf buffers.	Enroll in Audubon Cooperative Sanctuary Program (ACSP) then establish low stature upland prairie buffers in about 25% (50 acres) of rough areas and along pond edges.	Vegetated Filter Strip: TSS= 1 tons/yr TN= 7 lbs/yr TP= 9 lbs/yr	Medium	Terrace Hill Golf Course	Ecological Consultant/ Contractor	$80,000 to design and install upland prairie buffers on 50 acres	Implement over 1-15 Years (2013-2027)
4	Terrace Hill Golf Course	1 acre	Golf Course (Private)	1 acre depressional area on the far east side of golf course along Fairway View Dr. Entire course drains to area then drains east under Fairway View Dr. via a stormsewer to form Terrace Hill Drain. Note: high sediment and phosphorus loading was documented just downstream.	Retrofit area to be a bioswale/wetland by removing turf grass, regrading, reconfiguring stormsewer, and installing native wetland vegetation.	Wetland Detention: TSS= 2.3 tons/yr TN= 6 lbs/yr TP= 9 lbs/yr	High	Terrace Hill Golf Course	Ecological Consultant/ Contractor; NRCS	$30,000 to design and install bioswale/wetland	1-10 Years (2013-2022)
5	Far eastern tip of watershed, S. of Algonquin Rd	275 lf	Owner; Residential HOA (Private)	275 linear feet of eroded gully on steep sideslope south of high quality reach of Woods Creek (WCR14).	Design and install project to stabilize eroded gully.	Gully Stabilization: TSS= 41 tons/yr TN= 69 lbs/yr TP= 35 lbs/yr	Low	Residential HOA	Ecological Consultant/ Contractor; NRCS	$40,000 to design and install gully stabilization	10-20+ Years (2023-2032+)
12	County Line Rd., Boyer Rd., Harnish Dr.	500 lf	Algonquin (Public)	Potential bike path/trail connection at County Line Rd. to Boyer Rd. to Harnish Dr. to connect Woods Creek Trail in Algonquin.	Design and install trail connection at County Line Rd. to Boyer Rd. to Harnish Dr. to connect Woods Creek Trail in Algonquin.	Not Applicable	Medium	Algonquin	Contractor	$50,000 to install 500 lf of path	As development resumes in area

ALGONQUIN TOWNSHIP

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
WETLAND RESTORATION (See Figure 52)											
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.											
6	See Algonquin (site is located in future Village of Algonquin annexation area)										
PRIORITY GREEN INFRASTRUCTURE PROTECTION AREAS (See Figure 56)											
Technical and Financial Assistance Needs: Technical and financial assistance needed to acquire open space or implement conservation design is high because of land, design/permitting, and construction costs.											
5	See Algonquin (site is located in future Village of Algonquin annexation area)										

CRYSTAL LAKE

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
DETENTION BASIN RETROFITS & MAINTENANCE (See Figure 51)											
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 require the greatest assistance.											
91	Hunters Ridge Subdivision	1.0 acres	Residential HOA (Private)	Existing dry bottom detention basin with mown turf grass within Hunters Ridge Subdivision.	Design and implement project to replant entire basin with native prairie vegetation then maintain indefinitely.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Low	Residential HOA	Ecological Consultant/ Contractor; Crystal Lake	$6,000 to design & install prairie vegetation; $1,500/year maintenance	10-20+ Years (2023-2032+)
92	Hunters Ridge Subdivision	3.5 acres	Residential HOA (Private)	Existing wet/wetland bottom detention basin within Hunter Ridge Subdivision that is heavily dominated by invasive species.	Implement maintenance program to remove invasive species.	Not Applicable	Low	Residential HOA	Ecological Consultant/ Contractor	$3,000/year maintenance	Ongoing
93	N. of Alexander Blvd.	1.0 acre	Unknown (Private)	Existing naturalized dry bottom detention basin in fair condition.	Implement maintenance program to enhance and preserve condition of naturalized detention basin.	Not Applicable	Low	Owner	Ecological Consultant/ Contractor	$500/year maintenance	Ongoing
94	Kings Gate Subdivision	3.75 acres	Residential HOA (Private)	Existing dry bottom detention basin servicing Kings Gate Subdivision. The basin is mown turf grass with a rip-rap channel between the inlet and outlet.	Design and implement project to remove rip-rap channels and replant entire basin with native prairie vegetation then maintain indefinitely.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Medium	Residential HOA	Ecological Consultant/ Contractor; Crystal Lake	$20,000 to design & install prairie vegetation and remove rip-rap; $2,500/year maintenance	10-20+ Years (2023-2032+)
95, 96	S. of Alexander Blvd.	8.0 acres	Residential HOA (Private)	Two wet bottom detention basins servicing surrounding residential development; both basins are invaded heavily by invasive species.	Implement maintenance program to remove invasive species.	Not Applicable	Low	Private Residents	Ecological Consultant/ Contractor	$4,000/year maintenance	Ongoing
99, 100	E. & W. of Golf Course Rd.	3.0 acres	Residential HOA (Private)	Two existing dry bottom detention basins with mown turf grass.	Design and implement project to replant both basins with native prairie vegetation then maintain indefinitely.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Low	Residential HOA	Ecological Consultant/ Contractor; Crystal Lake	$15,000 to design & install prairie vegetation; $2,000/year maintenance	10-20+ Years (2023-2032+)
102	N. of Ackman-Willows Edge Subdivision	7.0 acres	Residential HOA (Private)	Existing wet bottom detention basin servicing Willows Edge Subdivision. Basin buffer is narrow and invasive species are abundant along the shoreline.	Design and implement project to extend prairie buffer and remove invasive species from existing buffer and shoreline.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Medium	Residential HOA	Ecological Consultant/ Contractor	$15,000 to design & install prairie buffer; $2,000/year maintenance	10-20+ Years (2023-2032+)
104, 105	Waterford Subdivision	2.0 acres	Residential HOA (Private)	Two existing naturalized wetland/wet bottom detention basins in unfinished subdivision. Both basins are dominated by invasive species.	Implement maintenance program to remove invasive species.	Not Applicable	Low	Residential HOA	Ecological Consultant/ Contractor	$1,500/year maintenance	Ongoing
106, 107, 108	Stonebridge Townhomes of Four Colonies	3.0 acres	Residential HOA (Private)	Three existing dry bottom/turf grass detention basins servicing surrounding residential development.	Design and implement project to replant basins with native prairie vegetation then maintain indefinitely.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Low	Residential HOA	Ecological Consultant/ Contractor; Crystal Lake	$15,000 to design & install prairie vegetation; $3,000/year maintenance	10-20+ Years (2023-2032+)
111	N. of Ackman Rd.	1.5 Acres	Residential HOA (Private)	Existing wet bottom detention basin lined with invasive trees and shrubs.	Implement maintenance program to remove invasive species.	Not Applicable	Low	Residential HOA	Ecological Consultant/ Contractor	$1,000/year maintenance	Ongoing
112	S. of Ackman Rd.	1.0 acre	Residential HOA (Private)	Existing dry bottom/turf grass detention basin in residential development.	Design and implement project to replant basin with native prairie vegetation then maintain indefinitely.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Low	Residential HOA	Ecological Consultant/ Contractor; Crystal Lake	$6,000 to design & install prairie vegetation; $1,500/year maintenance	10-20+ Years (2023-2032+)
116	N. of Alexandra Blvd.	1.5 acres	Residential HOA (Private)	Existing dry bottom/turf grass detention basin in residential development.	Design and implement project to replant basin with native prairie vegetation then maintain indefinitely.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Low	Residential HOA	Ecological Consultant/ Contractor; Crystal Lake	$6,000 to design & install prairie vegetation; $1,500/year maintenance	10-20+ Years (2023-2032+)
115, 117, 118, 119	Along Woods Creek Tributary Reach 3	5.0 acres	Residential HOA (Private)	Four existing naturalized wet/wetland bottom detention basins along Woods Creek Tributary that are heavily invaded by invasive species.	Implement maintenance program to remove invasive species and reseed/replant failed areas.	Not Applicable	Medium	Residential HOA	Ecological Consultant/ Contractor	$5,000/year maintenance; $20,000 reseeding/planting	Ongoing

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
STREAMBANK & CHANNEL RESTORATION (See Figure 53)											
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.											
TRC: Unnamed Trib. C	Between Randall Rd. and WCTR4	537 linear feet	Crystal Lake & DOT (Private)	537 linear feet of stream/ditch tributary to WCTR4 within vacant lot slated for future use by DOT as compensatory storage related to the proposed Randall Rd. expansion project.	Incorporate water quality BMPs within the stream reach as part of compensatory storage plans.	Not Applicable	Medium	DOT	Crystal Lake	Not yet determined	Not yet determined
RIPARIAN AREA RESTORATION & MAINTENANCE (See Figure 54)											
Technical and Financial Assistance Needs: Technical assistance needed to implement riparian area restoration maintenance is moderate at first because an environmental consultant is usually hired to complete a plan and implement the work. However, costs can be greatly reduced over time if municipal or park district staff complete some restoration and most of the long term maintenance in house. Private landowners will require the greatest assistance.											
14	Riparian Corridor along Woods Creek Trib. Reach 3	15 Acres	Residential HOA (Private)	15 average condition riparian acres along 2,893 lf of Woods Creek Trib. 3 (WCTR3). Corridor is owned and managed by Residential HOA. The primary concern is encroaching invasive trees and shrubs and lack of general ecological management such as controlled burning.	Implement program to remove invasive trees and shrubs and begin an ecological management program that includes controlled burning.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Medium	Residential HOA	Ecological Consultant/ Contractor	$25,000 to remove invasive trees & shrubs; $2,500/year maintenance	Ongoing

CRYSTAL LAKE PARK DISTRICT

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
DETENTION BASIN RETROFITS & MAINTENANCE (See Figure 51)											
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 require the greatest assistance.											
97	Hampton Park	3.5 acres	CLPD (Public)	Existing dry bottom detention basin in Hampton Park with mown turf grass. Basin is used heavily for recreation.	Design and implement project to naturalize entire basin with native prairie vegetation then maintain indefinitely.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Low	CLPD	Ecological Consultant/ Contractor	$20,000 to design & install prairie vegetation; $2,000/year maintenance	10-20+ Years (2023-2032+)
98	Ken Bird Park	3.0 acres	CLPD (Public)	Existing dry bottom detention basin in Ken Bird Park with mown turf grass. Basin is used periodically for recreation.	Design and implement project to naturalize entire basin with native prairie vegetation then maintain indefinitely.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Medium	CLPD	Ecological Consultant/ Contractor	$18,000 to design & install prairie vegetation; $2,000/year maintenance	10-20+ Years (2023-2032+)
103	Sterling Meadows Park	2.5 acres	CLPD (Public)	Existing dry bottom detention basin in Sterling Meadows Park with mown turf grass. Basin is rarely used for recreation.	Design and implement project to naturalize entire basin with native prairie vegetation then maintain indefinitely.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Medium	CLPD	Ecological Consultant/ Contractor	$15,000 to design & install prairie vegetation; $2,000/year maintenance	10-20+ Years (2023-2032+)
101	Woodscreek Park	17.0 acres	CLPD (Public)	Existing naturalized wet bottom detention basin online with Woods Creek Tributary in Woodscreek Park. Nearly 300 acres drains to the detention. The basin and buffer are in fair condition but are invaded by invasive species.	Implement 3-4 year maintenance program to remove invasive species and reseed or plant poorly established prairie buffer and emergent wetland areas; maintain indefinitely.	Extended Wet Detention: TSS=30 tons/yr TN= 716 lbs/yr TP= 134 lbs/yr	High	CLPD	Ecological Consultant/ Contractor	$30,000 to reseed/plant prairie & wetland areas; $5,000/year maintenance	1-5 Years (2013-2017); Ongoing Maintenance
109, 110	Samuel John's Park	3.5 acres	CLPD (Public)	Two existing dry bottom detention basins in Samuel John's Park with mown turf grass. Basins are used heavily by Crystal Lake South HS students.	Design and implement project to naturalize both basins with native prairie vegetation then maintain indefinitely.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Low	CLPD	Ecological Consultant/ Contractor	$20,000 to design & install prairie vegetation; $2,000/year maintenance	10-20+ Years (2023-2032+)
113, 114	Fetzner Park	4.5 acres	CLPD (Public)	Two existing dry bottom detention basins in Fetzner Park with mown turf grass; basins are adjacent to degraded riparian area along Woods Creek Tributary Reach 2. Note: site is considered a "Critical Area".	Design and implement project to naturalize both basins with native prairie vegetation and maintain indefinitely. Incorporate detention retrofits into Critical Riparian Area Restoration project #13.	Dry Detention: TSS=7 tons/yr TN= 148 lbs/yr TP= 18 lbs/yr	Critical Area	CLPD	Ecological Consultant/ Contractor	$20,000 to design & install prairie vegetation; $2,500/year maintenance	1-5 Years (2013-2017)
121, 123	Winding Creek Park	4.5 acres	CLPD (Public)	Two existing wet bottom detention basins that are online with Woods Creek Tributary in Winding Creek Park. The basin buffers are narrow and dominated by invasive species.	Design and implement project to naturalize the shorelines of both basins with native prairie and wetland vegetation then maintain indefinitely. Work with Residential HOA to incorporate two small detentions adjacent/east into the project.	Extended Wet Detention: TSS=86% TN= 55% TP= 68.5%	Medium	CLPD	Ecological Consultant/ Contractor	$40,000 to design & install prairie buffer and wetland plants; $2,500/year maintenance	10-20+ Years (2023-2032+)
124	Indian Prairie Park	3.5 acres	CLPD (Public)	Existing dry/wetland bottom detention basin in Indian Prairie Park with turf grass (not mowed) side slopes. Invasive reed canary grass is abundant in the basin bottom. The basin presents a good opportunity to retrofit with native vegetation to improve water quality and habitat.	Design and implement project to naturalize entire basin with native prairie vegetation then maintain indefinitely.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Medium	CLPD	Ecological Consultant/ Contractor	$20,000 to design & install prairie vegetation; $2,000/year maintenance	10-20+ Years (2023-2032+)
STREAMBANK & CHANNEL RESTORATION (See Figure 53)											
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.											
WCTR2: Woods Cr. Trib. Reach 2	Fetzner Park	2,396 linear feet	CLPD (Public)	2,396 lf of stream on public land (CLPD: Fetzner Park) that is highly channelized	Design and install up to four artificial riffles within the stream channel. Complete project in conjunction with Critical Detention Project #113/114 and Critical Riparian Area Restoration project #13.	Not applicable	High	CLPD	Ecological Consultant/ Contractor; USACE; IDNR; NRCS	$12,000 to install four riffles	1-5 Years (2013-2017)

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
WCTR4: Woods Cr. Trib. Reach 4	Winding Creek Park & Bike Path	1,560 linear feet	CLPD (Public)	1,560 lf of stream on public land (CLPD: Winding Creek Park & Bike Path) that is highly channelized and exhibits moderate streambank erosion in areas. There is heavy shading by invasive trees and shrubs on the streambanks.	Remove invasive trees and shrubs from the streambanks and replace with native vegetation.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Low	CLPD	Ecological Consultant/ Contractor;	$12,000 to remove invasive trees and shrubs; $10,000 to establish native vegetation	10-20+ Years (2023-2032+)
TRB: Unnamed Trib. B	N. of Alexandra Blvd. along path in Woodscreek Park	1,407 linear feet	CLPD; School (Public)	1,407 lf of channelized ditch that flows along the path between Alexandra Blvd. and Woodscreek Park. There is heavy shading by invasive trees and shrubs on the streambanks.	Investigate feasibility to divert ditch to the west/ north of the school and into the existing large wetland complex for flood reduction and water quality improvement benefits.	Not applicable	Low	CLPD; Crystal Lake; School	Ecological Engineer, USACE; NRCS	$15,000 to conduct feasibility study	10-20+ Years (2023-2032+)
RIPARIAN AREA RESTORATION & MAINTENANCE (See Figure 54)											
Technical and Financial Assistance Needs: Technical assistance needed to implement riparian area restoration and maintenance is moderate at first because an environmental consultant is usually hired to complete a plan and implement the work. However, costs can be greatly reduced over time if municipal or park district staff complete some restoration and most of the long term maintenance in house. Private landowners will require the greatest assistance.											
13	Woods Creek Trib. Reach 2 Riparian Corridor in Fetzner Park	15 acres	CLPD (Public)	15 acre narrow/degraded riparian corridor along 2,396 lf of Woods Cr. Trib. (WCTR2) on public land (CLPD: Fetzner Park). Degradation is caused by a predominance of invasive shrubs, trees, and turf grass along the streambanks and immediate buffer that result in poor water quality filtering and heavy shading causing streambank erosion. Note: site is considered a "Critical Area".	Design and implement project to improve condition of riparian area by selectively removing invasive trees, shrubs, and turf grass from the stream banks/immediate buffer then establishing a native vegetation buffer. Complete project in conjunction with Critical Detention Project #113/114 and high priority Streambank/Channel Restoration WCTR2.	Vegetated Filter Strip: TSS= 3 tons/yr TN= 63 lbs/yr TP= 11 lbs/yr	Critical Area	CLPD	USACE; Ecological Consultant: Tree Service	$70,000 to design and implement; $2,500/year maintenance	1-5 Years (2013-2017)
15	Riparian Corridor along Woods Creek Trib. Reach 4 along Winding Creek Park	14 Acres	CLPD (Public)	14 average to poor condition riparian acres along 1,560 lf of Woods Creek Trib. 4 (WCTR4). Corridor is owned and managed by CLPD. The primary concern is encroaching invasive trees and shrubs and lack of general ecological management such as controlled burning.	Implement program to remove invasive trees and shrubs and begin an ecological management program that includes controlled burning.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Medium	CLPD	Ecological Consultant/ Contractor	$15,000 to remove invasive trees & shrubs; $2,000/year maintenance	Ongoing
OTHER MANAGEMENT MEASURES (See Figure 57)											
Technical and Financial Assistance Needs: Technical and financial assistance needed to implement these projects varies depending on complexity.											
11	Willow's Edge Park	30 acres	CLPD (Public)	Approximately 30 acre park (Willow's Edge) owned and managed by CLPD. The park includes remnant wetlands, excavated ponds, and natural buffers. CLPD has plans to improve the park in the future with picnic areas, playfields, frisbee golf, and dog park. Improvements will also include restoration/ maintenance of existing natural areas.	Incorporate natural area restoration retrofits and management into future improvement plans. Improvements may include retrofitting the north excavated pond to be a wetland filter, removal of invasive herbaceous and woody species from all buffer areas, and installation of native vegetation in appropriate areas.	Vegetated Filter Strip & Wetland Detention: TSS=1.25tons/yr TN= 12 lbs/yr TP= 5 lbs/yr	Medium	CLPD	Ecological Consultant/ Contractor; USACE	$80,000 to retrofit north pond, remove invasives, and establish native vegetation	As site improvements are implemented

DUNDEE TOWNSHIP

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
WETLAND RESTORATION (See Figure 52)											
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.											
1	See Algonquin (site is located in future Village of Algonquin annexation area)										
2	See Algonquin (site is located in future Village of Algonquin annexation area)										
PRIORITY GREEN INFRASTRUCTURE PROTECTION AREAS (See Figure 56)											
Technical and Financial Assistance Needs: Technical and financial assistance needed to acquire open space or implement conservation design is high because of land, design/permitting, and construction costs.											
1 & 2	See Algonquin (sites are located in future Village of Algonquin annexation areas)										

GRAFTON TOWNSHIP

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
STREAMBANK & CHANNEL RESTORATION (See Figure 53)											
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.											
WCTR1: Woods Cr. Trib. Reach 1	Ackman Rd. to Woodscreek Park	853 linear feet	Resident (Private)	853 lf of stream on private property that is channelized but with minimal streambank erosion. There is also heavy shading by invasive trees and shrubs on the streambanks and immediate buffer.	Remove invasive trees and shrubs from the streambanks and immediate buffer area and replace with native vegetation.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Low	Owner	Ecological Consultant/ Contractor	$8,000 to remove invasive trees and shrubs; $5,000 to establish native vegetation	10-20+ Years (2023-2032+)
TRA: Trib. A	See Grafton Township- Riparian Area Restoration & Maintenance Site 12										
RIPARIAN AREA RESTORATION & MAINTENANCE (See Figure 54)											
Technical and Financial Assistance Needs: Technical assistance needed to implement riparian area restoration maintenance is moderate at first because an environmental consultant is usually hired to complete a plan and implement the work. However, costs can be greatly reduced over time if municipal or park district staff complete some restoration and most of the long term maintenance in house. Private landowners will require the greatest assistance.											
12	Woods Creek Tributary Headwaters	12.7 acres	Private Owners (Private)	12.7 degraded riparian acres on private land along Unnamed Tributary A (TRA) at headwaters of Woods Creek Tributary. TRA is a ditch that was excavated within a wetland to help drain water for farming purposes. Note: site is considered a "Critical Area".	Conduct feasibility study then restore natural riparian/headwater wetland hydrology and function by modifying the outlet at Unnamed Tributary A (TRA).	Wetland Detention: TSS=25 tons/yr TN= 189 lbs/yr TP= 56 lbs/yr	Critical Area	Owner	Crystal Lake; USACE; Ecological Consultant	$15,000 for feasibility study; $10,000 tributary modification	1-5 Years (2013-2017)

LAKE IN THE HILLS

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
DETENTION BASIN RETROFITS & MAINTENANCE (See Figure 51)											
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 require the greatest assistance.											
71	Adjacent to Woods Cr., N. of Algonquin Rd	3.0 acres	Business (Private)	Existing naturalized wetland bottom detention basin being invaded by invasive species.	Implement maintenance program to remove invasive species from detention basin.	Not Applicable	Low	Business Association	Ecological Consultant/ Contractor	$2,500/year maintenance	Ongoing
72	Adjacent to Woods Cr., W. of Harvest Gate	8.0 acres	LITH (Public)	Existing naturalized dry bottom detention basin in fair condition; some invasion by invasive species.	Implement maintenance program to remove invasive species from detention basin.	Not Applicable	Medium	LITH	Ecological Consultant/ Contractor	$3,500/year maintenance	Ongoing
73	Adjacent to Woods Cr., W. of Harvest Gate	1.0 acre	LITH (Public)	Existing dry bottom detention basin comprised of mown turf grass adjacent to Woods Creek. Site presents a good retrofit opportunity that would extend green infrastructure along Woods Creek.	Design and implement project to install native prairie vegetation throughout basin then maintain indefinitely.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Medium	LITH	Ecological Consultant/ Contractor	$10,000 to design & install prairie vegetation $1,500/year maintenance	10-20+ Years (2023-2032+)
74	Adjacent to Ken Carpenter Park; S. of Heavens Gate	3.5 acres	LITH (Public)	Existing dry bottom detention basin comprised of mown turf grass adjacent to Ken Carpenter Park. Site presents an excellent retrofit opportunity that would extend green infrastructure along Woods Cr.	Design and implement project to install native prairie vegetation throughout basin then maintain indefinitely.	Extended Wet Detention: TSS= 3 tons/yr TN= 52 lbs/yr TP= 6 lbs/yr	High	LITH	Ecological Consultant/ Contractor	$18,000 to design & install prairie vegetation $2,000/year maintenance	1-10 Years (2013-2022)
75	Echo Park	15.0 acres	LITH (Public)	Large dry bottom/turf grass detention basin in Echo Park. Site presents an excellent opportunity to retrofit with native vegetation for water quality improvement and wildlife habitat.	Design and implement project to install native prairie vegetation throughout basin, much of surrounding/unused park area, then maintain indefinitely.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Medium	LITH	Ecological Consultant/ Contractor	$60,000 to design & install prairie vegetation $4,000/year maintenance	10-20+ Years (2023-2032+)
76, 77	Adjacent to Ken Carpenter Park	10.0 acres	LITH (Public)	Two existing dry bottom detention basins that were naturalized using IEPA 319 Program dollars. Basin 77 is in relatively good condition while basin 76 is being invaded by invasive species.	Continue maintenance program to remove invasive species from detention basins. Supplemental seed of basin 76 with native prairie vegetation as needed.	Not Applicable	Medium	LITH	Ecological Consultant/ Contractor	$5,000/year maintenance; $10,000 to supplemental seed basin 76	Ongoing
78	Meadows Commercial Development	5.0 acres	Business (Private)	Existing wet bottom basin with steep slopes comprised of mown turf grass. Basin is poorly designed to treat for water quality or provide wildlife habitat.	Design and implement project to install a native prairie vegetation buffer, install native emergent plants along shoreline, and maintain indefinitely.	Extended Wet Detention: TSS= 86% TN= 55% TP= 68.5%	Low	Business Association	Ecological Consultant/ Contractor	$50,000 to design & install prairie buffer & emergent plants; $3,000/year maintenance	10-20+ Years (2023-2032+)
79	North Star Phase I, N. of Harvest Gate	2.5 acres	Residential HOA (Private)	Existing wet bottom detention basin servicing residential subdivision. Basin is abundant with invasive species.	Implement maintenance program to remove invasive species from detention basin.	Not Applicable	Low	Residential HOA	Ecological Consultant/ Contractor	$2,000/year maintenance	Ongoing
80, 81	Meadows Commercial Development	2.0 acres	Business (Private)	Two existing wet/wetland bottom detention basins in poor condition dominated by invasive species.	Implement maintenance program to remove invasive species from detention basins.	Not Applicable	Low	Business Association	Ecological Consultant/ Contractor	$2,000/year maintenance	Ongoing
83	W. of Crystal Lake Rd.	1.0 acre	Business (Private)	Existing wet bottom detention in poor condition dominated by invasive species.	Implement maintenance program to remove invasive species from detention basin.	Not Applicable	Low	Business Association	Ecological Consultant/ Contractor	$1,500/year maintenance	Ongoing
84	Woods Creek Village Subdivision	3.5 acres	Residential HOA (Private)	Existing wetland bottom detention basin in poor condition dominated by invasive species.	Implement maintenance program to remove invasive species from detention basin.	Not Applicable	Low	Residential HOA	Ecological Consultant/ Contractor	$2,500/year maintenance	Ongoing
85	Acorn Commercial Center	5.5 acres	Residential HOA (Private)	Existing wet bottom detention basin servicing Acorn Commercial Center. Basin is in relatively poor condition dominated by invasive species.	Implement maintenance program to remove invasive species from detention basin.	Not Applicable	Medium	Residential HOA	Ecological Consultant/ Contractor	$2,500/year maintenance	Ongoing
86	Lake in the Hills Police Department	0.25 acre	LITH	Existing wetland bottom detention basin dominated by invasive species.	Implement maintenance program to remove invasive species from detention basin.	Not Applicable	Medium	LITH	Ecological Consultant/ Contractor	$500/year maintenance	Ongoing

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
WETLAND RESTORATION (See Figure 52)											
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.											
7	Big Sky Park	2.5 acres	LITH: Big Sky Park (Public)	Potentially feasible wetland restoration site located along east side of Big Sky Park/west of Randall Rd. next to recreational use area that floods frequently.	Restore wetland by: 1) determine project feasibility, 2) design and permit project; 3) construct and plant wetland; and 4) conduct short and long term maintenance and monitoring to ensure establishment.	Wetland Detention: TSS=1 tons/yr TN=4 lbs/yr TP=2 lbs/yr	Critical Area	LITH	Ecological Consultant/ Contractor; USACE; NRCS/ SWCD; IEPA	$35,000 to design/permit/install/ maintain wetland	1-5 Years (2013-2017)
STREAMBANK & CHANNEL RESTORATION (See Figure 53)											
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.											
WCR9: Woods Creek Reach 9	Carpenter Park N. of Algonquin Rd.	1,871 linear feet	LITH (Public)	1,871 lf of stream on public land (LITH: Carpenter Park) that is moderately channelized with moderately eroded streambanks. There is also heavy shading by invasive trees and shrubs on the streambanks and immediate buffer.	Design, permit, and implement project to restore eroded streambanks using bioengineering techniques, improve channel bottom with artificial riffles, and restore immediate buffer by removing invasive species and replanting with native vegetation.	Bank Stabilization: TSS= 89 tons/yr TN= 151 lbs/yr TP= 75 lbs/yr	Medium	LITH	Ecological Consultant/ Contractor; USACE; IDNR; NRCS	$50,000 design/permit; $250,000 install	10-20+ Years (2023-2032+)
WCR10: Woods Creek Reach 10	Carpenter Park	1,817 linear feet	LITH (Public)	1,871 lf of stream on public land (LITH; Carpenter Park) that is moderately channelized with severely eroded streambanks. There is also heavy shading by invasive trees and shrubs on the streambanks and immediate buffer. Note: site is considered a "Critical Area".	Design, permit, and implement project to restore eroded streambanks using bioengineering techniques, improve channel bottom with artificial riffles, and restore immediate buffer by removing invasive species and replanting with native vegetation.	Bank Stabilization: TSS=278 tons/yr TN=556 lbs/yr TP=278 lbs/yr	Critical Area	LITH	Ecological Consultant/ Contractor; USACE; IDNR; NRCS	$50,000 design/permit; $300,000 install	1-5 Years (2013-2017)
WCR11: Woods Creek Reach 11	Carpenter Park	3,129 linear feet	LITH (Public)	3,129 lf of stream on public land (LITH; Carpenter Park) that is highly channelized with highly eroded streambanks. There is also heavy shading by invasive trees and shrubs on the streambanks and immediate buffer. Note: site is considered a "Critical Area".	Design, permit, and implement project to restore eroded streambanks using bioengineering techniques, improve channel bottom with artificial riffles, and restore immediate buffer by removing invasive species and replanting with native vegetation.	Bank Stabilization: TSS=479 tons/yr TN= 957 lbs/yr TP= 479 lbs/yr	Critical Area	LITH	Ecological Consultant/ Contractor; USACE; IDNR; NRCS	$55,000 design/permit; $450,000 install	1-5 Years (2013-2017)
WCR12: Woods Creek Reach 12	Morningside Park/Acorn Ln.	1,553 linear feet	LITH & TLC (Public)	1,533 lf of stream on public land (LITH & TLC) that is naturally meandering with moderately eroded streambanks.	Design, permit, and install up to three artificial riffles within the stream channel.	Not applicable	Medium	LITH & TLC	Ecological Consultant/ Contractor; NRCS	$15,000 to design, permit, and install 3 artificial riffles	10-20+ Years (2023-2032+)
WCR13: Woods Creek Reach 13	Between Spillway and Algonquin Rd.	2,140 linear feet	Residents (Private)	2,140 lf of stream flowing through residential area downstream from Woods Creek Lake spillway. The stream is generally meandering; the streambanks are moderately eroded. Banks along 80% of upstream section are stabilized by various practices.	Design, permit, and implement project to restore eroded streambanks along 400 lf of downstream section of reach using bioengineering techniques, and restore immediate buffer by removing invasive species and replanting with native vegetation.	Bank Stabilization: TSS=15 tons/yr TN= 25 lbs/yr TP= 13 lbs/yr	Low	Residents; LITH	Ecological Consultant/ Contractor; USACE; IDNR; NRCS	$25,000 design/permit; $100,000 install	10-20+ Years (2023-2032+)
WCTR5: Woods Cr. Trib. Reach 5	Miller Rd. to Woods Creek	1,913 linear feet	DOT (Public)	1,913 lf of highly channelized but minimally eroded stream flowing along east side of Randall Road within right-of-way. There is shading by invasive trees and shrubs on the streambanks.	Design, permit, and install up to three artificial riffles within the stream channel. Remove invasive trees and shrubs from the streambanks and replace with native vegetation.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Low	MCDOT	Ecological Consultant/ Contractor	$15,000 to design, permit, and install 3 riffles; $20,000 to remove invasive trees and shrubs; $8,000 native vegetation	10-20+ Years (2023-2032+)
BRD1: Boulder Ridge Drain	Boulder Ridge Golf Course to Woods Creek in Carpenter Park	833 linear feet	LITH (Public)	833 lf of stream originating on east side of Boulder Ridge Golf Course and flowing east to Woods Creek within LITH-Carpenter Park. The stream is moderately channelized with moderately eroded banks. There is shading by invasive trees on the streambanks.	Design, permit, and install up to three artificial riffles within the stream channel. Remove invasive trees from the streambanks and replace with native vegetation.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Low	LITH	Ecological Consultant/ Contractor	$15,000 to design, permit, and install 3 riffles; $15,000 to remove invasive trees and shrubs; $5,000 native vegetation	10-20+ Years (2023-2032+)

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
RIPARIAN AREA RESTORATION & MAINTENANCE (See Figure 54)											
Technical and Financial Assistance Needs: Technical assistance needed to implement riparian area restoration and maintenance is moderate at first because an environmental consultant is usually hired to complete a plan and implement the work. However, costs can be greatly reduced over time if municipal or park district staff complete some restoration and most of the long term maintenance in house. Private landowners will require the greatest assistance.											
6	Woods Creek Riparian Corridor in Carpenter Park	108 acres	LITH (Public)	108 undeveloped/protected public riparian acres along Woods Creek between Algonquin Rd. and Randall Rd. owned and managed by LITH. The corridor contains some areas in average ecological condition but most is degraded. Note: 52 degraded riparian acres along Woods Creek Reaches 10 & 11 are considered a "Critical Area".	Restore the ecological condition of the riparian corridor by first developing a "Natural Resource Inventory & Management Plan" then implement recommendations. Recommendations will likely include complete restoration in some areas via removal of invasive trees and shrub followed by enhancement or establishment of native vegetation. Other areas will only need ongoing maintenance.	Vegetated Filter Strip: TSS= 6.5 tons/yr TN= 129 lbs/yr TP= 25 lbs/yr	Critical Area	LITH	Ecological Consultant/ Contractor	$8,000 for NRI/Management Plan; $8,000/acre for areas needing restoration; $1,000/acre for areas needing maintenance; $250,000 total	Ongoing
7	Woods Creek Riparian Corridor in Morningside Pk. /Acorn Lane	27 acres	LITH & TLC (Public)	27 undeveloped/protected riparian acres along Woods Creek (WCR12) between Algonquin Rd. and Woods Creek Lake and managed by LITH (N. or Woods Cr.) and TLC (S. of Woods Cr.) The corridor is mostly degraded by invasive species. TLC has done some small scale restoration work. South of the stream.	Restore the ecological condition of the riparian corridor by first developing a "Natural Resource Inventory & Management Plan" then implement recommendations. Note: McHenry County DOT is interested in using this area as compensatory storage related to the proposed Randall Rd. expansion. If used, compensatory storage areas should include BMPs that improve overall water quality and wildlife habitat as secondary benefit.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Medium High: (Randall Project)	LITH & TLC; MCDOT	Ecological Consultant/ Contractor; USACE; NRCS	$4,000 for NRI/Management Plan; $6,000/acre for areas needing restoration; $1,000/acre for areas needing maintenance; $55,000 total; Cost for comp. storage BMPs is unknown	1-10 Years (2013-2022) or when Randall Rd. expansion occurs
8	Private & Public (LITH) Lots along Woods Creek Lake	Approx. 11,700 lf or 5.5 acres	LITH (Public); Residents (Private)	11,700 lf or 5.5 acres along a 10 to 30 foot buffer around Woods Creek Lake. The majority of this buffer consists of mown turf grass associated with residential lots and parks.	Design and install buffers that allow lake shoreline owners and park users to balance recreational shoreline uses with natural buffers.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Low	LITH; Private Residents	Ecological Consultant/ Contractor; USACE; NRCS	$10,000 per 100 lf lot/10-30 ft wide: $1,170,000 Total	Ongoing
9	Woods Creek Lake Spillway to Algonquin Rd.	2,140 lf or 2.0 acres	Residents (Private)	2,140 lf or 2.0 riparian acres along a 20 ft wide buffer on both sides of Woods Creek (WCR13) between the Spillway at Woods Creek Lake and Algonquin Rd. that is owned/managed by adjacent residents. Most of the riparian area is dominated by invasive trees, shrubs, and mown turf grass.	Design and implement project to improve condition of riparian area by removing invasive species and establishing native vegetation.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Low	Private Residents; LITH	Ecological Consultant/ Contractor; USACE; NRCS	$10,000 per 100 lf lot; $225,000 if completed as one project	10-20+ Years (2023-2032+)
16	Miller Rd. to Woods Creek	1,913 lf or 2.0 acres	DOT (Public)	1,913 lf or 2.0 riparian acres along Woods Creek Trib. (WCTR5) between Miller Rd. and Woods Creek. That is within the Randall Rd. right-of-way. There is shading by invasive trees and shrubs in the riparian buffer.	Remove invasive trees and shrubs from the riparian buffer.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Low	MCDOT	Tree Service	$15,000 to remove invasive trees and shrubs	10-20+ Years (2023-2032+)
LAKE SHORELINE RESTORATION (See Figure 55)											
Technical and Financial Assistance Needs: Lake shoreline restoration projects are somewhat complex and require moderate to high technical and financial assistance needs to design, construct, and maintain the restoration.											
Indian Trail, Hilltop, Nockels, Turtle Island, Echo Hill	Five LITH owned parks around Woods Creek Lake (see Figure 55)	1,000 lf	LITH (Public)	Approximately 400 lf of eroded shoreline at Turtle Island Park; 250 lf at Indian Trail Beach; 100 lf at Echo Hill Park; 100 lf at Hilltop Beach; 150 lf at Nockels Park. Some stabilization work has been implemented by LITH around Turtle Island but is partially failing. Note: all sites are considered "Critical Areas".	Design, permit, and implement projects to stabilize shorelines using bioengineering techniques combined with hard armoring only if necessary.	Bank Stabilization: TSS=32.5tons/yr TN= 65 lbs/yr TP= 32.5 lbs/yr	Critical Areas	LITH	Ecological Consultant/ Contractor; USACE; NRCS	Turtle Island: $50,000 Indian Trail: $35,000 Echo Hill: $20,000 Hilltop: $20,000 Nockels: $25,000 $150,000 Total	Ongoing between 1 and 10 years (2013-2022)

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
OTHER MANAGEMENT MEASURES (See Figure 57)											
Technical and Financial Assistance Needs: Technical and financial assistance needed to implement these projects varies depending on complexity.											
6	Lake in the Hills Village Hall	5 acres	LITH (Public)	5 acres of open space adjacent to LITH Village Hall that includes a stormwater swale and adjacent upland area. All areas are currently mown turf grass.	Design and install a demonstration project that includes naturalizing the stormwater swale and adjacent upland areas with native vegetation.	Grass Swale: TSS=2.1 tons/yr TN= 3 lbs/yr TP= 1 lbs/yr	High	LITH	Ecological Consultant/ Contractor	$20,000 to design and install native vegetation	1-10 Years (2013-2022)
7	Dam & Spillway at Woods Creek Lake	na	LITH (Public)	Existing dam and spillway at Woods Creek Lake	LITH continue to inspect the integrity of the dam at Woods Creek Lake annually.	Not Applicable	High	LITH	USACE	No cost if done internally	Annually
8	Woods Creek Lake	52 acres	LITH (Public)	Mercury levels in Woods Creek Lake collected under the Illinois Fish Contaminant Monitoring Program found concentrations in largemouth bass that exceed recommended levels leading to a fish consumption advisory for bass larger than 15 inches.	Implement water sampling project to evaluate if conditions within Woods Creek Lake become suitable for microbes to produce methyl mercury, which is the form that biomagnifies and reaches elevated concentrations in fish.	Not Applicable	High	LITH	Jody Kubitz: Senior Consultant with Cardno Entrix	$6,000 to implement water sampling program	1-5 Years (2013-2017)
9	Woods Creek Lake	52 acres	LITH (Public)	Total aquatic plant cover in Woods Creek Lake was estimated at 54% according to the Illinois Department of Natural Resources (IDNR 2009). Invasive Eurasion watermilfoil (*Myriophyllum spicatum*) is one of the most common plants in the lake at depths between 5 and 10 feet.	Control invasive aquatic plant (Eurasion watermilfoil) abundance in Woods Creek Lake and maintain total aquatic plant cover under 40% by treating target areas of the lake with select aquatic herbicides.	Not Applicable	Medium	LITH	Lake Management Consultant	$30,000 for one time whole lake treatment	When desired by LITH
10	Boulder Ridge Golf Course	300 acres	Golf Course (Private)	Approximately 300 acre golf course (Boulder Ridge) with extensive mown turf grass rough areas and ponds with rip-rap edge/turf buffers.	Enroll in Audubon Cooperative Sanctuary Program (ACSP) then establish low stature upland prairie buffers in about 25% (75 acres) of rough areas and along pond edges.	Filter Strip: TSS=2.2 tons/yr TN= 24 lbs/yr TP= 18 lbs/yr	Medium	Boulder Ridge Golf Course	Ecological Consultant/ Contractor	$120,000 to design and install upland prairie buffers on 75 acres	Implement over 1-15 Years (2013-2027)
13	Woods Creek Lake	52 acres	LITH (Public)	Significant sediment deposition is occurring in the upper half of Woods Creek Lake as a result of sediment transport via Woods Creek. The extend of sediment deposition and need for sediment removal needs to be determined.	Conduct study to estimate the amount of sediment deposition occurring in the upper end of Woods Creek Lake and determine existing and/or future need for sediment removal. Also explore the potential to create a sediment basin west of Crystal Lake Rd. that can be maintained annually by LITH.	Not Applicable	High	LITH	Lake Management Consultant; USACE	$25,000 to conduct sediment study; cost for potential dredging is not known	1-5 Years (2013-2017)

RUTLAND TOWNSHIP

ID#	Location	Units (size/ length)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
WETLAND RESTORATION (See Figure 52)											
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.											
3	See Algonquin (site is located in future Village of Algonquin annexation area)										
RIPARIAN AREA RESTORATION & MAINTENANCE (See Figure 54)											
Technical and Financial Assistance Needs: Technical assistance needed to implement riparian area restoration and maintenance is moderate at first because an environmental consultant is usually hired to complete a plan and implement the work. However, costs can be greatly reduced over time if municipal or park district staff complete some restoration and most of the long term maintenance in house. Private landowners will require the greatest assistance.											
5	Northeast corner of Plote Quarry	3 aces along 1,864 lf QD1	Plote (Private)	Approximately 3 riparian acres along 1,864 linear feet section of stream (QD1) originating at Plote-owned gravel quarry. Riparian area is mostly disturbed soils dominated by invasive species resulting from quarry work.	Restore riparian buffer by regarding and stabilizing soil with native vegetation.	Filter Strip: TSS= 73% TN= 40% TP= 45%	Low	Plote	Ecological Consultant/ Contractor; NRCS	$30,000 to regrade & stabilize soils with native vegetation	10-20+ Years (2023-2032+)
PRIORITY GREEN INFRASTRUCTURE PROTECTION AREAS (See Figure 56)											
Technical and Financial Assistance Needs: Technical and financial assistance needed to acquire open space or implement conservation design is high because of land, design/permitting, and construction costs.											
3	See Algonquin (site is located in future Village of Algonquin annexation area)										

6.0 INFORMATION & EDUCATION PLAN

This Information & Education Plan (I&E Plan) recommends campaigns that are designed to enhance understanding of the issues, problems, and opportunities within Woods 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 Woods Creek watershed is to gain a better perspective of how the watershed evolved over time into what exists today.

Woods Creek watershed was once covered by prairie, oak savanna, and wetland ecosystems maintained and managed primarily by wildfires. This ecological setting was balanced with clean water and diverse plant and wildlife populations. During these times, most of the water that fell as precipitation was infiltrated in upland prairie and savanna communities and within extensive wetlands that existed along stream corridors.

Ecological conditions changed drastically following European settlement in the mid 1800s. The majority of prairie and savanna was tilled while drain tiles and channel dredging occurred in wet areas and along stream channels as farming became the primary land use by the early 1900s, continuing through the 1980s. In the 1990s and 2000s residential/commercial and industrial development became common in the watershed. This development resulted in increased urban runoff from impervious surfaces.

Lake in the Hills Stormsewer awareness sign

Beginning in 2004 and continuing through to the present (2012), Woods Creek Lake (located within Woods Creek watershed) and Crystal Creek and the Fox River downstream appeared on the Illinois Environmental Protection Agency's (Illinois EPA) 303d impaired waters list. Despite a heavily urbanized watershed, the quality of water leaving Woods Creek watershed is generally fair and does not appear to contribute significantly to the water quality problems facing Crystal Creek and the Fox River downstream. However, much of the documented pollutant load in Woods Creek watershed is being absorbed by Woods Creek Lake. Woods Creek Lake, therefore, benefits greatly by water quality improvement projects and campaigns implemented in Woods Creek watershed.

The Woods Creek watershed leading stakeholders/partners: Village of Algonquin, Village of Lake-in-the-Hills, City of Crystal Lake, and Crystal Lake Park District became concerned for the health of the watershed and formed the Woods Creek Watershed Committee (WCWC) partnership in 2010. The partnership believes that the process of creating and implementing this Watershed-Based Plan will unite stakeholders, help them understand the issues and opportunities facing the watershed, and initiate projects that improve watershed conditions.

Recommended Information & Education Campaigns

A successful I&E Plan first raises awareness amongst 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):

Village of Algonquin trail signage

- 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.

Development of an effective I&E Plan begins by defining I&E goals and objectives. The WCWC specifically addressed watershed information and education issues by developing an education goal with objectives:

Goal D: Provide watershed educational opportunities.

Objectives:

1) Inform stakeholders and the general public that a Watershed-Based Plan has been developed for Woods Creek watershed then educate on the beneficial uses of the plan.
2) Implement the Information & Education Plan (I&E Plan) section of the Woods Creek Watershed-Based Plan.

The following key education agendas and campaigns are included in the I&E Plan:

- Target property owners to help them understand the link between their land management choices and its impact on the watershed resources.
- Educate the general public about the benefits of ecological/natural area restoration and management.
- Educate private land owners along Woods Creek Lake and miscellaneous stream/tributary corridors about the importance of proper land management to benefit the Green Infrastructure Network.
- Role of the Green Infrastructure Network for public and school outdoor education.
- Alternatives or management for phosphorus and road salt use.
- Flood proofing structural flood problems in residential areas.
- Annual tour of watershed by elected officials and others that are interested to see the progress on restoration, areas that need improvement, or failed projects.
- Offer outdoor "Volunteer Days" to get the general public to experience the watershed.
- Student projects for high schools or college, boy scouts/girl scouts top service project, etc.
- Implement demonstration projects, or highlight existing case studies within the watershed that promote the benefits of watershed protection and best management practices.

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, watershed roles, and ages. 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 riparian landowners, general public, local government, elected officials, homeowner and business associations, developers, lake property owners, and schools.

Algonquin natural area restoration sign

Creating and distributing a message for each audience is done via campaigns that address education goal objectives. The I&E Plan objectives for Woods Creek watershed were determined through stakeholder meetings. An I&E Plan matrix (Table 37) 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) "Package" (vehicle) for delivery of the message, 3) "Schedule", 4) "Lead & Supporting Organizations", 5) "Outcomes/ Behavior Change", and 6) "Estimated Cost".

The I&E Plan includes a variety of campaigns that are ongoing, as requested, or held every 3 or 5 years. As with any plan, 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 8.0 of this plan contains a "Report Card" with milestones related to watershed education that can be used to evaluate I&E Plan implementation efforts.

Noteworthy- Existing Education Campaigns

The project partners: Algonquin, Lake-in-the-Hills, Crystal Lake, and Crystal Lake Park District currently have a number of watershed education campaigns in place.

<u>Algonquin:</u>
Conservation Community Program
Natural Areas Stewardship Program
Environmental Education and Program

<u>Crystal Lake Park District:</u>
Nature Center Programs
- Field trips & Scout programs
- Traveling Naturalist
- Natural Resource Volunteer Program

<u>Crystal Lake:</u>
Nature-Focused Program
Water Conservation Program
Gold Leaf Award Program
Rain Barrel Incentives Campaign
"Crystal Clear for Crystal Lake"

<u>Lake in the Hills</u>
Lake Notes brochures
Nature Camps Program
Rainwater Reuse Program

This Page Intentionally Left Blank

Table 37. Information and Education Plan Matrix.

Education Action or Campaign	Target Audience	Package (vehicle)	Schedule	Lead and (Supporting) Organizations)	Outcomes/Behavior Change	Estimated Cost
Inform the general public, that a Watershed-Based Plan has been developed for Woods Creek watershed to gain interest in implementing recommended actions.	General Public	Use as many existing forms of media such as YouTube, social media, newsletters, websites, and newspapers to inform the public about plan and ways that the public can obtain the plan and help implement projects.	Immediately following plan completion	WCWC; (Municipalities; CLPD)	The majority of the public in the watershed have excellent knowledge of the watershed conditions and who to contact to get involved and implement projects. The public also begins to alter every day activities leading to watershed improvement.	No cost if using existing resources
Educate the public on water supply as it relates to groundwater recharge, potential contamination, and the link between how property owners manage the land.	General Public	Offer a "Groundwater Recharge and Quality Event Day" that includes educational workshops and field trips around the watershed to educate the general public about groundwater and ways to change everyday activities to promote recharge and water quality.	Once every five years	WCWC; Municipalities (KCDD; MCPDD; SWCD; FREP)	"Event" day attendees understand the importance of groundwater recharge and quality and begin to change everyday activities. By doing this neighbors and others become aware and also change.	$3,000 per event
Educate the general public on the benefits of ecological/natural area restoration and management.	General Public; Homeowners	Offer outdoor workshops at existing ecological restoration sites to help the general public and homeowners understand how removing non-native species and replacing with native vegetation or how streambank stabilization benefits water quality, wildlife habitat, and green infrastructure. Also invite native plant nursery specialist to help the general public identify and choose appropriate native plants and trees for use in home landscaping and where to purchase them.	Once every five years	Municipalities; CLPD (FREP, USDA; SWCD; TLC; Consultant)	The general public and homeowners become more aware of the use of native plants and their benefits in ecological restoration. When visiting a nursery, homeowners are able to identify native plants or go to nurseries or plant sales that specialize in native plants. Homeowners certify backyard restorations under Conservation@Home or the National Wildlife Federation-Backyard Wildlife Habitat Certification Program.	$2,000 per event
Educate private land owners along Woods Creek Lake and stream corridors how to properly manage land to benefit green infrastructure.	Private land owner along Woods Creek Lake & Stream Reaches	Conduct workshops for riparian and lake shoreline owners that recommends bioengineering options, funding sources, and qualified contractors for stabilizing eroded banks and establishing and managing a natural buffer. Distribute "Riparian Area Management Guide for Citizens" (developed by Lake County Stormwater Management Commission).	Once every five years	Consultant (USDA; USACE; TLC; LITH)	Private landowners along Woods Creek Lake and stream corridors recognize the benefits of bioengineering to reduce bank erosion and how natural buffers improve water quality and wildlife habitat as part of green infrastructure.	$3,000 per event
Provide schools with information about Woods Creek watershed as a means to support outdoor curriculum within the watershed's green infrastructure.	Teachers/ Students	Provide schools with copies of the Woods Creek watershed Executive Summary to educate students about watershed planning and the importance of green infrastructure to improve overall watershed conditions. Integrate basic watershed planning and education into existing elementary, middle, and high school science curriculum and provide professional speakers.	As requested from schools	WCWC (Municipalities; CLPD)	All students that live in Woods Creek watershed or other surrounding watersheds will understand the environment in which they live and realize the importance of maintaining a healthy place for people and nature to live in harmony. What is learned will be passed on to parents and future generations.	$6,000 for 300 copies of Executive Summary
Educate all stakeholders about the best alternatives or management of phosphorus use on lawns.	All Stakeholders	Use media to communicate to a wider variety of landowners the negative impacts of using fertilizer high in phosphorus. Provide free soil testing for landowners to determine if phosphorus is needed on lawns.	Publicize annually and soil testing as requested	Municipalities; USDA (CLPD; TLC; FREP)	The majority of landowners begin to use fertilizer with appropriate phosphorus content thereby reducing phosphorus loading into stormsewers and downstream waterbodies.	$2,000 per event
Provide educational information on flood proofing to owners with structural flood problems.	Property owners with flooding	Conduct personalized site meetings with landowners to develop options to mitigate for flooding.	As requested by landowners	Municipalities (FEMA)	Professionals work with landowners to mitigate current problems with solutions that are appropriate. Homeowners in flood prone areas understand and keep an eye on future planning upstream to ensure flood problems do not increase.	No cost
Hold annual tour of watershed for elected officials and others interested in watershed activities.	Elected Officials; All Stakeholders	Offer an annual bus tour of Woods Creek watershed for elected officials and others to see the progress on ecological restoration, areas that need improvement, and failed projects.	Annually	Municipalities; CLPD	Elected officials become more familiar with existing and potential restoration projects and learn more about what is working and what is not. Decisions regarding future proposed projects are more informed.	$2,000 per event
Offer "Volunteer Days" related to stewardship activities in the watershed to the general public.	General Public	Offer "Volunteer Days" for people to remove invasive species from natural areas, survey wildlife, or clean up litter from streams.	One program annually	Municipalities; CLPD; TLC (Consultant)	By interacting with the natural areas within the watershed, people develop an invested interest in watershed protection.	$500 per event

Education Action or Campaign	Target Audience	Package (vehicle)	Schedule	Lead and (Supporting) Organizations	Outcomes/Behavior Change	Estimated Cost
Develop student project opportunities for high schools or college, boy scouts/girl scouts top service projects, etc.	Students	Offer ecological restoration and wildlife habitat project opportunities for students.	As requested by students or Scout leaders	Municipalities; CLPD; TLC; FREP; USDA	By understanding how ecological restoration and habitat improvement benefits the watershed, students develop an invested interest in watershed protection.	$500 per student
Implement demonstration projects, or highlight existing case studies within the watershed.	Elected Officials; General Public; All Stakeholders	Use as many forms of media such as radio, you-tube, social media, newsletters, websites, and newspapers to inform the public when and where demonstration projects are implemented.	Immediately following plan completion & when projects are implemented	WCWC; SWCD	The majority of the public in the watershed know about demonstration projects, their benefits, and where they are located. The public begins to accept and support watershed improvement projects.	$3,000 per project
Install Woods Creek "Watershed Boundary" signs along major roads in the watershed.	General Public	Design and install signs at key points along major roads in the watershed that inform drivers and passengers that they are "Entering Woods Creek Watershed". The signs should also contain a website or contact person.	Following plan completion	Municipalities; CLPD	Thousands of drivers/passengers see Woods Creek watershed signage when entering the watershed. This sparks enough interest for many individuals to search municipal and park district internet sites where they will find links to the Woods Creek watershed home page currently being maintained by the Village of Algonquin. The website will provide all relevant information about the watershed including an electronic copy of the plan and schedule of upcoming events.	$5,000 for five signs
Educate residents and businesses about the benefits of constructing rain gardens and using rain barrels to capture stormwater.	Businesses; Homeowners	WCWC co-host an outdoor workshop with The Land Conservancy of McHenry County to discuss siting, construction, and planting of rain gardens; also sell and discuss rain barrel use.	Once every three years	WCWC, TLC; SWCD (Consultant)	Residents and businesses learn of the water quality, flood reduction, aesthetic beauty, and wildlife benefits that rain gardens and use of rain barrels have and begin installing them.	$2,000 per event
Provide homeowner and business associations with the knowledge needed to maintain naturalized detention basins.	Business & Homeowners Associations	WCWC offer free workshops to business and homeowner associations that own naturalized detention basins. The workshops should stress maintenance of existing naturalized basins and retrofits to improve poorly functioning or poorly designed basins.	Once every two years	WCWC; Municipalities; (Consultant)	Business and homeowner associations realize potential benefits of naturalized detention basins to reduce flooding, improve water quality, and provide wildlife habitat and implement ongoing maintenance activities and retrofits of poorly designed/functioning basins.	$2,000 per workshop
Maintain the existing Woods Creek watershed information sharing website and link to partner websites.	All Stakeholders	Maintain existing Woods Creek watershed website to keep people informed about watershed issues and opportunities.	Ongoing	Algonquin	Website users have information related to the watershed including potential and ongoing projects, watershed problems & opportunities, unique features, funding opportunities, and a calendar of upcoming events. An electronic copy of the watershed plan will also be included on the website.	No Cost

Abbreviation	Entity	Abbreviation	Entity
Crystal Lake	City of Crystal Lake	School	School District
CLPD	Crystal Lake Park District	SWCD	Soil and Water Conservation District
Consultant	Ecological or other consultant	TLC	The Land Conservancy of McHenry County
FEMA	Flood Emergency Management Agency	USDA	USDA Natural Resources Conservation Service
FREP	Fox River Ecosystem Partnership	USFWS	US Fish and Wildlife Service
KCDD	Kane County Department of Development	Algonquin	Village of Algonquin
MCPDD	McHenry County Planning and Building Department	LITH	Village of Lake in the Hills
Municipalities	Algonquin, LITH, City of Crystal Lake	WCWC	Woods Creek Watershed Committee

7.0 PLAN IMPLEMENTATION

7.1 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 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 38. Appendix D includes additional information about each stakeholder and possible roles.

There are several important first steps that Woods Creek Watershed Committee (WCWC) partners will need to accomplish prior to plan implementation. The partners include the Village of Algonquin, Village of Lake in the Hills, City of Crystal Lake, and Crystal Lake Park District.

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

Table 38. Key Woods Creek watershed stakeholders/partners.

Watershed Stakeholder/Partner	Acronym/Abbreviation
Businesses	Business
City of Crystal Lake	Crystal Lake
Crystal Lake Park District	CLPD
Developers	Developer
Ecological Consultants	Consultant
Fox River Ecosystem Partnership	FREP
Golf Courses	GC
Illinois, McHenry, and Kane County Dept. of Transportation	DOTs
Illinois Environmental Protection Agency	IEPA
Kane County Development Department	KCDD
McHenry County Planning and Development Department	MCPDD
Residents or Owners	Resident/Owner
School Districts	School
The Land Conservancy of McHenry County	TLC
Townships (Algonquin, Dundee, Grafton, Rutland)	TWP
USDA Natural Resource Conservation Service (Kane and McHenry County)	USDA
US Army Corps of Engineers-Chicago Region	USACE
US Fish & Wildlife Service	USFWS
Village of Algonquin	Algonquin
Village of Lake in the Hills	LITH
Village of Lakewood	Lakewood
Woods Creek Watershed Committee	WCWC

7.2 Implementation Schedule

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. Critical Area and High priority 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 "Programmatic & Site Specific Management Measure" recommendation located in the Management Measures Action Plan (Section 5) contains a column with a recommended "Priority" and/or "Implementation Schedule" based on the short term for critical area (1-5 years) and high priority (1- 10 years) projects and 10-20+ years for medium and low priority project recommendations. Other recommendations such as maintenance activities have ongoing or as needed schedules. Projects related to development should occur as new development occurs or resumes. 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.

7.3 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 the Woods 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 biodiversity 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 granted following an application process. The Illinois EPA 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. A good example in Woods Creek watershed is the proposed Randall Road expansion project. McHenry County DOT's goal will be to widen the road but this work may be recognized by a partner organization as an opportunity to provide other benefits such as water quality improvement, flood reduction, or habitat improvement at nearby parcels. 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 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 Woods Creek watershed partners in implementing the Watershed 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. Partners attracted to one acquisition 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 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 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. The best example of a needed partnership in Woods Creek watershed is that between the Village of Lake in the Hills and the remainder of the partners. Woods Creek Lake is located in Lake in the Hills and receives water from nearly the entire watershed. So, any water quality improvement project located in other jurisdictions upstream from Woods Creek Lake should be supported in some fashion by Lake in the Hills.

8.0 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.

8.1 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. Water in Woods Creek Lake is currently monitored under Illinois EPA programs but no formal water quality monitoring plan is in place for Woods Creek or any of its tributaries.

Known water quality data collected in the past 10-15 years is summarized in Section 3.13. The Illinois EPA does not monitor Woods Creek and therefore does not list Woods Creek as being impaired for any Designated Uses. Recent water quality and habitat data for Woods Creek & tributaries collected by Algonquin and Applied Ecological Services, Inc (AES) indicates moderate overall impairment. Total phosphorus (TP), turbidity/total suspended solids (TSS: sediment), and habitat alteration (channelization) are the primary *Aquatic Life* Designated Use impairments for Woods Creek and tributaries.

Illinois EPA determined through its Volunteer Lake Monitoring Program (VLMP) and Ambient Lake Monitoring Program (ALMP) that Woods Creek Lake is impaired for not meeting all of its Designated Uses. Woods Creek Lake is non-supporting for *Fish Consumption* Designated Use because of high mercury levels and *Aesthetic Quality* Designated Use due to high total suspended solids (TSS: sediment), high total phosphorus (TP), and abundance of aquatic plants.

The water quality monitoring plan is designed to; 1) capture snapshots of water quality within streams and Woods Creek Lake through 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 critically important that all future monitoring be completed using the same protocol and methods used by the Illinois EPA for comparison and QAQC purposes.** Illinois EPA Quality Assurance Project Plans (QAPPs) and Standard Operating Procedures (SOPs) can be found at http://www.epa.state.il.us/water/water-quality/ methodology/index.html.

Physical and chemical water quality criteria and indicators in streams are typically measured during base flow and again after a significant (≥ 1.5 inches) storm event. Monitoring water quality in lakes and streams usually includes monitoring for nutrients, bacteria, suspended solids, water clarity, and dissolved oxygen to name a few. Water quality samples should be sent to certified labs to analyze chemical water quality samples or to municipal treatment plant labs with proper Illinois Lab Accreditation. Physical parameters, such as temperature, oxygen concentration, specific conductance, and pH, should be collected in the field using a portable data collection unit. It is also important to obtain stream discharge calculations when monitoring pollutant loading in streams. These calculations are easily obtained by measuring the stream width, average depth, and flow rate at the monitoring location. In addition, biological (fish and macroinvertebrates) and habitat assessments can also be performed depending on the criteria being assessed.

In the future, water quality sampling related to individual Management Measures should also be monitored if possible. Management Measure monitoring should include samples of water entering the measure and a second sample at the water leaving the measure such as a detention basin that has been retrofitted. It is best to complete Management Measure monitoring during or shortly after large rain events (≥ 1.5 inches) to obtain data on how well the practice works. Biological and habitat quality monitoring should also be part of any habitat improvement project, such as a stream restoration. Because funding for such monitoring is typically limited, money should be built into the initial Management Measure project budget.

Monitoring Plan Implementation

Procedures by which physical, chemical, and biological monitoring data should be collected in the watershed, recommended monitoring locations, monitoring entity, and monitoring frequency are outlined in Table 39 and Figure 58. Note: monitoring locations related to Management Measures is not described as this monitoring will come later as projects are implemented.

Table 39. Existing and recommended water quality and biological monitoring locations.

Site	Recommended or Existing Monitoring Entity	Sampling Location (See Figure 58)	Sampling Frequency	Parameters Tested
Existing Monitoring Programs				
Woods Creek Lake	Illinois EPA Volunteer Lakes Monitoring Program	2 sites on lake (IEPA # IL RTZZ 1w)	Annually	Physical; Chemical; Biological
Woods Creek Lake	Illinois EPA Ambient Lakes Monitoring Program	3 sites on lake (IEPA # IL RTZZ 1w)	Every 5 Years	Physical; Chemical; Biological
Woods Creek Lake	Illinois Department of Natural Resources	Entire lake	Every 5 Years	Biological (Fish)
Recommended Monitoring Programs				
Woods Creek & Tributaries	Cooperative effort between WCWC partners: Algonquin, Lake in the Hills, Crystal Lake, and Crystal Lake Park District	3 sites: Woods Creek @ Dennis Ave. and Ken Carpenter Park west of Randall Rd; Woods Creek Tributary @ Morningside Park	Every 5 Years	Physical and Chemical
Woods Creek	Jacobs High School Biology Department in cooperation with RiverWatch & WCWC	Woods Creek @ Bunker Hill Drive	Yearly	Physical, Chemical, Biological (Macroinvertebrates)
Individual Management Measures	Stakeholder in cooperation with Environmental Consultants	Varies: Specific to each measure	Pre and Post	Physical, Chemical, and Biological

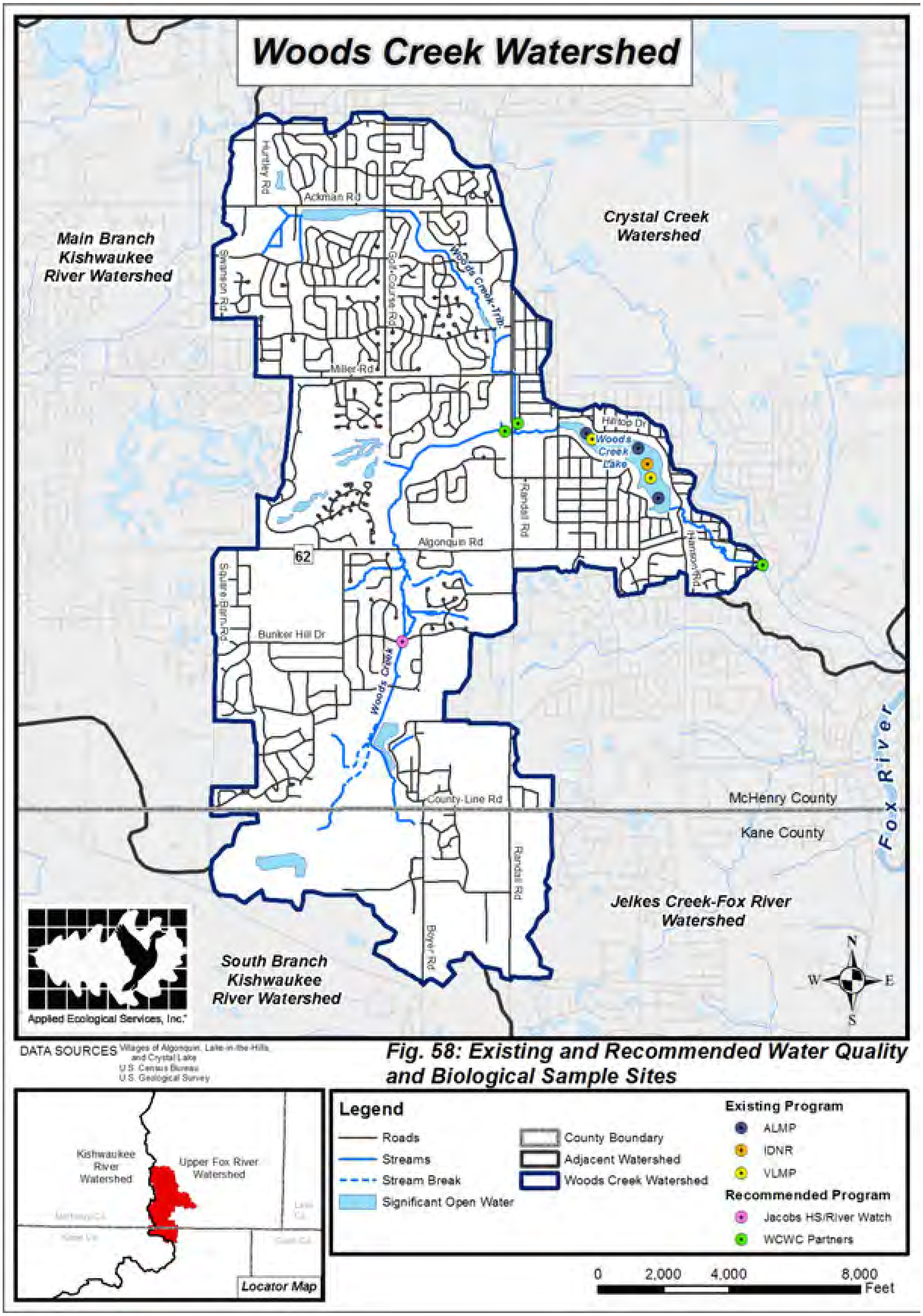


Fig. 58: Existing and Recommended Water Quality and Biological Sample Sites

Physical and Chemical Monitoring Methods & Recommendations

Physical and chemical monitoring of water can be time consuming and expensive depending on the complexity of the sampling 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.

Streams

Many different parameters can be included in physical monitoring of water quality in streams. Measurements of temperature, pH, conductivity, dissolved oxygen, turbidity should be collected in the field for any monitoring done on Woods Creek or tributaries 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.

Many different chemical parameters can be tested for in streams but it is recommended that testing only be completed for parameters outlined in Table 40. Unlike physical monitoring, chemical monitoring requires grab samples be collected and taken to certified labs for analysis. Future chemical monitoring in Woods Creek/tributaries should be done following significant rain events (≥ 1.5 inches) in order to capture storm event data that can be compared to baseline data and target pollutant values summarized in Section 4.0. This same monitoring technique can be used to determine pollutant removal efficiencies resulting from implementation of some Management Measures. It is also important to obtain stream discharge calculations at stream monitoring locations so that pollutant loads can be calculated if needed. Stream discharge is calculated by measuring the stream width, average depth, and flow rate (ft/sec) at the sample location.

It is crucial to collect representative water samples using careful handling procedures. 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, money can be saved by having one of the Woods Creek Watershed Committee (WCWC) partners analyze samples using a municipal water treatment plant lab if it has the proper certification. 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. The laboratory often provides the containers, ice chests for transport, labels, and chain-of-custody forms to the client as part of their service.

Two stream monitoring programs are recommended for Woods Creek watershed (Table 39). The first and most important monitoring effort should be implemented as a cooperative effort between the WCWC partners and occur every 5 years at three separate stream locations as shown on Figure 58. Monitoring at these key locations will yield data over time that will indicate if pollutants in the watershed are being reduced to target levels, are staying the same, or increasing.

The second recommended monitoring effort should be conducted by Jacobs High School Biology Department in cooperation with Illinois RiverWatch and WCWC partners. Monitoring should occur annually at one location as defined in Table 39 and Figure 58. Physical water quality parameters can be collected in the field but chemical parameters should be analyzed using one of the WCWC municipal treatment labs. Macroinvertebrates should also be collected using RiverWatch protocol.

Table 40. Stream monitoring water quality 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	<12 mg/l	Plastic	32 oz	Cool 4 °C	7 days
Total Dissolved Solids	<1,000 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
Nitrate-Nitrite Nitrogen	<15.0 mg/l	Plastic	4 oz	Cool 4 °C 20% Sulfuric Acid	28 days
Total Phosphorus	<0.0725 mg/l: Streams <0.05 mg/l: Lakes	Plastic	4 oz	Cool 4 °C 20% Sulfuric Acid	28 days
Chloride	<500 mg/l	Plastic	32 oz	Cool 4 °C	28 days

Lakes

Most water quality samples related to pollutant loading are obtained from streams because the data provides estimates of pollutant loading following storm events. In lakes however, the water is usually slow to cycle through the system and different techniques are needed to assess water quality. In addition to collecting many of the parameters included in Table 40, biologists and limnologists often use "productivity" of a lake to assess its health. Productivity is measured via the Trophic State Index (TSI), an index that uses phosphorus and chlorophyll concentrations as the primary means to assess lake health. The state of Illinois set the standard for Total Phosphorus (TP) at 0.05 mg/l for lakes. When phosphorus levels exceed 0.05 mg/l, lake-wide algal blooms can occur leading to decreased water clarity, decreased light penetration, and increased total suspended solids.

The work required to collect physical and chemical data and develop TSI values for Woods Creek Lake is currently being done by Illinois EPA under the Volunteer Lakes Monitoring Program (VLMP) and Ambient Lakes Monitoring Program (ALMP). This monitoring should continue in the future on an annual basis for VLMP and every five years for ALMP.

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 (fish Index of Biotic Integrity (fIBI)) and macroinvertebrates (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 to simply assess resource quality in a stream reach. With this said, it is not recommended that fish be sampled in the streams and tributaries upstream from Woods Creek Lake because the dam on the east end of the lake is a barrier that prevents the movement of fish that migrate out of the Fox River and Crystal Creek. The only location appropriate to conduct a stream fish survey is the reach of Woods Creek (WCR14) downstream from Woods Creek Lake and south of Algonquin Road, although this is not recommended as a monitoring program in this watershed plan.

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 reaches. 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 41). A manual for calculating IBI scores for streams in Illinois is available from IDNR. To reiterate, the only location appropriate to conduct a stream fish survey is the reach of Woods Creek (WCR14) downstream from Woods Creek Lake and south of Algonquin Road.

Macroinvertebrate Biotic Index (MBI)

The MBI is designed to rate water quality using 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 a MBI score less than 5.9 indicates a stream is not fully supporting *Aquatic Life* (Table 41). A manual for collecting and calculating MBI scores for streams is available from Illinois EPA.

Table 41. 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 IDNR 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. The QHEI is also used by the Illinois EPA to assess *Aquatic Life* use attainment in streams. The index can be used on any stream reach and on stream restoration projects to document improvements. Prior to stream restoration, a QHEI evaluation should be completed by the project ecologist or engineer. A follow-up QHEI for comparison purposes should be conducted by the same ecologist/engineer 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.

The QHEI was found to correlate well with biological integrity of streams in the Midwest. 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 42 summarizes QHEI score classifications. Stream restoration projects should strive to create conditions that produce QHEI scores of at least 60.

Table 42. 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

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.. To summarize, the SIDMA tool uses a seven step process to measure social indicators as shown in Figure 59.

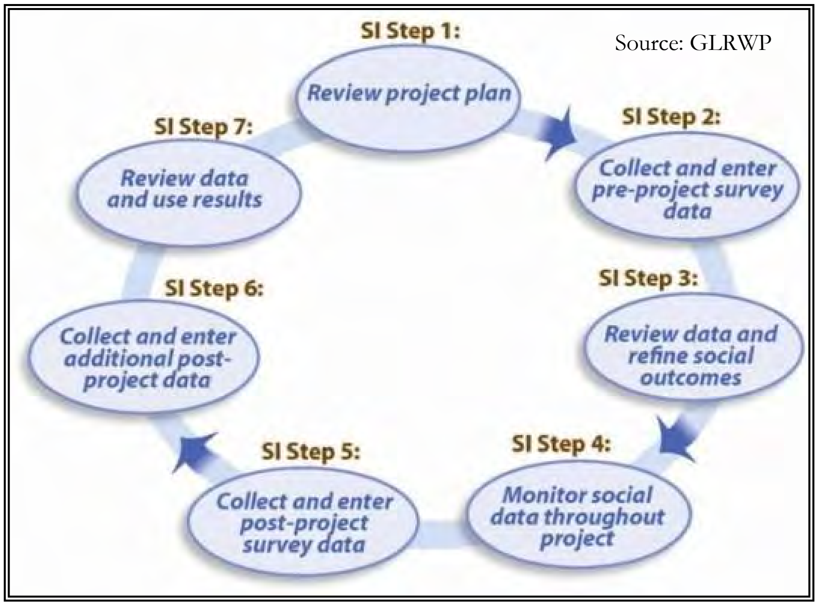


Figure 59. Steps to measure social indicators.

Several potential social indicators could be evaluated by the WCWC 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 43 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 43. Social indicators and measures related to understanding behavior toward water quality issues.

Social Indicator	Measure
1) Media Coverage	• # of radio broadcasts related to water quality protection • # of newspaper articles related to water quality protection
2) Citizen Awareness	• # 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 • # of requests to create public use areas with interpretive signage • % of stakeholders who are aware of watershed management information
3) Watershed Management Activities	• # of stream miles cleaned up per year • # of linear feet or miles of trails created or maintained each year • # of municipalities adopting watershed management plan • # of watershed groups implementing plan recommendations

Monitoring social indicators in the watershed should be the responsibility of WCWC. 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 followed by taking a randomized sample of individuals in the watershed from a phone directory or other means. Next, a survey should be developed that identifies citizens' perceptions of water quality problems and protection strategies. Citizens that respond to the survey should be 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 improve social behavior.

Water Quality Evaluation Criteria

Water quality criteria (expressed as measurable indicators & targets) need to be developed so that water quality objectives can be evaluated over time. The criteria are designed to be compared against data gathered from the Water Quality Monitoring Plan as well as other data and 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 2.0 of this plan includes a water quality goal (Goal E) with nine objectives. Criteria are selected for each water quality objective to determine whether components of the water quality goal are being met (Table 44). 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 4.0. Future evaluation of the criteria will allow WCWC 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 Subsection 8.2.

Table 44. Set of criteria related to water quality objectives.

GOAL E: Improve and monitor surface water quality.	
Water Quality Objective	**Criteria: Indicators and Targets**
1) Stabilize 8,960 linear feet of highly eroded streambank using bioengineering techniques.	• *Linear Feet of Restored Streambank:* "Critical Area" and high priority stream restoration projects implemented. • *Chemical & Physical Water Quality Standards:* <20 NTUs, <12 mg/l TSS, and <0.0725 mg/l TP in stream water quality samples. • *Trophic State Index:* Trophic State does not exceed "Eutrophic" in Woods Creek Lake. • *Biotic Indexes:* Macroinvertebrate communities achieve at least "Fair" resource quality. • *Social Indicator:* >50% of surveyed citizens know that streambank erosion is a problem in the watershed and are aware of and support streambank stabilization efforts.
2) Stabilize 846 linear feet of severely eroded shoreline along Woods Creek Lake using bioengineering techniques.	• *Linear Feet of Restored Shoreline:* "Critical Area" shoreline stabilization project implemented. • *Chemical & Physical Water Quality Standards:* <14 NTUs, <12 mg/l TSS in Woods Creek Lake water quality samples. • *Social Indicator:* >75% of surveyed Woods Creek Lake residents know that shoreline erosion is a problem in select areas and are aware of and support shoreline stabilization efforts.
3) Restore 50 acres of wetland within "Critical Area" potential wetland restoration sites.	• *Acres of Wetland Restoration:* "Critical Area" wetland restoration projects implemented. • *Social Indicator:* >50% of surveyed citizens know the importance of wetlands and support wetland restoration projects.

Water Quality Objective	Criteria: Indicators and Targets
4) Install natural shoreline buffers along private residential lots around Woods Creek Lake.	• *# of Lots with Buffers:* Implement at least 25 lake buffer improvement projects along private residential lots. • *Social Indicator:* >25% of surveyed lake residents know the importance of having and maintaining a natural buffer and would be willing to implement buffer projects.
5) Complete mercury analysis/ management study for Woods Creek Lake.	• *Mercury Management Study:* Complete mercury management study within 5 years.
6) Use best management practices when applying road salt during winter months.	• *Chloride (salt):* Less than 500 mg/l in stream or Woods Creek Lake samples. • *# of Municipalities using Alternatives:* All local communities experiment with at least one alternative to road salt and apply salt using best management practices. • *Social Indicator:* >75% of surveyed citizens know that salt degrades water quality and use best management application practices when applying around homes and businesses.
7) Manage overuse of phosphorus based on soil testing recommendations and Illinois Phosphorus Law.	• *Chemical Water Quality Standards:* <0.0751 mg/l TP in streams and <0.05 mg/l TP in lakes based on water quality samples. • *Trophic State Index:* Trophic State does not exceed "Eutrophic" in Woods Creek Lake. • *Social Indicator:* >25% of surveyed citizens and businesses know the current phosphorus level of their lawns and apply phosphorus based on these levels.
8) Retrofit all "Critical Area" and "High Priority" detention basins with native vegetation.	• *# of Detention Basin Retrofits*: All "Critical Area" and high priority detention basins retrofitted. • *Social Indicator:* >50% of surveyed stakeholders understand the water quality and habitat benefits created by retrofitting detention basins with native vegetation.
9) Implement the Water Quality Monitoring Plan section of the Woods Creek Watershed-Based Plan.	• *Monitoring Program:* IEPA (VLMP & ALMP) continue monitoring Woods Creek Lake. • *Monitoring Program:* IDNR continue fish surveys of Woods Creek Lake every 5 years. • *Monitoring Program:* WCWC partners establish Woods Creek/Tributaries monitoring program by 2017. • *Monitoring Program:* Jacobs HS w/RiverWatch & WCWC establish monitoring program on Woods Creek by 2014.

8.2 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 periodic plan updates and changes that 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 volunteer stakeholder participation to get projects completed, and must include a feedback mechanism to measure progress toward meeting goals. Watershed "Report Cards", developed specifically for the 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 eight plan goals and are located at the end of this section. The milestones are based on "Critical Term" (1-5 years (2013-2017)), "Short Term" (1-10 years (2013-2022)), and "Long Term" (10-20 years (2023-2032) 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 Woods Creek Watershed Committee (WCWC) should assign or hire a Watershed Implementation Coordinator to 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 the 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).

Goal A Report Card

Identify, protect, and manage the Green Infrastructure Network.

Historic and Current Condition:

- The historic landscape was a mix of prairie, savanna, and wetland prior to European settlement in the 1830s.
- In 2012, medium density residential comprises the most acreage in the watershed (1,812.3 acres; 32.9%) followed by transportation (753.1 acres; 13.7%), and commercial/retail (458.3 acres; 8.3%). Only 404.9 acres (7.4%) of wetlands remain.
- The largest loss of a land use/land cover is predicted to occur on agricultural land (-293.6 acres; -5.3%) in the next 30 years.
- A parcel level inventory found that green infrastructure comprises over 2,000 acres or nearly 40% of the watershed.
- Several Ecologically Significant Areas remain as green infrastructure: 5 ADID wetlands, Spella Park wetland, 2 McNAI sites.

Criteria to Meet Goal Objectives:

- # of communities incorporating Green Infrastructure Plan into Comprehensive Plans and development review maps.
- # of new developments on "Priority Green Infrastructure Protection Areas" that incorporate Conservation Design.
- % of protected green infrastructure parcels harboring "Ecologically Significant Areas" or T&E species.
- % of public natural area Green Infrastructure Network parcels with management plans that are implemented.
- Dollars leveraged from road expansion projects used to fund green infrastructure management.

Goal Milestones:	Grade
1-5 Yrs: *(Critical)* 1) The Green Infrastructure Plan is incorporated into all municipal Comp Plans and development reviews. 2) All "Priority Green Infrastructure Protection Area" recommendations are followed. 3) Management plans are developed for all of public natural area Green Infrastructure Network parcels. 4) >$100K is leveraged from road & other infrastructure projects for green infrastructure management.	
1-10 Yrs: *(Short)* 1) At least 50% of sites with Ecologically Significant Areas or T&E species are protected. 2) All "Priority Green Infrastructure Protection Areas" recommendations are followed. 3) All management plans developed for public natural area Green Infrastructure Network parcels are implemented. 4) >$200K is leveraged from road & other infrastructure projects for green infrastructure management.	
10-20 Yrs *(Long)* 1) At least 75% of sites with Ecologically Significant Areas or T&E species are protected. 2) All "Priority Green Infrastructure Protection Area" recommendations are followed. 3) All management plans developed for public natural area Green Infrastructure Network parcels are updated and implemented. 4) >$400K is leveraged from road & other infrastructure projects for green infrastructure management.	

Monitoring Needs/Efforts:

- Track number of communities that incorporate Green Infrastructure Plan into Comp Plans and development reviews.
- Track new developments on "Priority Green Infrastructure Protection Areas" that incorporate Conservation Design.
- Track number of protected parcels with "Ecologically Significant Areas" or T&E species.
- Track number of green infrastructure natural areas with management plans and those where implementation has occurred.
- Track dollars levered from road & other infrastructure projects that is used to manage green infrastructure.

Remedial Actions:

- Find out why a community does not include the Green Infrastructure Plan in Comp Plans and development reviews.
- Reassess municipal budgets for green infrastructure protection efforts and adjust if necessary.
- Check permitting process to ensure "Priority Green Infrastructure Protection Area" recommendations are considered.
- Determine if an attempt was made to leverage money from road & other infrastructure projects.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

Goal B Report Card

Create policy to protect watershed resources from the impacts of future development.

Current Policy and Regulations:

- Various levels of watershed protection policy and regulations exist for Woods Creek watershed.
  - Land development is regulated by county Stormwater Ordinances.
  - Other entities with watershed jurisdictional or technical advisory roles include the USACE, USFWS and IDNR, and the McHenry and Kane Soil and Water Conservation Districts (SWCDs).
  - Municipalities in the watershed may or may not provide additional watershed protection above and beyond existing county watershed ordinances under local Village Codes.
  - The Illinois EPA Bureau of Water regulates wastewater and stormwater discharges to streams and lakes via the National Pollutant Discharge Elimination System (NPDES) program.

Criteria to Meet Goal Objectives:

- # of municipalities that adopt the Woods Creek Watershed-Based Plan.
- # of municipal ordinances that include a protection overlay requiring Conservation Design on green infrastructure parcels.
- % of new developments where protection, restoration, and/or donation of natural areas is required.
- Policy is in place that requires Development Impact Fees/Special Service Area taxes used to fund green infrastructure.
- % of surveyed stakeholders who changed phosphorus use on IL Phosphorus Law policy.
- % of watershed partners who actively use the watershed plan for policy purposes.

Goal Milestones:	**Grade**
1-5 Yrs: *(Critical)* 1) All municipalities in the watershed adopt the Woods Creek Watershed-Based Plan. 2) All municipal ordinances include a watershed protection overlay that specifically requires some degree of Conservation Design for all development located on green infrastructure parcels. 3) Each municipality creates policy that requires Development Impact Fees/Special Service Area taxes.	
1-10 Yrs: *(Short)* 1) >50% of new developments protect, restore, and/or donate natural areas to the appropriate management agency. 2) All watershed partners actively use the watershed plan for policy purposes. 3) >25% of surveyed stakeholders recognize IL Phosphorus Laws and reduce phosphorus use on lawns.	
10-20 Yrs: *(Long)* 1) All municipalities include policy recommendations in Comp Plan and ordinance updates. 2) >50% of surveyed stakeholders recognize IL Phosphorus Laws and reduce phosphorus use on lawns.	

Monitoring Needs/Efforts:

- Track number of municipalities that adopt the Woods Creek Watershed-Based Plan.
- Track municipal ordinances that include Conservation Design policy on Green Infrastructure parcels.
- Each municipality track % of developments where natural areas are donated to appropriate agency for management.
- Track requirements of each municipality related to Impact Fees/SSAs that fund green infrastructure.
- Create stakeholder survey related to phosphorus use.
- Track number of municipalities that use the watershed plan for policy purposes.

Remedial Actions:

- Find out why a partner may not have adopted the Woods Creek Watershed-Based Plan or any of the policy recommendations and work with the partner(s) to address concerns.
- Find out how Impact Fees/SSAs are being collected and used to fund green infrastructure and work with partners to find appropriate natural area management companies.
- Offer free soil testing related to phosphorus use if surveys indicate no positive change.
- Work with partners to implement the watershed plan who do not have a professional on staff dedicated to this role.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

Goal C Report Card

Restore and manage aquatic and terrestrial habitat.

Current Condition:

- The historic landscape consisted of prairies, savannas, 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, and several streams were channelized.
- Several "Ecologically Significant Areas" remain within the watershed: 5 ADID wetlands, Spella Park wetland, 2 McNAI sites.
- Over 64% of stream length is moderately to high channelized; 62% of stream length is moderately to highly eroded.
- 269 acres (57%) of riparian corridor is in poor condition; 205 acres (43%) is average to good condition.
- 134 total detention basins, 9 (7%) provide "Good" ecological and water quality benefits, 34 (26%) provide "Fair" benefits, 91 (68%) basins provide "Poor" ecological/water quality benefits.
- Aquatic plant cover in Woods Creek Lake is 54%.

Criteria to Meet Goal Objectives:

- Percentage of natural area Green Infrastructure Network parcels with management plans that are implemented.
- Acres of riparian habitat managed, restored, or enhanced.
- Linear feet and/or number of stream reaches where habitat is enhanced.
- Percentage of good to fair ecological condition detention basins that are actively managed.
- Number of "Critical Area" and "High Priority" detention basins retrofitted with native vegetation.
- Overall aquatic plant cover in Woods Creek Lake less than 40%.

Goal Milestones:	**Grade**
1-5 Yrs: *(Critical)* 1) Management plans are developed for all of public natural area Green Infrastructure Network parcels. 2) ≥ 2 "Critical Area" stream reaches where habitat is enhanced. 3) >50% of all good to fair condition detention basins are managed. 4) ≥ 2 "Critical Area" detention basins retrofitted with native vegetation.	
1-10 Yrs: *(Short)* 1) All management plans for public natural area Green Infrastructure Network parcels are implemented. 2) >250 acres of riparian habitat is managed, restored, or enhanced. 3) ≥ 2 "Critical Area" or "High Priority" stream reaches where habitat is enhanced. 4) >75% of all good to fair condition detention basins are managed. 5) ≥ 4 "Critical Area" or "High Priority" detention basins retrofitted with native vegetation. 6) Aquatic plant cover in Woods Creek Lake is maintained at less than 40%.	
10-20 Yrs: *(Long)* 1) All management plans for public natural area Green Infrastructure Network parcels are updated and implemented. 2) >100 additional acres of riparian habitat is managed, restored, or enhanced. 3) ≥ 4 "Critical Area" or "High Priority" stream reaches where habitat is enhanced. 4) All good to fair condition detention basins are managed. 5) ≥ 10 "Critical Area" detention basins retrofitted with native vegetation. 6) Aquatic plant cover in Woods Creek Lake is maintained at less than 40%.	

Monitoring Needs/Efforts:

- Public entities track % and acres of natural green infrastructure areas where management plans have been developed and implemented.
- Track total linear feet of stream or number of stream reaches where habitat is enhanced.
- Track number of good to fair condition detention basins that are managed.
- Track number of "Critical Area" and "High Priority" detention basins retrofitted with native vegetation.
- IDNR and VLMP continue to estimate aquatic plant cover in Woods Creek Lake during scheduled inventories.

Remedial Actions:

- Public entities prepare annual budgets for restoring habitat and leverage mitigation dollars from proposed road expansions.
- Assist detention basin owners with selecting ecological management companies and potential funding sources.
- Meet with IDNR or VLMP prior to Woods Creek Lake surveys and request an inventory of aquatic plant cover.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

Goal D Report Card

Provide watershed educational opportunities.

Current Condition:

- The Village of Algonquin is currently spearheading and promoting the Watershed-Based Plan. Crystal Lake Park District, Crystal Lake, and Lake in the Hills are the other partners involved.
- The watershed partners: Algonquin, Crystal Lake Park District, Crystal Lake, and Lake in the Hills currently promote appreciation and stewardship of the watershed through many education and volunteer campaigns.
- Education will be ongoing and involve constant and continuous campaigns to reach as many target audiences as possible.

Criteria to Meet Goal Objectives:

- Number of ways taken to inform the general public that a watershed plan has been developed.
- Number of people that attend campaigns aimed at land management links to watershed impacts, benefits of ecological restoration, and benefits of managing green infrastructure.
- Number of people that attend education campaigns related to management of phosphorus and road salt use.
- Number of elected officials that attend watershed tours.
- Number of people attending "Volunteer Days" in the watershed.
- Number of school or boy/girl scout service projects.
- Number of demonstration projects implemented.

Goal Milestones:	**Grade**
1-5 Yrs: (Critical) 1) Watershed partners inform public about the watershed plan via media and watershed activity campaigns. 2) At least one elected official representing each watershed partner attend a watershed tour. 3) $\geq$2 demonstration projects are implemented.	
1-10 Yrs: (Short) 1) $\geq$20 people attend each land management, ecological restoration, and green infrastructure campaign. 2) $\geq$30 people attend each phosphorus and road salt education campaign. 3) At least two elected officials representing each watershed partner attend a watershed tour. 4) $\geq$50 people attend each "Volunteer Days" event. 5) $\geq$5 school or boy/girl scout projects are supported by watershed partners. 6) $\geq$4 demonstration projects are implemented.	
10-20 Yrs: (Long) 1) $\geq$20 people attend each land management, ecological restoration, and green infrastructure campaign. 2) $\geq$50 people attend each "Volunteer Days" event. 3) $\geq$5 school or boy/girl scout projects are supported by watershed partners. 4) $\geq$4 demonstration projects are implemented.	

Monitoring Needs/Efforts:

- Track number of ways taken to inform general public that a watershed plan has been developed.
- Track number of people attending land management, ecological restoration, and green infrastructure campaigns.
- Track number of people that attend education campaigns related to management of phosphorus and road salt use.
- Track number of elected officials that attend each watershed tour.
- Track number of school and boy/girl scout projects supported.
- Track number of demonstration projects implemented.

Remedial Actions:

- Woods Creek Watershed Committee (WCWC) consider hiring a Watershed Implementation Coordinator to organize education programs.
- Ask state, county, and government agencies such as IDNR, NRCS, and Conservation Districts to sponsor workshops.
- Actively pursue target audiences if attendance at education campaigns is low.
- Put out requests for volunteers to spearhead watershed education campaigns.
- Contact elected officials with a personal invite to attend watershed tours.
- Provide access and signage for all watershed improvement projects to promote them as demonstrations.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and $<$ 40% = failed.

Goal E and F Report Card

Improve and monitor surface water quality.
Improve groundwater recharge.

Current Conditions:

- Water quality in Woods Creek is generally fair based on collected data. All parameters tested meet recommend standards during base flow conditions. However, total phosphorus, and total suspended solids exceed recommended standards following significant storm events just upstream of Woods Creek Lake; streambank erosion is a primary cause.
- Woods Creek Lake is fully supporting for aquatic life but impaired for fish consumption because of high mercury levels, and impaired for aesthetic quality because of total suspended solids, total phosphorus, and aquatic plants.
- Sensitive Aquifer Recharge Areas: 4,535 acres (82%) is "Low to Moderate" sensitive, 520 acres (10%) is "Moderately High" sensitive, and 453 acres (8%) has "High" potential for aquifer recharge.
- ISWS modeling shows significantly lower levels of stream discharge (-40% to -60%) and significant shallow bedrock aquifer drawdown (70 to 100 feet) by 2049 compared to predevelopment conditions.

Criteria to Meet Goal Objectives:

- Linear feet of restored streambank and lake shoreline.
- Acres of wetland restoration.
- Mercury management study completed for Woods Creek Lake?
- Number of entities using alternatives to road salt.
- % of surveyed stakeholders who changed phosphorus use on lawns based on soil testing.
- Number of detention basins retrofitted with native vegetation.
- Water quality monitoring plan in place; chemical water quality standards: <20 NTUs, <12 mg/l TSS, <0.0725 mg/l TP.
- % of Sensitive Aquifer Recharge Areas (SARA) developed using model policies in county "Groundwater Protection Plans".

Goal Milestones:	Grade
1-5 Yrs: *(Critical)* 1) Construction plans developed for all "Critical Area" and "High Priority" streambank restoration projects. 2) Construction plans developed for eroded shorelines at five LITH parks along Woods Creek Lake. 3) A mercury study is completed for Woods Creek Lake. 4) The municipalities in the watershed implement recommended water quality monitoring plan. 5) All municipalities adopt policy that protects Sensitive Aquifer Recharge Areas (SARA).	
1-10 Yrs: *(Short)* 1) All "Critical Area" and "High Priority" streambank restoration projects implemented. 2) Shorelines at all five LITH parks along Woods Creek Lake stabilized. 3) "Critical Area" wetlands are restored on all parcels where new development occurs. 4) Actions included in the mercury study are implemented by LITH. 5) Alternatives to road salt are used by all municipalities. 6) 25% of surveyed stakeholders reduce phosphorus use on lawns based on soil testing. 7) All "Critical Area" detention basins are retrofitted with native vegetation.	
10-20 Yrs: *(Long)* 1) > 25 residential lots along Woods Creek Lake have restored shoreline. 2) "Critical Area" wetlands are restored on all parcels where new development occurs. 3) Alternatives to road salt are used by all municipalities and DOTs. 4) 50% of surveyed stakeholders reduce phosphorus use on lawns based on soil testing. 5) All "High Priority" detention basins are retrofitted with native vegetation. 6) Water quality monitoring indicates <20 NTUs, <12 mg/l TSS, <0.0725 mg/l TP in Woods Creek.	

Monitoring Needs/Efforts:

- Water chemistry will need to continue indefinitely to track changes in water quality.
- Track # of streambank, shoreline, wetland, and detention retrofit projects implemented.
- Produce stakeholder survey related to phosphorus use on lawns.

Remedial Actions:

- Assess number of projects and actions that have been implemented versus water quality changes to determine if projects are effectively removing pollutants.
- Review policy changes made to protect Sensitive Aquifer Recharge Areas (SARS).

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

<table>
<tr><th colspan="2">Goal G Report Card
Increase and/or improve recreational opportunities</th></tr>
<tr><td colspan="2">Current Conditions:
• Biking path/trails are abundant in the watershed, especially along the Woods Creek and Woods Creek Tributary. However, there are areas that lack connectivity.
• The primary fishing opportunities are found at Woods Creek Lake and Woodscreek Park. Fishing along Woods Creek is limited.
• Many publically owned detention basins in the watershed currently support fish and could be improved for fishing access.
• The watershed partners: Algonquin, Crystal Lake Park District, Crystal Lake, and Lake in the Hills currently provide a wide variety of recreational opportunities via local programs and campaigns.</td></tr>
<tr><td colspan="2">Criteria to Meet Goal Objectives:
• Number of bike path/trail connections made.
• Number of detention basins and stream reaches where fishing access is created or improved.
• Number of new recreation areas or enhancements to existing areas that protect and incorporate green infrastructure.</td></tr>
<tr><td>Goal Milestones:</td><td>Grade</td></tr>
<tr><td>1-5 Yrs: 1) Plan is developed for bike path/trail connection at County Line Rd. to Boyer Rd. to Harnish Dr.
(Critical) 2) One publically owned detention basin is improved to support fishing.</td><td></td></tr>
<tr><td>1-10 Yrs: 1) Bike path/trail connection at County Line Rd. to Boyer Rd. to Harnish Dr. is implemented.
(Short) 2) Two publically owned detention basins and one stream reach along Woods Creek is improved to support fishing.
3) All new recreation areas and improvements to existing areas incorporates green infrastructure amenities.</td><td></td></tr>
<tr><td>10-20 Yrs: 1) All new recreation areas and improvements to existing areas incorporates green infrastructure amenities.
(Long) 2) All new residential developments that include detentions incorporate fishing access.</td><td></td></tr>
<tr><td colspan="2">Monitoring Needs/Efforts:
• Track number of bike path/trail connections made.
• Track number of detention basins and/or stream reaches where fishing access is created or improved.
• Track number of new recreation areas or enhancements to existing areas that protect and incorporate green infrastructure.</td></tr>
<tr><td colspan="2">Remedial Actions:
• Reassess municipal budgets related to recreation.
• Perform survey of publically owned basins and stream reaches where fishing opportunities can be created or improved.
• Require a planning/review step for new recreation areas or enhancements to existing areas that aims to protect and incorporate green infrastructure.</td></tr>
<tr><td colspan="2">Notes:</td></tr>
</table>

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

Goal H Report Card

Mitigate for existing structural flood problem areas.

Current Condition:

- Two documented Flood Problem Areas (FPAs) were identified in the Woods Creek watershed. FPA #1 is located at Wood Creek's intersection with Woods Creek Lane in the Village of Algonquin. During extremely high water events, Woods Creek overtops Woods Creek Lane. This happens because the culverts under Woods Creek Lane are likely undersized and Woods Creek Lane lies relatively low within the FEMA 100-year floodplain. Obvious mitigation opportunities include the construction of a conspan bridge over Woods Creek or increase in existing culvert size. The Village of Algonquin recently implemented a channel maintenance program in this area which is alleviating the flood problem to some degree.
- FPA #2 is located downstream from the dam on Woods Creek Lake between Hilltop Drive and Algonquin Road (Route 62) within the Village of Lake in the Hills. Overbank flooding causes structural damage to homes and other buildings located within FEMA's 100-year floodplain. Potential mitigation measures in this area are limited. Options include flood proofing individual structures, increasing flood storage volume upstream, and reducing impervious cover as new and re-development occurs upstream

Criteria to Meet Goal Objectives:

- Annual inspection of Dam at Woods Creek Lake by LITH.
- Number of stream restoration projects that reconnect the stream channel to the adjacent floodplain.
- % of new and redevelopment that incorporates impervious reduction stormwater measures.
- # of identified FPAs that are mitigated for.

Goal Milestones:	**Grade**
1-5 Yrs: *(Critical)* 1) The dam at Woods Creek Lake is inspected annually by LITH. 2) Stream reaches WCR2, WCR3, WCR5, WCR10, WCR11 and TRA1 are evaluated for potential to reconnect hydrologically to adjacent floodplain.	
1-10 Yrs: *(Short)* 1) The dam at Woods Creek Lake is inspected annually by LITH. 2) All "Priority Green Infrastructure Protection Areas" are developed using Conservation Design. 3) Mitigate for flooding at FPA #1. 4) At least one stream reach is modified to help the hydrologic connection to the adjacent floodplain.	
10-20 Yrs: *(Long)* 1) The dam at Woods Creek Lake is inspected annually by LITH. 2) All "Priority Green Infrastructure Protection Areas" are developed using Conservation Design. 3) At least one stream reach is modified to help the hydrologic connection to the adjacent floodplain.	

Monitoring Needs/Efforts:

- Track number of inspections of Woods Creek dam conducted by LITH.
- Track number of stream projects that include floodplain reconnection.
- Track number of new and redevelopments that incorporate impervious reduction stormwater measures.
- Track number of mitigated Flood Problem Areas

Remedial Actions:

- Reassess municipal budgets for green infrastructure protection efforts.
- Conduct follow-up visits to Flood Problem Area sites during flood events to determine if additional remedial work is needed.
- Conduct inventory of new and redevelopments to determine feasibility for potential flood reduction retrofits.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

9.0 LITERATURE CITED

Arendt, Randall. *Growing Greener: Putting Conservation into Local Plans and Codes*, Island Press, 1999.

Baxter & Woodman, Inc. and Planning and Management Consultants, Inc. November 2006 County of McHenry, Illinois- Groundwater Resources Management Plan: Report 1 Groundwater Resources Management Framework.

Benedict, Mark A. and Edward T. McMahan. Green Infrastructure: linking landscapes and communities. Washington: Island Press, 2006.

Booth, D. and L. Reinelt. 1993. Consequences of Urbanization on Aquatic Systems-measured effects, degradation thresholds, and corrective strategies, pp. 545-550 *cited in* Schueler, T. 1994. The Importance of Imperviousness. Watershed Protection Techniques. 1(3): 100-111.

Center for Watershed Protection. 1998. A Comprehensive Guide for Managing Urbanizing Watersheds. Prepared for USEPA Office of Wetlands, Oceans and Watersheds and Region V.

Chicago Metropolitan Agency for Planning. June 2007. Guidance for Developing Watershed Action Plans in Illinois.

City of Crystal Lake. 2001; currently being amended. 2030 Comprehensive Plan of City of Crystal Lake. Prepared by City of Crystal Lake Planning and Economic Development Department.

Crystal Lake Park District. December 2009. 2010-1014 Comprehensive Parks & Recreation Master Plan.

Daly, J., T. Lutes et. al. "Federal Township Plats of Illinois 1804-1891"Glaciation." Accessed July 11, 2011. http://landplats.ilsos.net/FTP_Illinois.html

Galli, J. 1990. Thermal impacts associated with urbanization and stormwater management best management practices. Metro. Wash. Counc. Gov., Maryland Dep. Environ. Washington, D.C. 188 pp *cited in* Schueler, T. 1994. The Importance of Imperviousness. Watershed Protection Techniques. 1(3): 100-111.

Hansel, A. "Glaciation." *Encyclopedia of Chicago*. Last modified 2005. Accessed June 30, 2011. http://www.encyclopedia.chicagohistory.org/pages/516.html

Illinois Department of Natural Resources-Division of Fisheries District 6. March 2009. Public Lake Fish Survey Report.

Illinois Pollution Control Board. 2011. Part 302: Water Quality Standards, Illinois Adm. Code 35: Environmental Protection. Chicago, IL.

Kane County. April 2012. Kane County's Draft 2040 Plan. Kane County Development & Community Services Dept.

Kelly, W. R., and S. D. Wilson., 2008. An Evaluation of Temporal Changes in Shallow Groundwater Quality in Northeastern Illinois Using Historical Data. Illinois State Water Survey Scientific Report 2008-01.

McHenry County. February 19, 2008. Addendum to McHenry County Subdivision Ordinance-Conservation Design Standards and Procedures.

McHenry County. October 2009. Groundwater Protection Action Plan-Section 1: Groundwater Recharge.

Meyer, S. C., H. A. Wehrmann, H. V. Knapp, Y-F. Lin, F. E. Glatfelter, D. Winstanley, J. R. Angel, J. F. Thomason, and D. Injerd., 2009b. Opportunities and Challenges of Meeting Water Demand in Northeastern Illinois. Illinois State Water Survey Contract Report (in preparation).

Michigan Department of Environmental Quality. June 1999. Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual.

Northeast Illinois Planning Commission, U.S. Department of the Interior, Fish and Wildlife Service, Chicago-Metro Wetlands Office & U.S. Environmental Protection Agency, Region 5. 1998. Advanced Identification (ADID) Study McHenry Co. Illinois.

Northeast Illinois Planning Commission, US Fish & Wildlife Service Chicago IL Field Office, U.S. Environmental Protection Agency, Region 5, and Kane County Department of Environmental Management. 2004. Advanced Identification (ADID) Study Kane Co. Illinois.

Ohio Environmental Protection Agency. 1999. Association between nutrients, habitat, and the aquatic biota in Ohio rivers and streams. Ohio EPA Technical Bulletin MAS/1999-1-1, Columbus.

Schueler, T. 1994. The Importance of Imperviousness. Watershed Protection Techniques. 1(3): 100-111.

United States Environmental Protection Agency. March 2008. Handbook for Developing Watershed Plans to Restore and Protect Our Waters. Office of Water-Nonpoint Source Control Branch. Washington, DC. EPA 841-B-08-002.

U.S. Department of Agriculture (USDA), 1979b. Soil Survey of Kane County, Illinois. Natural Resources Conservation Service, Soil Conservation Service, Washington, DC, April.

U.S. Department of Agriculture (USDA), 2002. Soil Survey of McHenry County, Illinois. Electronic Version, Natural Resources Conservation Service, Soil Conservation Service, Washington, DC, February.

United States Department of Agriculture. 1986. Technical Release 55 (TR-55). Urban Hydrology for Small Watersheds.

United States Environmental Protection Agency. December 2000. Ambient Water Quality Criteria Recommendations: Information Supporting the Development of State and Tribal Nutrient Criteria for Rivers and Streams in Nutrient Ecoregion VI. EPA 822-B-00-017.

United States Environmental Protection Agency. December 2000. Ambient Water Quality Criteria Recommendations: Information Supporting the Development of State and Tribal Nutrient Criteria for Lakes and Reservoirs in Nutrient Ecoregion VI. EPA 822-B-00-008.

United States Geological Survey in cooperation with United States Environmental Protection Agency. 2006. Present and Reference Concentrations and Yields of Suspended Sediment in Streams in the Great Lakes Region and Adjacent Areas

Village of Algonquin. 2001. Woods Creek Watershed Protection Plan. 61 Pages.

Village of Algonquin. 2008. Comprehensive Plan. Prepared by Village Staff, Teska Associates, Inc., Christopher B. Burke Engineering, Zukowski, Rogers, Flood & McArdle.

Village of Lake in the Hills. August 2000. Clean Lakes Program Phase I Diagnostic Feasibility Study of Woods Creek Lake, Lake in the Hills, Illinois. Prepared by Devery Engineering, Inc. with assistance from Blue Water Science in cooperation with Illinois Environmental Protection Agency.

Village of Lake-in-the-Hills. 2002; last amended Sept. 22, 2009. Lake-in-the-Hills 2002 Comprehensive Plan. Prepared by Planning Resources, Inc.

Waters, T.F. 1995. Sediment in Streams: Sources, Biological Effects, and Control. American Fisheries Society Monograph 7. Bethesda, Maryland, 251pp.

Wetzel, R.G. 1983. Limnology. Saunders College Publishing, Orlando, Florida. Pp. 289-297.

Zielinski, J. 2002. Watershed Vulnerability Analysis. Center for Watershed Protection. Ellicott City, MD, 22pp.

10.0 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): 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 Illinois EPA 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.

Base Flood Elevation (BFE): The elevation delineating the level of flooding resulting from the 100-year flood frequency elevation. (See also **Floodplain**.)

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 Measure**

Biodiversity: The variety of organisms (plants, animals and other life forms) that includes the totality of genes, species and ecosystems in a region.

Bio-infiltration (rain gardens): 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.

Biological Oxygen Demand (BOD): The amount of dissolved oxygen that is required by microscopic organism (e.g. bacteria) to decompose organic matter in waterbodies.

Biological Stream Characterization (BSC): A multi-tiered stream quality classification based primarily on the attributes of lotic (living in moving water) fish communities. The predominant stream quality indicator used in this process is the Index of Biotic Integrity (IBI), comprised of 12 metrics, which form a basis for describing the health or integrity of the fish community. When insufficient fishery data are available for calculating an IBI value, BSC criteria allow the use of sport fishing information or macroinvertebrate data to rate streams. BSC provides a uniform process of characterizing streams statewide and is used by a variety of sources for stream protection, restoration and planning efforts.

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).

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. In addition to being unsightly, channelized streams have a uniform gradient, no riffle and pool development, no meanders (curves) and very steep banks. The vegetation is frequently removed and replaced with riprap, concrete or other hard surfaces. During low flow periods in the summer, many channelized streams have low dissolved oxygen levels, in part due to shallow, slow-moving water. Under these conditions, they provide poor habitat for fish or other stream organisms such as benthic macroinvertebrates.

Channel: Any river, stream, creek, brook, branch, natural or artificial depression, ponded area, lakes, flowage, slough, ditch, conduit, culvert, gully, ravine, swale, wash, or natural or man-made drainageway, in or into which surface or groundwater flows, either perennially or intermittently.

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 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: EPA requirements that states and authorized Indian Tribes specify appropriate water uses to be achieved and protected. 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. Each water body does not necessarily require a unique set of uses. Instead, the characteristics necessary to support a use can be identified so that water bodies having those characteristics can be grouped together as supporting particular uses.

Detention basin: A man-made structure for the temporary storage of stormwater runoff with controlled release during or immediately following a storm.

Discharge (streamflow): The volume of water passing through a channel during a given time, usually measured in cubic feet per second.

Digital Elevation Model (DEM): Regularly spaced grid of elevation points used to produce elevation maps.

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 from channelization.

Drainage basin: Land surface region drained by a length of stream channel; usually 1,000 to 10,000 square miles in size.

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 potentially 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."

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 Insurance Rate Map (FIRM): A map prepared by the Federal Emergency Management Agency that depicts the special flood hazard area (SFHA) within a community. The FIRM includes zones for the 100-year and 500-year floodplains and may or may not depict Regulatory Floodways.

Flood problem area (FPA): One or more buildings, roads or other infrastructure in one location that are repeatedly damaged by flooding.

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 to that must be reserved to discharge the 100-year flood without increasing the water surface.

General Use Water Quality Standards (State): The Illinois Pollution Control Board (IPCB), a sister Agency to the Illinois EPA, develops water quality standards in Illinois. These standards serve to protect aquatic life, human health or wildlife, although wildlife based criteria have not yet been derived.

Geographic Information System (GIS): A computer-based approach to interpreting maps and images and applying them to problem-solving.

Glacial Drift: Earth and rocks which have been transported by moving ice or land ice.

Global Positioning System (GPS): Satellite mapping systems that enables locators and mapping to be created via satellite.

Grassland: An area such as a prairie or a meadow dominated by grass or grass-like vegetation.

Green infrastructure: 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 tributaries in a drainage basin.

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 inclusion soil: A soil unit (usually adjacent to hydric soils) that are not wet enough to form hydric properties but do have some hydric properties.

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.

Hydrograph: A way of measuring and graphing stream flow, or discharge, as it varies with time.

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 (Illinois EPA): 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/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.

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.

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): The IBI is based on fish surveys with the rating dependent on the abundance and composition of the fish species in a stream. Fish communities are useful for assessing stream quality because fish represent the upper level of the aquatic food chain and therefore reflect conditions in the lower levels of the food chain. Fish population characteristics are dependent on the physical habitat, hydrologic and chemical conditions of the stream, and are considered good indicators of overall stream quality because they reflect stress from both chemical pollution and habitat perturbations. For example, the presence of fish species that are intolerant of pollution are an indicator that water quality is good. The IBI is calculated on a scale of 12 to 60, the higher the score the better the stream quality.

Infiltration: That portion of rainfall or surface runoff that moves downward into the subsurface soil.

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).

Loess: A fine-grained unstratified accumulation of clay and silt deposited by wind.

Macroinvertebrates: 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. The method detects change in biological systems that result from the actions of human society. The MBI is very similar to the IBI except it is based on sampling macroinvertebrates (insects, worms etc.) that live in the stream rather than fish. The MBI scale is from 1 to 10, with 1 being the highest stream quality indicator and 10 being the worst. A MBI less than 5 on the 2004 revised scale indicates a good macroinvertebrate population. As with fish, the presence of pollution-intolerant macroinvertebrate species is an indicator of good water quality. Since macroinvertebrates are less mobile than fish, the MBI is a good index to evaluate upstream/downstream impacts of point source discharges.

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: see Terminal Moraine.

National Flood Insurance Program (NFIP): Managed by the Mitigation Division within the Federal Emergency Management Agency (FEMA), participants in the NFIP adopt and enforce floodplain management ordinances to reduce future flood damage and in exchange are eligible to receive federally funded flood insurance.

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 vegetation/plants: Plant species that have historically been found in an area.

Natural community: an assemblage of plants and animals interacting with one another in a particular ecosystem.

Natural divisions: Large land areas that are distinguished from each other by bedrock, glacial history, topography, soils, and distribution of plants and animals.

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 or NPSP): 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.

National Pollutant Discharge Elimination System (NPDES Phase II): Clean Water Act law requiring smaller communities and public entities that own and operate an 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

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: Any land that is not developed and is often set aside for conservation or recreation purposes. It can be either protected or unprotected. Protected open space differs from unprotected in that it is permanently preserved by outright ownership by a body chartered to permanently save land, or by a permanent deed restriction such as a conservation easement. Open space is important to a watershed's hydrology, habitat, water quality, and biodiversity.

Outwash: Sand and gravel deposits removed or washed out from a glacier.

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. They typically include private residences with acreage exceeding the surrounding minimum zoning, partly developed industrial sites, or institutions (churches, schools, etc.) with extensive grounds.

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.

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.

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.

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.

Remedial measures: Used to solve known watershed problems or to improve current watershed conditions. Remedial measures include retrofitting drainage system infrastructure such as detention basins and stormsewer outfalls to improve water quality, adjust release rates, or reduce erosion.

Remnant: a small fragmented portion of the former dominant vegetation or landscape which once covered the area before being cleared for human land use.

Retention facilities: A facility designed to completely retain a specified amount of stormwater runoff without release except by means of evaporation, infiltration or pumping.

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.

Section 319: see U.S. Environmental Protection Agency Section 319.

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.

Silt: Fine mineral particles intermediate in size between clay and sand.

Stakeholders: Individuals, organizations, or enterprises that have an interest or a share in a project. (see also Watershed Stakeholders).

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.

Stormsewershed: An area of land whose stormwater drains into a common storm sewer system.

Stream corridor: The area of land that runs parallel to a stream.

Stream reach: A stream segment having fairly 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.

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.

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.

Terminal moraines: 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.

Topography: The relative elevations of a landscape describing the configuration of its surface.

Total dissolved solids (TDS): A measure of the dissolved solids in water sample.

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.

Total Maximum Daily Load (TMDL): A TMDL is the highest amount of a particular pollutant discharge a waterbody can handle safely per day.

Trophic State Index (TSI): Trophic State is a measure of the degree of plant material in of 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 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.

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.

USDA TR55 Document: A single event rainfall-runoff hydrologic model designed for small watersheds and developed by the USDA, NRCS, and EPA.

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.

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.

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 stakeholder: A person who has a personal, professional, legal or economic interest in the watershed and the outcome of the watershed planning process.

Watershed partner(s): Key watershed stakeholders who take an active role in the watershed management planning process and implementing the watershed plan. Partners in Woods Creek watershed include Algonquin, Crystal Lake, Lake in the Hills, and Crystal Lake Park District.

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 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.

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.

Wet 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.