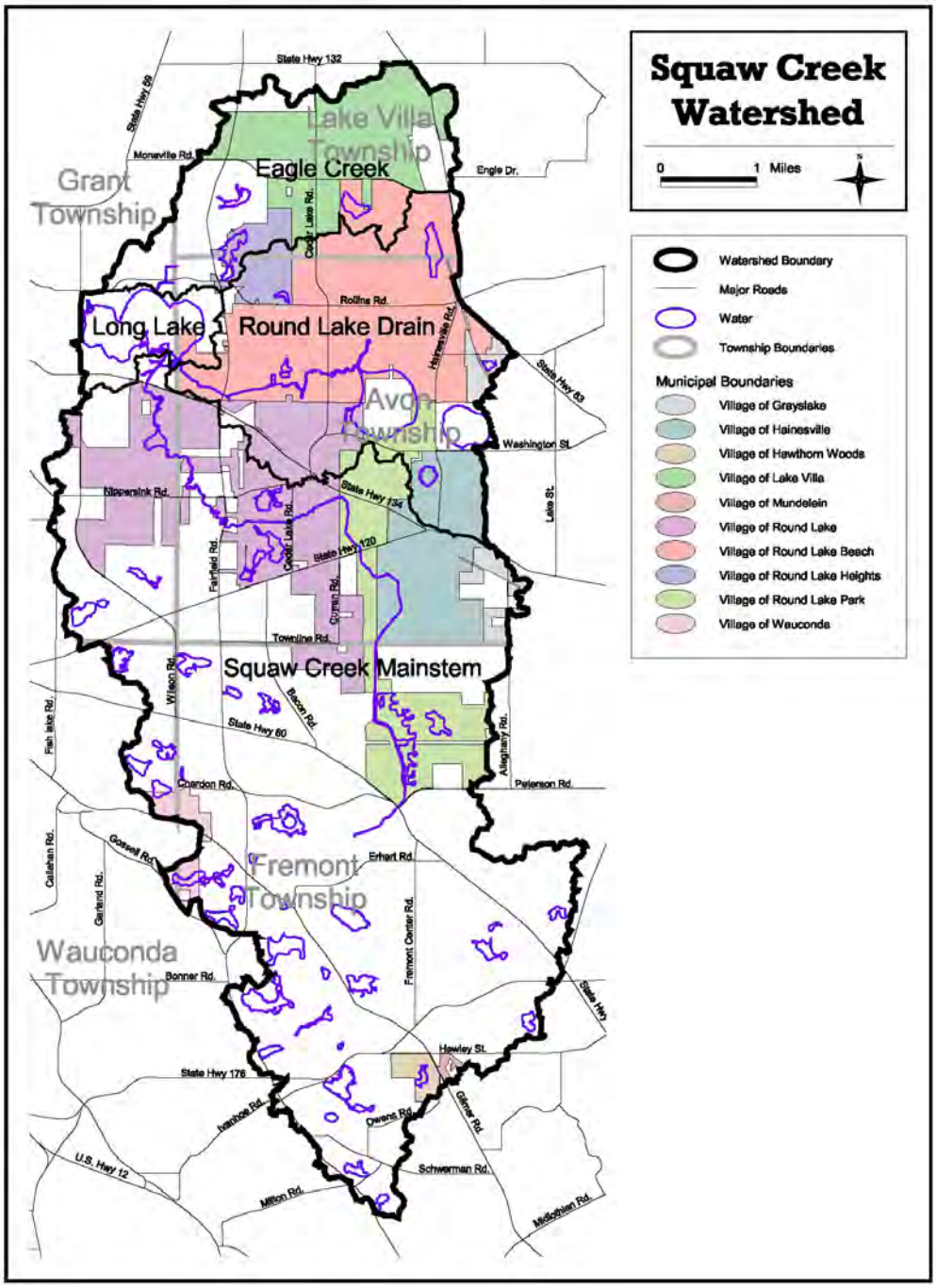
Squaw Creek Watershed Management Plan

May, 2004



Our mission is to develop a feasible management plan for the Squaw Creek watershed that balances all of the uses and demands on the watershed's natural resources in a manner that preserves and enhances a healthy environment, improves water quality, and reduces flood damages.

- Squaw Creek Watershed Planning Committee

Foreword

The Squaw Creek Watershed Management Plan was developed through a cooperative effort between the Lake County Stormwater Management Commission and representatives of the watershed's stakeholders. More than 20 different entities, ranging from homeowner's associations to municipal governments and county agencies, consistently attended monthly meetings during the planning process. Over 20 public meetings were held to solicit input from the stakeholder committee.

The Squaw Creek Watershed Management Plan was developed to provide a "blueprint" for reducing flood damages, improving water quality, and protecting natural resources in the watershed. The Plan is intended to assist private citizens and the local, State, and Federal units of government concerned with managing the water resources of this watershed in a cost-effective and environmentally sound manner.

The Plan contains a summary of data collected for the watershed, quantifies water resource-related problems, presents goals and objectives agreed upon by the stakeholder group, and presents a list of recommended actions for effectively managing the watershed's resources in concert with activities such as comprehensive planning, zoning, and transportation planning. The Plan provides a basis for inter-jurisdictional communication and coordination on water resources issues.

This Plan is an advisory document for stakeholders of the watershed, but we encourage stakeholders to endorse the Plan, utilize the document as a reference, and pursue implementation. This document does not contain subwatershed regulatory requirements, but instead provides proactive guidance on opportunities to balance the uses and demands on the watershed's resources to improve the quality of life for future generations.

Lake County Stormwater Management Commission

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Watershed Engineer

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Executive Director

Acknowledgements

The dedication and support of the Squaw Creek Watershed Planning Committee and other watershed stakeholders in the planning process made development of this plan possible. The Village of Round Lake and Fremont Township graciously hosted our planning committee meetings. Hey and Associates, Inc. assisted with data collection and plan preparation.

The following people generously gave their time to speak to the Planning Committee about water resources, flooding, environmental, and habitat issues: Tom Price - Conservation Design Forum; Dennis Sandquist - Lake County Planning, Building, and Development Department; Gary Hanline – Baxter Healthcare; and Sarah Nerenburg – Northeastern Illinois Planning Commission.

Funding for the Squaw Creek Watershed Management Plan was made available through the Lake County Stormwater Management Commission.

Squaw Creek Planning Committee

Name	Organization
Mike Adam	Lake County Health Dept. – Lakes Mgmt. Unit
Bonnie Thomson Carter	Lake County Board District 5
Curt Cashman	Village of Round Lake Beach
David Cassin	Lake County Soil and Water Conservation District
Russell Christian	Avon Township
Jennifer Filipiak	Lake County Forest Preserve District
Terry Foley	Village of Mundelein
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Suzanne Harris	Long Lake Improvement Association
Richard Hartman	Grant Township Territory Association
Al Hoekstra	Long Lake Improvement Association
John Huebner	Village of Round Lake
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Joe Rippel	Grant Township
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Dennis Sandquist	Lake County Planning, Building, and Development Department
Gary Schaefer	Hey and Associates, Inc.
Larry Scott	Village of Round Lake Park
Pete Tekampe	Fremont Township, Squaw Creek Drainage District

Squaw Creek Watershed Planning Committee – Corresponding Members
(Corresponding members did not attend planning meetings consistently but were included on the mailing list throughout the planning process)

Name	Organization
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Rich Hill	Village of Round Lake Beach
Jan Horton	Illinois Emergency Mgmt. Agency
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Yvonne Molidor	Squaw Creek Drainage District

Squaw Creek Watershed Planning Committee – Corresponding Members (continued)

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Dan Quick	Village of Wauconda
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Barbara Sheffer	Fox River EcoSystem Partnership
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Cindy Skrukrud	Friends of the Fox River
Kirk Smith	Village of Grayslake
Kay Starostovic	Grant Township
Janet Stecklein	Savanna Springs Homeowners Assn.
Sander Sundberg	Long Lake Improvmt. & Sanitation Assn.
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Nancy Williamson	IDNR – Region 2
Richard Wojcik	IDOT Div. of Highways
Al Valentin	Round Lake Sanitary District
Daniel B. Venturi	Lake Villa Township
Simon Zunamon	Resident

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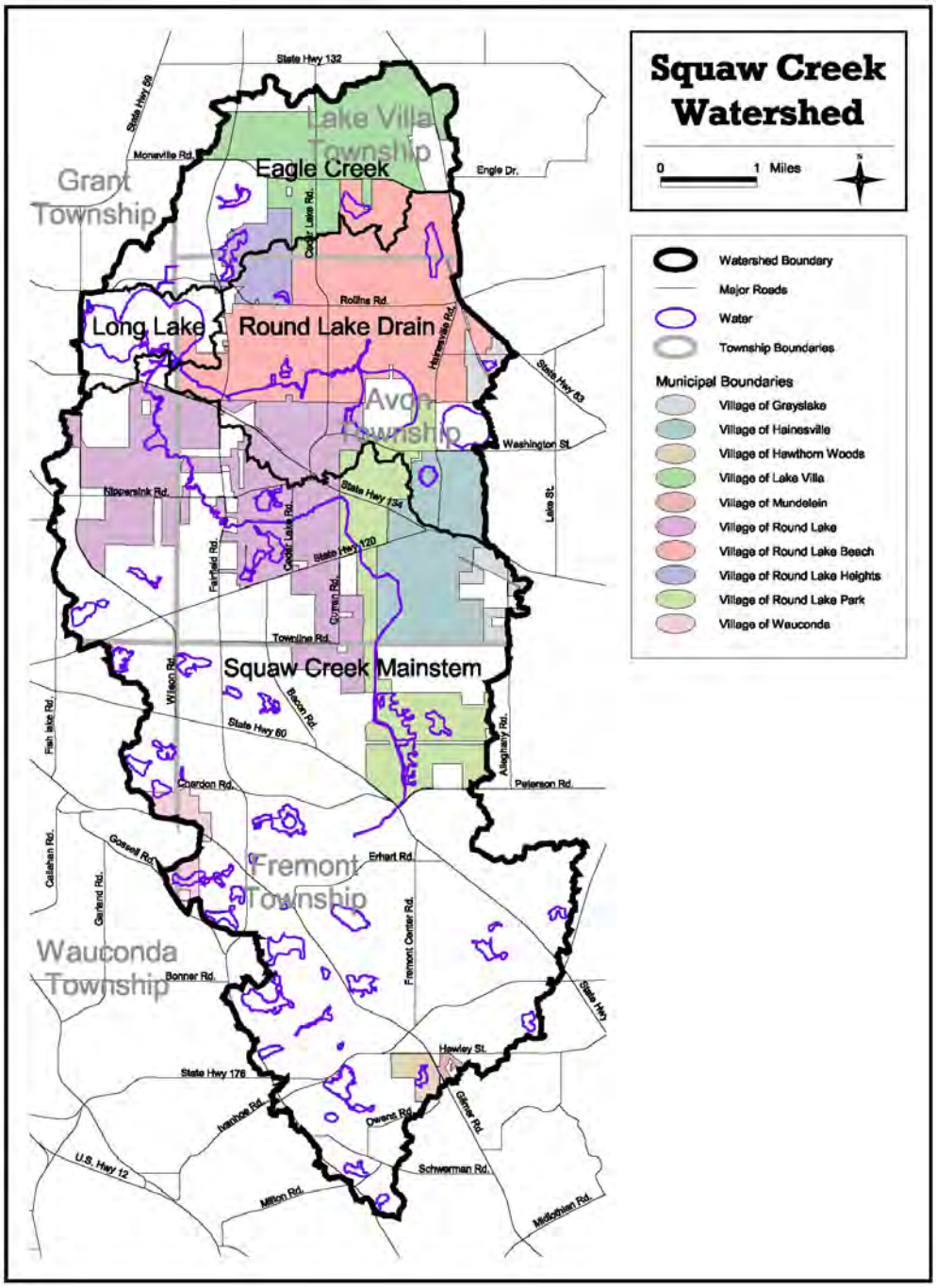

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- Squaw Creek Watershed Planning Committee

EXECUTIVE SUMMARY

Watershed planning is a proactive way for municipalities, townships, forest preserves, developers, residents, and other stakeholders to better plan for the future and increase their ability to manage their water resources in a cost-effective and environmentally sound manner. In Lake County, the agency tasked with watershed planning is the Lake County Stormwater Management Commission (SMC). SMC prepares watershed plans in coordination and cooperation with stakeholders of the watershed as staff capacity and funding become available.

Background

In January 2001, the Squaw Creek watershed planning effort began. The Squaw Creek watershed was chosen for watershed planning for several reasons:

- The watershed size (one of the largest in Lake County),
- The significant amount of water resources and public open space (approximately 45% of the watershed area),
- The existence of numerous water resources-related problems in the watershed, such as flooding and water quality problems, and
- The projected rate of growth (one of the highest in Lake County).

The Squaw Creek watershed is one of the largest watersheds in Lake County, with a total drainage area of 39.5 square miles (25,250 acres) at the outlet of Long Lake. The watershed consists of three large sub-watersheds:

- Squaw Creek (16,892 acres),
- Round Lake Drain (4,587 acres), and
- Eagle Creek (2,991 acres).

Another 778 acres drains directly to Long Lake via overland flow, storm sewers, and rainfall on the lake's surface.

The Squaw Creek watershed contains a significant amount of water resources and public open space. Approximately 9,400 acres of wetland, floodplain, or public open space exists in the watershed. An additional 1,950 acres of property owned by the Lake County Forest Preserve District is located within the Squaw Creek watershed. The watershed also contains several

significant lakes, including Long Lake (335 acres), Round Lake (215 acres), Highland Lake (110 acres), and Cranberry Lake (44 acres).

The watershed is currently experiencing rapid growth and is expected to add over 50,000 people, 20,000 households and 4000 acres of new growth by the year 2020. Most of this growth will be in the Squaw Creek mainstem watershed that now is largely rural and agricultural land use. The population growth and the associated landuse changes can have a significant effect on the watershed's resources.

Plan Purpose

The purpose of preparing this Plan is to define a watershed-based strategy to guide stakeholders on how to make better decisions with regard to future development, to develop a strategy to reduce existing flood damages, to manage water quality to ensure that beneficial water uses are not impaired, and to protect and restore the natural resources of the watershed. The planning process also provides an opportunity for stakeholders in the watershed to meet regularly to discuss their watershed-related concerns and guide the development of a Plan that can be used as a common reference point for future cooperation. The Squaw Creek Watershed Stakeholders Committee met over 20 times during the planning process.

Watershed Assessment

Squaw Creek is a highly modified aquatic system of ditches, lakes and wetlands. The pre-settlement watershed was flat and poorly drained due to relatively impermeable soils. The development of the watershed for agriculture from 1850 to 1940 removed most of the wetlands and prairie that existed. The drainage of the watershed was changed at that time from slowly draining wetlands and depressions that trapped and held runoff to a series of ditches and farm tiles that rapidly conveyed runoff to lakes. Urban development has converted portions of the agricultural drainage system into storm sewers and additional ditches. Urban development has also added a significant amount of impervious surface to the watershed, increasing the volume of stormwater runoff to the streams and lakes in the watershed. Much of this urban development occurred from 1950 to 1970 prior to floodplain mapping, so many houses were built in areas later identified as flood hazard areas.

Flooding. An analysis performed during the planning process indicates that there may be more structures in the Round Lake Drain floodplain than shown on the current FEMA mapping. The analysis included overlaying the existing FEMA flood elevations on recent, detailed topography and aerial photography. Another reason that more areas could be in a flood hazard area is that the "current" official flood insurance studies for the watershed are old and may not accurately define the floodplain, having been prepared in 1979. Older floodplain studies are not based on current rainfall statistics and lack the detailed definition of drainage structures and topography that are part of more current floodplain study procedures. The older studies also do not include the changes that have occurred in the watershed over the last 24 years.

The Plan also concludes that local drainage problems in the Round Lake Drain may be a significant problem. Local drainage problems are typically related to insufficient storm sewer or drainage path capacity causing water to pond in yards, streets, basements, etc.. The majority of the historic local drainage problems that have been reported are located in the Round Lake Drain subwatershed; however, some of these problems may have been resolved by recent projects undertaken by the Villages of Round Lake Beach, Round Lake, Round Lake Heights, and Round Lake Park and the SMC.

Water Quality. Water quality problems are primarily noted for Long Lake, largely as a result of it receiving the effluent from the Lake Villa and Round Lake Sanitary District sewage treatment plants until they were phased out in the 1980s. Long Lake is also located at the downstream end of the Squaw Creek watershed and receives inflow from all of the major tributaries. As a result, pollutants flowing in any of the tributaries can affect the water quality in Long Lake. Often, pollutants that remain suspended in a flowing stream will settle out in a lake.

Water quality data collected by Baxter Healthcare at different stream locations in the watershed were used to assess existing pollutant sources. Agricultural landuses appear to be a significant source of sediment and nutrients. Concentrations of these constituents were higher for agricultural parts of the watershed during normal streamflow and during runoff events when compared to the urban stream segments that were sampled. The urban water quality sampling found that runoff concentrations were typically higher than in-lake concentrations of these

constituents; however, the in-stream concentrations were typically similar or better than concentrations for stream segments that support warm water fisheries. It does not appear that in-stream water quality is limiting any stream aquatic life or other beneficial uses.

Natural Resources. The pre-settlement natural resources of the watershed were greatly affected by agricultural development, but 27 significant areas containing threatened and endangered species still remain in the watershed. The disconnection of wetlands from the normal flow path of runoff by construction of new ditches has fragmented the aquatic habitat of the watershed, particularly along the Squaw Creek mainstem.

Analysis of in-stream conditions indicates that lack of habitat is preventing the colonization of the streams by desirable aquatic life. Frequent maintenance of the streams to ensure vitally needed flow capacity without a plan to allow some habitat to remain has contributed to this problem. Opportunities exist to develop a greenway, or corridor of preserved open space, that would parallel existing floodplains and wetlands. A rough greenway currently exists because of the protection that the Lake County Watershed Development Ordinance (WDO) provides for floodplains, wetlands, and wetland buffers; but the WDO provisions are countywide minimum criteria that regulate, rather than prohibit, activities that may modify these natural resources.

Goals and Objectives

The stakeholder committee met monthly throughout the entire planning process. At the first stakeholder meeting, attendees identified their watershed-related concerns. From their original list, supplemented by subsequent discussions, the stakeholder committee developed five main goals for the watershed:

1. Reduce existing flood damage potential and prevent the creation of increased flood damage potential.
2. Improve water quality in the watershed's streams and lakes.
3. Preserve, protect, and enhance existing natural areas; and restore or create new, sustainable natural areas
4. Develop and utilize tools for Plan implementation.
5. Involve the public in the use and stewardship of the Squaw Creek watershed.

Specific objectives were identified for each goal, and the Plan includes recommended actions for achieving the objectives.

Recommendations

Flooding. New floodplain studies are needed to better define flooding risk and damage for properties in the watershed. Solutions to alleviate flooding risk will then be needed to mitigate potential flood damage. The Plan recommends evaluating a number of specific sites for storage reservoirs, increased channel capacity, and levees. The Plan also recommends that a coordinated drainage study be undertaken for the Round Lake Drain subwatershed to evaluate flooding due to inadequate local drainage and development in depressional storage areas. An evaluation of the feasibility of manipulating the water levels for Round, Highland, and Long Lakes to reduce flooding is recommended. The Plan also recommends developing a stream maintenance plan that will allow aquatic habitat to establish, while still preserving the ability to convey flood flows. The development of a watershed-specific flood response plan is also recommended.

Water Quality. Enrollment of more farms in voluntary federal and local programs to reduce soil erosion and limit fertilizer and pesticide usage is encouraged to improve water quality. Specific projects to reconnect streams and ditches to drained hydric soils and wetlands have been proposed for further evaluation, particularly at the Grant Woods and Ray Lake Forest Preserves. More aggressive soil erosion and sediment control measures are recommended for the watershed because of the significant high quality lakes that are present. Increased efforts to monitor the watershed's streams and lakes are recommended to document Plan progress and provide more diagnostic data.

Natural Resources. A number of habitat restoration projects are recommended for further evaluation. These include projects at the Grant Woods and Ray Lake forest preserves that may have water quality and flood control benefits in addition to restoring natural resources. The addition of pool and riffle complexes throughout the watershed is recommended. These additions could raise stream ratings by adding aquatic habitat to the stream systems.

Streambank stabilization projects are recommended for the 6,400 linear feet of severely eroding streambank identified in the Plan. These projects can enhance natural resources by incorporating native plant species. They also improve downstream water quality. A significant streambank stabilization project and stream restoration project along the Round Lake Drain is recommended, since the majority of this stream has been identified as having moderate or severe erosion of the banks. Multi-objective opportunities for wetland creation and restoration have also been identified along Round Lake Drain.

Plan Implementation. An implementation strategy was developed and included in the Plan. The implementation strategy recognizes that some implementation tools, such as grant funding, are currently available; while other implementation tools, such as watershed fact sheets and Plan brochures, need to be developed before they can be utilized.

Funding is often a limiting constraint when considering implementation of any project, and watershed projects are no different. A variety of funding opportunities, including grants and private support, have been identified in the Plan. Numerous grant opportunities exist for watershed-related projects, and different grant funds can often be used as a match for one another. For example, a community may contribute $10,000 towards a watershed-beneficial project and secure an additional $10,000 from Grant Source A. Upon receiving approval of Grant A, they may be able to leverage their $20,000 ($10,000 + $10,000) to secure an additional $20,000 from Grant Source B to implement an expanded project scope. The Plan also recommends that local governments coordinate their five-year capital improvement and operations and maintenance budgets to identify ways to cooperatively fund projects.

Using a multi-objective approach to implementation is also recommended in the Plan. A conceptual Greenway Plan was developed to illustrate how a corridor of connected natural and open space areas could be preserved for water quality, flood conveyance and storage, aquatic and wildlife habitat, and recreational purposes. A greenway acts as a multi-objective water resources infrastructure and is often cheaper and more cost-effective than other options like storm sewers. The conceptual Greenway was developed considering opportunities to protect existing threatened and endangered species habitat, wetlands, streams, and lakes. The Greenway Plan describes strategies for assembling the necessary parcels including: ownership, deed restrictions,

easements, developer incentives like density trading, and additional regulatory protection measures such as conservation overlay districts.

Public Involvement. The Plan recognizes the need for public involvement in the watershed. Numerous opportunities exist for the public to make use of the watershed's resources. In addition, the public can act as stewards for their watershed. Many times positive public involvement is limited by a lack of awareness, and the Plan includes several recommendations for educating the public on watershed issues.

Recommended public involvement activities include the continued support for the Squaw Creek Stakeholder Committee, the development and distribution of watershed-related educational materials, creation of a resource information sheet to assist schools with developing watershed-related curriculum, the creation of a web site dedicated to the watershed, and advertising to increase awareness of recreational opportunities related to the watershed's resources.

Summary

The Squaw Creek Watershed Management Plan is a resource that watershed stakeholders can use to better plan for the future and increase their ability to manage their water resources in a cost-effective and environmentally sound manner. The Plan should be a living document and should be periodically updated to:

- reflect changes that occur within the watershed,
- include new data that is collected,
- consider additional analyses that have been performed,
- add needs that have been identified,
- acknowledge achievements, and
- evaluate the level of Plan success.

Plan updating is especially important for an area that is changing quickly. This Plan establishes a starting point by compiling existing data, establishing a set of goals and objectives developed by a coalition of stakeholders, defining actions that will help achieve the objectives, and identifying a strategy for implementing the recommended action plan.

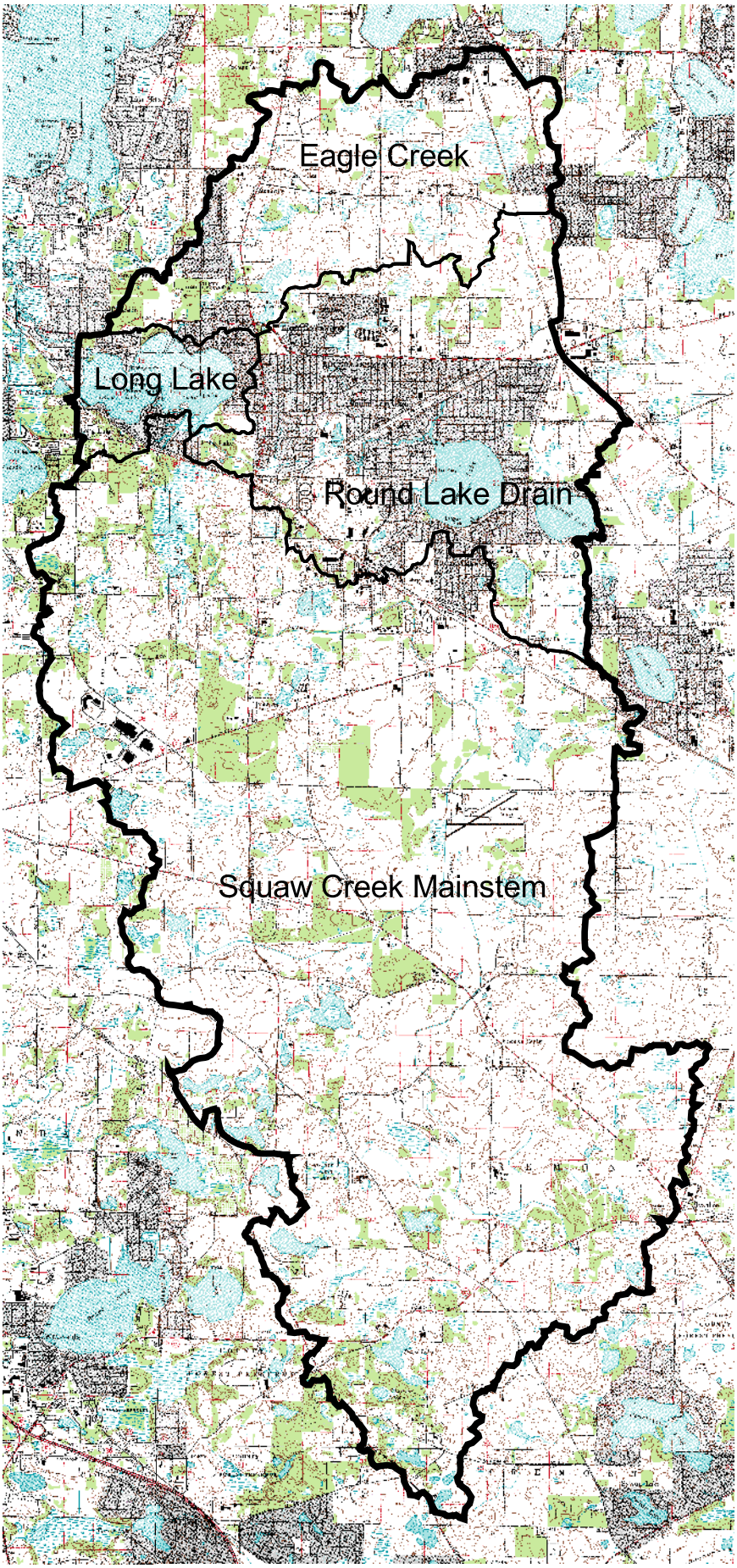
CHAPTER 1
THE PLANNING PROCESS

1.1 INTRODUCTION

The Lake County Stormwater Management Commission (LCSMC) has prepared this Squaw Creek Watershed Stormwater Management Plan (the Plan) with the assistance of Hey and Associates, Inc. The Plan includes the watershed above the outlet from Long Lake (Figure 1-1). The Squaw Creek watershed consists of three major watersheds that were studied in detail: the Squaw Creek Mainstem below Route 134, the Round Lake Drain, and Eagle Creek. The Plan area is approximately 25,000 acres (39.45 square miles) in size. Its location in Lake County in relation to other watersheds is shown in Figure 1-2.

1.2 PURPOSE

The Plan presents a technical and administrative strategy for managing stormwater quantity and quality through the Year 2020 to reduce existing flood damages, prevent future flood damages, increase wildlife habitat, and improve water quality in the Squaw Creek Watershed. It presents specific action recommendations to prevent or mitigate flood damage and to attain beneficial water resources uses by addressing the sources of use impairment. The Plan fulfills many of the goals and objectives of the 2002 LCSMC Comprehensive Stormwater Management Plan.



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

SOURCE: Illinois Department of Natural Resources

Major Watersheds

Figure No. 1-1

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

0 5 Miles

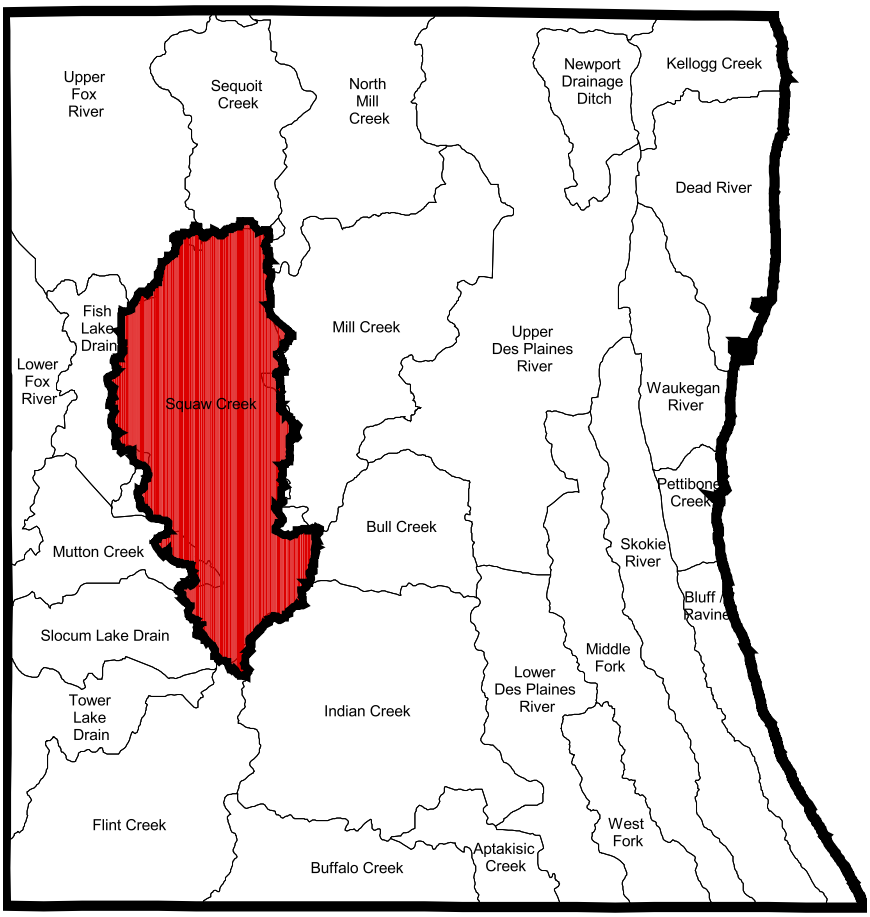
N

Lake County

Watershed Boundary

Lake County Sub-Watersheds

SOURCE: Lake County Stormwater Management Commission



Squaw Creek Watershed in Lake County

Figure No. 1-2

Prepared by: Hey and Associates, Inc. 2003 (kgk)

1.3 STAKEHOLDER COMMITTEE

The Plan presents goals, objectives and action recommendations for managing the surface runoff from existing and future development. The Plan was guided by stakeholders in the watershed who met over a dozen times to provide input and reaction to Plan elements including their assessment of issues and their vision for the future of the watershed.

The stakeholder committee ranked the following issues as the ten most important for the Squaw Creek watershed. More detail on stakeholder concerns can be found in the Appendix.

1. Prevent future flood damages
2. Enhance the water quality of the waterbodies in the Squaw Creek watershed
3. Pursue buyouts of repetitively damaged floodprone structures
4. Pursue and develop sources for funding Plan implementation
5. Address current flood damages
6. Improve public education regarding stormwater management
7. Ensure that land use planning and regulations complement natural resources protection
8. Control increases in runoff volume
9. Ensure that wetland banking is available in the watershed
10. Identify critical open space

Using this input, technical data describing the watershed and its existing and potential future problems were developed and then presented to the stakeholders at a series of meetings. Input from the stakeholders was used to refine the data analysis and to guide the development of goals, objectives and action recommendations. Finally, the draft plan was presented to the stakeholders for review and comment leading to a final plan that reflected stakeholder input.

1.4 ORGANIZATION OF THE PLAN

The Plan discusses the development history of the watershed in Chapter 2. Key technical concepts are discussed in Chapter 3. Data describing the watershed including its hydrology, water quality, natural resources, flooding and projected future development

are then presented in Chapter 4. Next, the watershed data is used to present specific existing and potential future problems that could increase flooding or impair water quality or natural resources (Chapter 5). The goals and objectives are presented in Chapter 6. Specific action recommendations to address problems are presented (Chapter 7) along with a Greenway Plan (Chapter 8). Finally, sources of funding to implement plan recommendations are discussed in Chapter 9.

1.5 RELATIONSHIP TO OTHER PLANS

The Plan builds upon a number of earlier water resource plans for the study area. These plans include:

- The Lake County Comprehensive Stormwater Management Plan, Lake County Stormwater Management Commission, 1990 and 2002 update prepared by CDM, Inc.
- The Areawide Water Quality Management Plan for Northeastern Illinois in particular Chapter 19 for the Fox River Watershed by the Northeastern Illinois Planning Commission (NIPC), 1977.
- Flood Hazard Mitigation Strategy for Lake County, Illinois, NIPC, 1995.
- Lake County Flood Hazard Mitigation Plan, LCSMC, 1999.
- Fox River Watershed Draft Planning Document, Lake County Stormwater Management Planning Committee, 1990.
- Long Lake Watershed Preauthorization Planning Report, U.S. Department of Agriculture, Soil Conservation Service, 1986.
- Baxter Laboratories Watershed Study, 2003.

The 2002 Lake County Comprehensive Stormwater Management Plan presents the foundation for stormwater planning in Lake County and in particular for the Watershed Development Ordinance (WDO). The Squaw Creek Plan specifically addresses Goal 4 of the Comprehensive Plan which calls for the development of comprehensive basin plans for each of the 26 watersheds in Lake County.

The Areawide Water Quality Management Plan met the requirements of Section 208 of the Clean Water Act to define the causes of use impairments to water bodies in northeastern Illinois. Chapter 19 contained specific recommendations for the Fox River watershed including Squaw Creek. The AWQMP recommended the phase-out of the Lake Villa and Round Lake S.D. wastewater treatment plants to protect Long Lake. The Long Lake Watershed Report presented estimated pollutant loadings to Long Lake from the Squaw

Creek watershed and recommended management strategies to reduce these loads. The Fox River Watershed Draft Planning Document began to organize data resources for the Squaw Creek watershed and to identify water resources problems. The 1995 Flood Hazard Mitigation Strategy and the 1999 Flood Hazard Mitigation Plan developed a countywide approach to preventing and managing flood damages.

The Plan is built upon these previous efforts and also reflects the vision, issues, and priorities of the stakeholder committee and LCSMC staff.

CHAPTER 2
HISTORY

2.1 INTRODUCTION

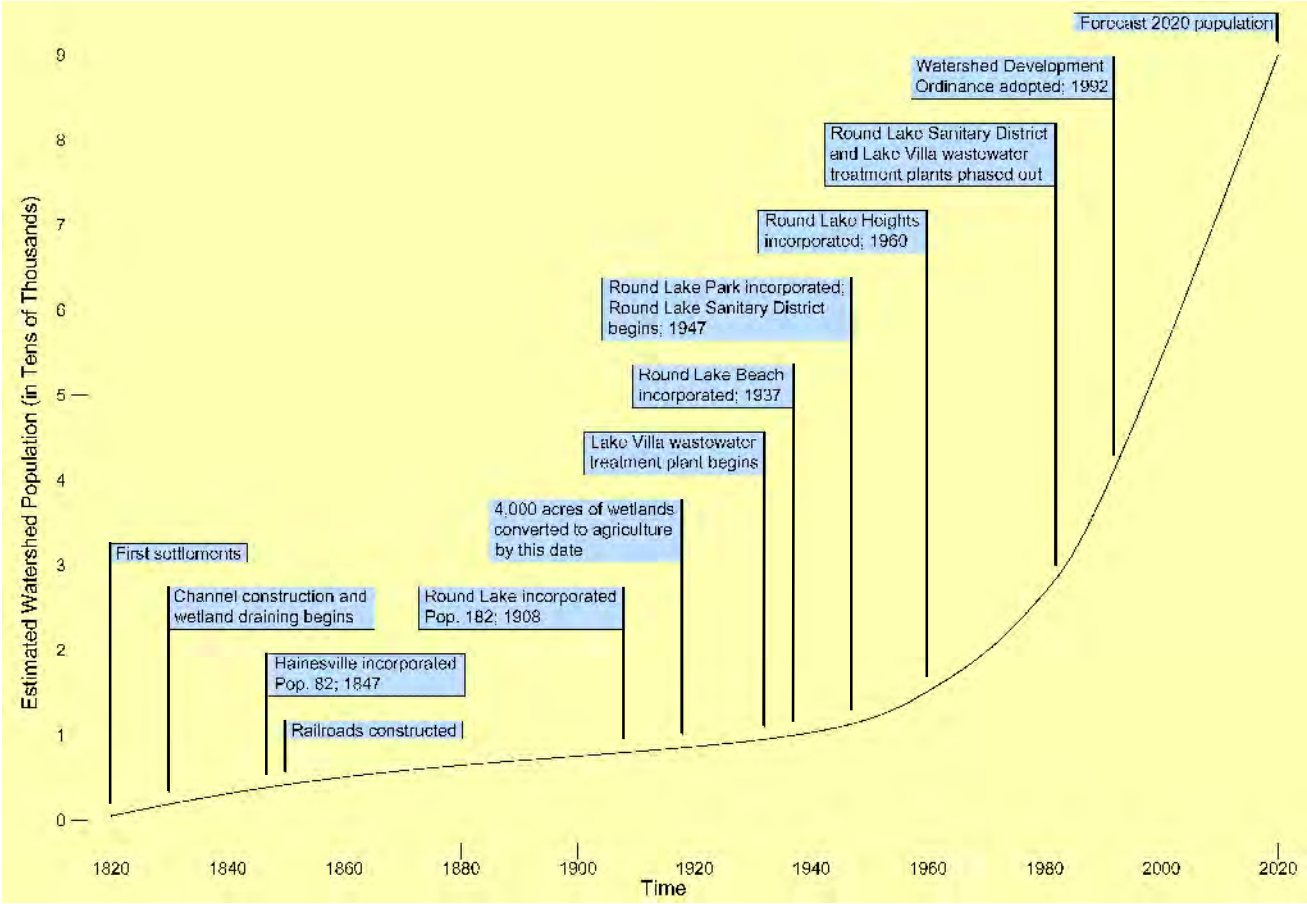
The Squaw Creek Watershed that we see today is very different from the one encountered by European settlers in the early 1800s. Figure 2-1 presents a timeline of significant events in the watershed.

2.2 INFLUENCE OF AGRICULTURE

Farmers used ditches and tiles to dry up many wetlands to increase cropland. This caused streamflow to become less stable, at least in the eyes of the settlers. Loss of tree cover was blamed for increased runoff rates and volumes. The effect of these agricultural modifications was noticeable at water-powered mills throughout the Fox where less baseflow meant less power (IDNR, 1998).

The landscape of Fremont Township in the Squaw Creek watershed was described by a newspaper columnist in 1836 as follows: "I immediately saw the numerous advantages which it possessed over their surrounding country, having about an equal quantity of prairie and timber, and both of these of the best quality, being well watered by streams and lakes…" However, this same reporter in 1844 noted that "The progress of eight years has wrought a change which I had not expected to see… Public roads have been established in every direction… The prairies are in a high state of cultivation and covered with fields of grain…" (IDNR, 1998).

Squaw Creek Watershed



Squaw Creek Development Timeline

Figure No. 2-1

Prepared by: Hey and Associates, Inc. 2003 (kgk)

2.3 FLOODING

Flooding on the Fox and its tributaries was frequent and destructive based on settlers reports from the early 1800s. Early settlers blamed the prairie sod for flooding, stating "…in those early days, when the whole surface of the land was covered with the tough prairie sod, like an impenetrable thatch, the heavy rains and, in the spring, melting snows, poured volumes of water into all … tributaries, that frequently overflowed their banks and so filled the river that it became a torrent impassable…" The harmful flooding effects of eliminating forests and swamps also was well noted (IDNR, 1998).

2.4 NATURAL RESOURCES

The Illinois Department of Natural Resources "Fox River Area Assessment, Volume 5, Early Accounts of the Ecology of the Fox River Area" describes the area as a "…mosaic of grassland, woodland, marshland, and open water." (IDNR, 1998) The settlers noted that there were two kinds of prairie: poorly drained level areas with tall grass, and rolling, well-drained upland with shorter grass. It was noted that as wildfires were suppressed, woody growth replaced prairie (IDNR, 1998).

The 1852 *Historical and Statistical Sketches of Lake County* noted that Cranberry Lake was noted for its regular cranberry production. Round Lake was one of the most beautiful lakes in the county. Squaw Creek (also known as Deer Creek) had one of the best sawmills in the county (Probably in western Avon Township around 1850). The eastern portion of this (Fremont) Township is mostly prairie, while the western portion is mostly woodland and oak openings. The "Big Sag" is the name of a marshy tract of land embracing a thousand acres or more in the townships of Avon and Fremont.

The IDNR has estimated that Lake County was 45 percent wetland prior to European settlement (IDNR, 1998). The current figure is closer to 11 percent, a loss of 45,000 acres almost entirely due to agricultural development.

2.5 URBAN DEVELOPMENT AND DEMOGRAPHICS

Railroads were added to the watershed in the 1850s. This accelerated the rate of agricultural development and settlement. In 1890 the population of Avon Township was 1,081. By 1910 it had increased to 1,785. Round Lake had a population of 182 in 1910 and Hainesville had a population of 66. Over 85 percent of Lake County was in farms with nearly as many cattle as people in the county. The principal crops were corn and oats (Illinois Rivers and Lakes Commission, 1915).

By 1950, the population of unincorporated Avon Township was 2,796, and Fremont Township had a population of 1,906. The 1950 population of Round Lake was 573 people and Hainesville had 154 people. Growth in the watershed really accelerated in the 1950s. By 1960 the municipalities (Hainesville, Round Lake, Round Lake Park, Round Lake Beach and Round Lake Heights) in the watershed had doubled from 4455 in 1950 to 8705. By 1990, when the Lake County WDO was drafted, the municipal population of the watershed was at 25,414. In the 2000 census the municipal population was 41,215. It appears that about half of the growth in the watershed has occurred while the WDO was in effect.

This population growth was accompanied by municipal improvements. In particular the Lake Villa and Round Lake Sanitary District built wastewater collection systems and sewage treatment plants and began discharging nutrient-rich effluent to the Squaw Creek watershed in the 1950s. The Round Lake Plant started diverting its effluent away from the watershed in the early 1980s, and the Lake Villa Plant stopped discharging into Eagle Creek in 1991 (Long Lake LCHD report). Effluent loads were subsequently redirected to the Fox Lake Regional Wastewater Treatment Facility. However, the effect of these discharges, especially phosphorus loads, is still evident in water quality problems on Long Lake.

The above collection of anecdotal and factual data combine to present a brief history of the changes to the watershed's land use. The effects of these changes on wildlife habitat, hydrology, plant communities, and water quality of Squaw Creek, Eagle Creek, the

Round Lake Drain, Long Lake, Round Lake, and Cranberry Lake are discussed in Chapters 4 and 5.

In 1890 the total population of the Squaw Creek watershed was less than 5000 people, or fewer than 15 people per square mile. These people resided almost exclusively on farmsteads. The effect of these 5000 people on the hydrology of the watershed was profound however. The removal of the prairie and timber and the improvement of drainage to allow farming of lowland caused a dramatic shift in the hydrology of Squaw Creek, particularly in its Mainstem.

Although large flood events occurred with regularity prior to European settlement in the watershed, the removal of vegetation changed the annual water budget. Interception storage of rainfall was reduced since crops and open fields did not have as much capability to capture and hold rainfall compared to dense prairie or tree canopy. Evapotranspiration also was reduced since the overall biomass was reduced significantly. Improvements in drainage reduced the time of concentration as runoff was moved more efficiently from where it fell to receiving streams. By the early 1900s, improvements such as the drainage of the 1000-acre Big Sag wetland completed the major hydrologic modifications in the watershed for agriculture.

Prior to these improvements, runoff from small or moderate storm events flowed through the watershed from one depression to another, slowly working its way to downstream lakes. In fact, there was no Squaw Creek in many parts of the watershed, only a series of depressions such as the Big Sag connected by wetland and wet prairie. The 15-foot deep trapezoidal channel that is Squaw Creek from Route 60 to Route 120 is an agricultural drainage channel created to allow farming of the surrounding lowlands. This channel, and many like it, were constantly well maintained and kept clear of debris jams and dense vegetation so that their drainage capacity was assured.

These agricultural improvements produced runoff in areas where previously, rainfall had been captured on vegetation surfaces or in depressions and was either evaporated back

into the atmosphere, transpired by plants, or infiltrated into shallow groundwater. With agriculture, runoff more quickly reached a main drainage channel (the new Squaw Creek) and was then discharged to receiving lakes, in particular Long Lake. The annual fraction of rainfall that reached Long Lake (the watershed "yield") increased, and it arrived in spurts with each storm rather than as a relatively steady stream.

These changes, along with the stabilization of water levels by dams to retain more water for recreation, altered lake habitat as well. Constant maintenance of normal water levels in the lakes drowned shoreline wetland vegetation dependent on variable water levels. This reduced in-lake habitat. The increased efficiency of water delivery through channels constructed through highly erodible hydric soils increased sediment delivery to the lakes.

By 1950 a significant portion of the environment that was in place to receive new urban development was already highly modified for agriculture and recreation uses. This modification was and is largely irreversible because of drainage rights attendant with property tributary to the channels that now form Squaw Creek and the Round Lake Drain. Naturalization of these ditches may be possible however as long as drainage rights are preserved.

Development from 1950 to 1990 added to the volume of runoff by increasing impervious areas and further improving drainage efficiency. Pollutants associated with urban development also were added to the system by the new drainage systems. The construction of sewage treatment plants in the 1940's ultimately increased watershed yield, as groundwater used for municipal water supply now entered the surface water system (streams) as treatment plant effluent. This effluent also carried nutrients such as phosphorus and nitrogen that were not removed in the treatment process. These nutrients were carried directly to Long Lake from Eagle Creek, where the Lake Villa plant discharged, and from the Round Lake Drain, where the Round Lake Sanitary District discharged.

Most of the development between 1950 and 1990 was accomplished without any of the mitigation measures that are now part of the WDO. There was little or no requirement

for detention. Soil erosion and sediment control was seldom practiced or vigorously enforced. Without detention there was no capture and settling of urban runoff pollutants.

Peak flood flows and water surface elevations increased due to the increase in impervious area without detention. The variability of instream flows increased downstream of development even for frequent small events. This added to erosion of the already unstable artificial channels and carried sediment downstream.

CHAPTER 3

TECHNICAL BACKGROUND

3.1 INTRODUCTION

The technical portion of the planning process followed a logical sequence of gathering all available data to describe the watershed and its problems (Chapter 4) and then using that data to assess problems (Chapter 5). The conclusions of this technical analysis were then used to refine draft goals and objectives developed with stakeholder input (Chapter 6) and to develop action recommendations (Chapter 7) to address problems. The following sections present background on the watershed planning process and introduce important technical concepts.

3.2 WATERSHEDS

Watersheds are described in terms of their topography, hydrology, water quality and natural resources. Each of these features result from the geology and biology that originally formed the watershed. Watershed planning seeks to manage the changes that man has made to the watershed as it was settled and developed to prevent flooding, conserve natural resources and protect water quality.

3.3 TOPOGRAPHY

The boundaries of a watershed are based on where water will flow when participation "runs off" the ground surface. These boundaries reflect the topography of the watershed. In other words, at the watershed boundary, rain falling outside the watershed edge flows away from the watershed and rain falling inside the edge flows to streams and lakes inside the watershed.

3.4 HYDROLOGY

Hydrology describes what happens to precipitation when it falls on a watershed. There are three possibilities for this precipitation: it can wet the surfaces of plants and soil (or pavement) or fill depressions until the "interception storage" capacity is exceeded; it can infiltrate into the soil (previous areas) until this "infiltration capacity" is exceeded; or it can flow downhill after "interception storage" and "infiltration capacity" are exceeded. The interception storage capacity of a watershed is determined by land cover and the roughness and number and size of depressions in the watershed. Dense plant coverage, particularly trees when in leaf has a higher interception storage capacity than rock or pavement. Infiltration capacity reflects the character of the soils and geology of a watershed. Sand and gravel have a higher infiltration capacity than clay or pavement. Watersheds covered in trees or in dense vegetation yield less runoff volume for unit rainfall than do watersheds that have more pavement (impervious areas). Watersheds with more sand and gravel soils and geology yield less surface runoff and more groundwater flow than do watersheds that have clay soils and geology.

Precipitation that his captured by interception storage eventually either evaporates or it used in plant transpiration (together called evapotranspitation) and returned to the atmosphere. Precipitation that infiltrates into the soil eventually becomes groundwater some of which reaches streams and lakes and some of which becomes deep groundwater storage. The following chart shows what is called the water budget for a watershed.

Precipitation = Runoff (water in excess of interception and infiltration capacity) + Evapotranspiration + Infiltration to Groundwater (shallow and deep)

Hydrology is the lifeblood of a watershed. The volume and rate of runoff and the quantity of infiltration and groundwater determine flooding, the pattern and size of the streams, the distribution of natural resources and water quality. Flooding occurs when the rate of runoff exceeds the capacity of channels and lakes to convey it without

overtopping their banks and inundating adjacent areas (the floodplain). Flooding is a rare event and occurs even in undeveloped watersheds when infiltration and interception storage are exceeded. This can be exacerbated when vegetation is not present from late fall to spring or when the ground is frozen and no infiltration can occur. The early settlers reported numerous instances of flooding even though little or no development was present. Development can worsen flooding by replacing vegetation and pervious areas with hard surfaces which reduces infiltration and interception storage, increases runoff rates and volumes and more efficiently conveys flows to channels and lakes. Flood damages occur when development is allowed into floodplains or when development increases the rate of discharge or reduces the capacity of channels to cause the floodplain to increase.

The rate and volume of frequent runoff events largely determines the shape and pattern of channels and streams when considered together with watershed slope and geology. These channels and streams are the response to millennia of runoff from stable pre-development watersheds. When ditches and tile are added for agriculture or hard surfaces and sewers are added for urban development, this stable runoff relationship is upset unless measures are taken to mitigate these actions. Channels that received a particular flow rate once every two years on average can see that same flow rate many times a year. This causes the channels and streams to expand leading to unstable streambanks and erosion. Increases in the volume of runoff can have a particular influence on the physical character of streams and wetlands and therefore can influence ecology as well.

The natural resources of a watershed also are largely determined by hydrology. Watersheds that have high infiltration rates tend to have fewer wetlands and streamflow with a significant groundwater component. This affects water quality and ecology because of temperature and water chemistry. Watersheds that have low infiltration rates tend to be dominated by surface runoff since there is little opportunity for infiltration to groundwater.

3.5 NATURAL RESOURCES

The natural resources of a watershed consist of plants and animals and the soil or water (lakes, streams, and wetlands) where they live. The relative distribution of these natural resources is a reflection of the topography of the landscape left behind by the glaciers and interaction of hydrology and the geology of the watershed. Flat and relatively impermeable watersheds like Squaw Creek tend to have poorly defined streams and channels and lots of wetlands and ponds. More steeply sloped watersheds with relatively permeable soils tend to have well defined streams and fewer wetlands and ponds.

The analysis of existing and potential impacts to natural resources focuses on loss of habitat for desirable organisms and loss of diversity of organisms resulting from habitat loss. Habitat loss can result from direct impacts such as the draining of wetlands for agriculture or clearing of trees for urban development or even cleaning debris from channels. It also can result from changes to hydrology such as increased surface runoff volume, decreased groundwater flow, or increases in the frequency of runoff events. Finally, habitat can be lost due to changes in water quality such as adding nutrients to lakes or increasing water temperature beyond what selected fish can tolerate.

3.6 WATER QUALITY

The importance of water quality is reflected in the uses that are dependent on it. Aquatic life cannot be sustained in highly polluted water. Species not tolerant of pollution will be supplanted by tolerant species if water quality is degraded. Swimming will not be available on polluted lakes. High nutrient concentrations can lead to algae blooms that render lakes unfit for swimming or boating.

The analysis of existing and potential effects of changes in water quality first focuses on whether or not it meets the standards set for aquatic life or recreational uses. Next it looks at what changes in land use due to development have on water quality. It also

looks at changes to pollutant loads from sources such as streambank erosion that may be a reflection of changes to hydrology. The water budget presented earlier is a critical way to organize the sources of pollutants and their relative importance. For example, if most of streamflow is surface runoff it makes sense to focus on pollutant sources that contribute to surface runoff such as paved areas and urban and agricultural erosion. If groundwater is a critical component of the water budget then it makes sense to look at sources that contribute to groundwater such as agricultural chemicals in field tile flow.

The following sections present summaries of data for each of the above topics, as well as, data on future development, open space and land use.

CHAPTER 4

THE SQUAW CREEK WATERSHED

4.1 INTRODUCTION

The Squaw Creek watershed with political boundaries is shown on Figure 4-1. The watershed above Long Lake is divided into three separate and distinct watersheds: the Squaw Creek Mainstem, the Round Lake Drain, and Eagle Creek. Additional area outside these watersheds drains directly to Long Lake. The total watershed encompasses portions of ten municipalities and five townships. This chapter provides relevant data for the watershed, including topography, land use, drainage infrastructure, climate, soils, surface water resources, groundwater resources, wetlands, lakes, and stream and lake water quality.

4.2 SUMMARY OF FINDINGS

- The Squaw Creek watershed is relatively flat. It also contains soils and geology that have relatively low infiltration capability. This combination of slope, soils, and geology led to the formation of wetlands and ponds due to the poor drainage. Prior to settlement there were few streams in the upper part of the watershed. Flow moved slowly from wetlands to ponds allowing settling of sediment.
- Eagle Creek and Round Lake Drain have similar but slightly steeper watersheds than the Squaw Creek Mainstem. Their pre-settlement drainage characteristics were very similar to the Mainstem.
- The pre-settlement vegetation of the watershed was about 21 percent wetland, 24 percent prairie and 55 percent savanna.
- Agricultural development improved the drainage in all three watersheds but particularly in the Mainstem. Ditches were constructed through wetlands and field tiles were added to complete the draining of wetlands for agricultural production.
- Agricultural development removed about 5400 acres of the prairie and 4,000 acres of the wetlands. This land was used for production of crops.

- The addition of ditches and tiles to the Squaw Creek watershed increased the variability and size of streamflow and introduced more energy to scour sediment from the constructed ditches and natural streams.
- Agricultural development changed the water budget for the watershed by increasing groundwater flow (field tile addition) by increasing surface runoff (row crops and efficient ditches and tiles) and by decreasing evapotranspiration (less plant mass).
- Urban development has changed the Squaw Creek water budget by decreasing groundwater flow (removal of farm tiles) by increasing surface runoff (increased impervious surfaces and storm sewers) and by further decreasing evapotranspiration (replacement of vegetation with hard surfaces).
- Relative to 1990 data, population is expected to grow by 160 percent (59,000 people) and households to grow by 190 percent (22,600 households) by 2020.
- Urban land use is expected to grow by 3,800 acres by the year 2020. This will add about 2.25 square miles of impervious area to the watershed.
- The floodplain studies for Eagle Creek and the Round Lake Drain are old (1979). They were not done using the current higher rainfall data used by LCSMC.
- The Squaw Creek watershed contains a large amount of drained depressional storage that was disconnected from streamflow by the construction of ditches.
- At least one wastewater treatment plant needs to have its capacity increased to support the projected growth for the watershed to the year 2020.
- There appears to be adequate water service capacity to support the projected growth for the watershed to the year 2020.
- A significant part of the watershed is open space owned by the LCFPD (1950 acres or 8 percent). Very significant additional areas are either wetland or floodplain or other public open space (9,400 acres or 37 percent). These floodplain and wetland areas are largely protected by the current Watershed Development Ordinance (WDO).
- The streams in the watershed are generally deficient in habitat. There are many areas of streambank erosion. Many of the banks lack adequate shading.

Problems are worse in the Mainstem and the Round Lake Drain downstream of Round Lake than on Eagle Creek.

- Aquatic life is limited in the Mainstem by lack of habitat.
- Water quality does not limit a warm water fishery or a good benthic population in any of the watershed's streams.
- Sediment and nutrient concentrations in runoff and tile flow exceed existing levels in the lakes to which they discharge.
- Round Lake, Highland Lake and Cranberry Lake all have very good water quality.
- Long Lake has poor water quality but is recovering from several decades of sewage treatment plant discharge to it.
- Twenty state threatened and endangered species refuges have been identified in the watershed. State threatened and endangered species include 29 plants, 10 birds, 4 fish and 1 herpetile.
- The aquatic habitat of lakes in the watershed is threatened by invasive species such as zebra mussels and Eurasian milfoil.

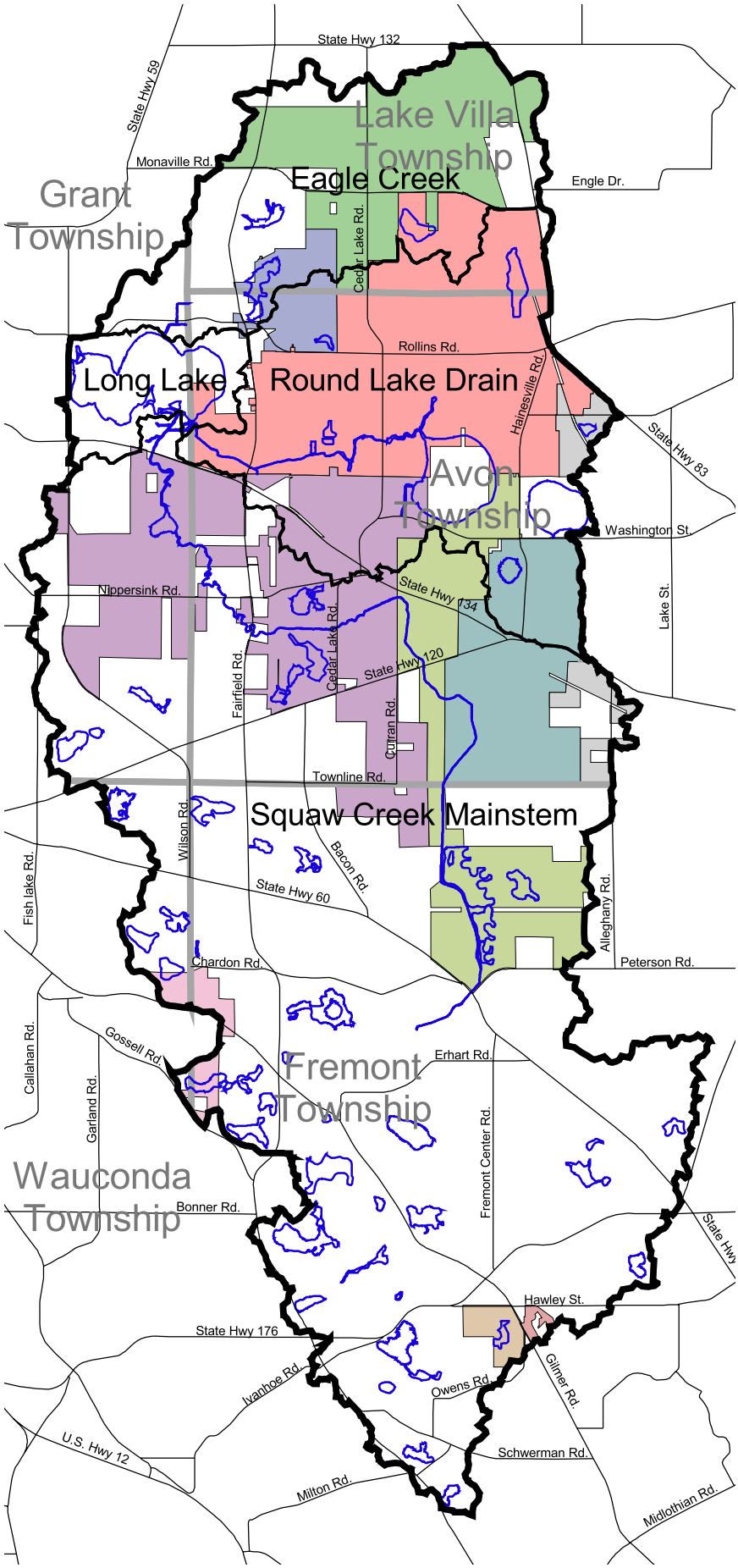
4.3 TOPOGRAPHY

The importance of topography in watershed planning was discussed in Chapter 3. The topography of the Squaw Creek watershed is presented in Figure 4-2. The watershed generally is quite flat. This topography contributed to the formation of ponds and wetlands due to the relatively poor drainage throughout the watershed.

Each of the three watersheds has its own particular topographic character. The Mainstem is relatively flat at a gradient of 5.1 feet per mile below Route 60 and 6.1 feet per mile above Route 60. The Round Lake Drain gradient is steeper than the Mainstem at 10.5 feet per mile. Eagle Creek's gradient is steeper than both the Mainstem and the Round Lake Drain at 13.0 feet per mile.

This topography helped to shape the drainage and vegetation patterns prior to European settlement. Its flatness, along with the nature of watershed soils and geology, resulted in

poor drainage and large floodplains. This in turn helped to direct the pre-settlement vegetation to prairie, wetlands and ponds.



Squaw Creek Watershed

0 1 Miles

N

- Watershed Boundary
- Major Roads
- Water
- Township Boundaries

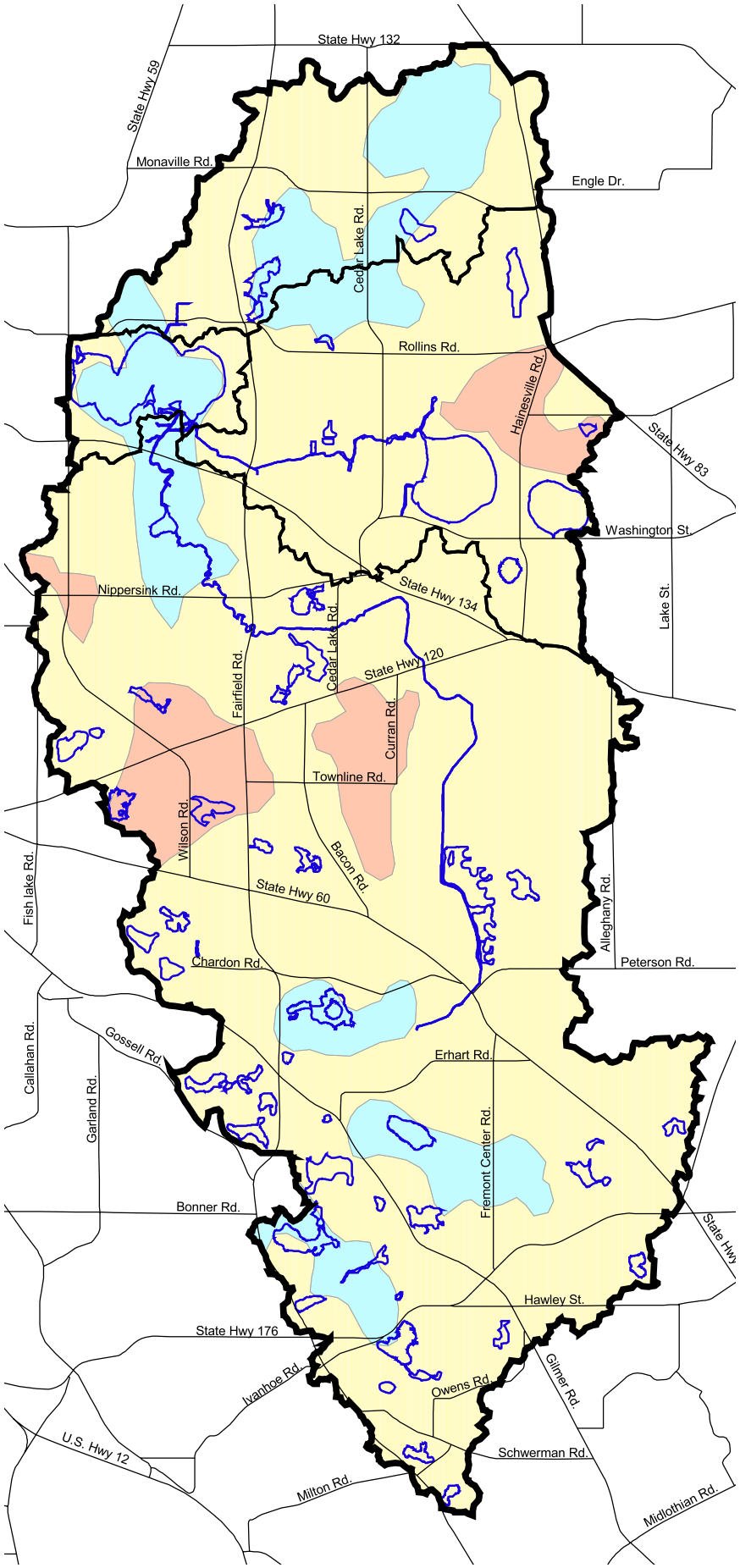
Municipal Boundaries

- Village of Grayslake
- Village of Hainesville
- Village of Hawthorn Woods
- Village of Lake Villa
- Village of Mundelein
- Village of Round Lake
- Village of Round Lake Beach
- Village of Round Lake Heights
- Village of Round Lake Park
- Village of Wauconda

Political Boundaries

Figure No. 4-1

Prepared by: Hey and Associates, Inc. 2003 (kgk)



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

Water

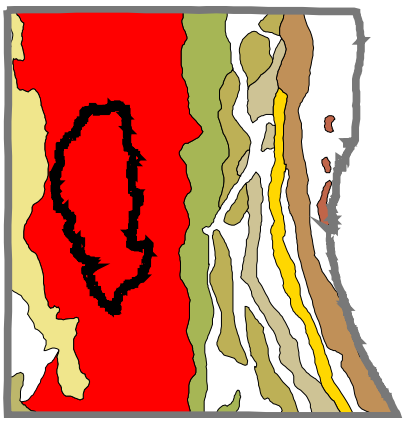
Surficial Geology

Grayslake Peat

Henry Formation

Wadsworth Formation

SOURCE: Illinois State Geological Survey



Glacial Moraines in Lake County

Blodgett

Cary

Deerfield

Fox Lake

Highland Park

Park Ridge

Tinley

Valparaiso (undifferentiated)

Zion City

Surficial Geology and Geomorphology

Figure No. 4-2

Prepared by: Hey and Associates, Inc. 2003 (kgk)

4.4 SURFICIAL GEOLOGY

Surficial geology is important because it affects infiltration, groundwater and streamflow as was discussed in Chapter 3. Figure 4-2 presents the surficial geology of the Squaw Creek watershed (ISGS, 1973). The Squaw Creek Watershed is located over the Valparaiso Moraine, a deposit of relatively impermeable glacial till. Till consists mostly of clay mixed with some sand and gravel. Figure 4-3 is a profile through the surficial geology presenting different geologic formations in the watershed and shows that the surficial geology of the watershed is till. The impermeable nature of this till along with the flat topography contributed to the formation of the large number and size of wetland and pond complexes in the watershed prior to settlement. It also indicates that groundwater was probably not a large component of streamflow until tiles were added for agriculture. Due to this impermeable geology, this portion of Lake County is not a significant recharge area for groundwater supplies (ISGS, 1973).

4.5 VEGETATION PATTERNS

Prior to European settlement, the Squaw Creek watershed supported all but the forest community of the major natural terrestrial communities occurring in the Fox River watershed in Illinois (IDNR, 1998) as shown on Figure 4-4 (LCFPD, 1999).

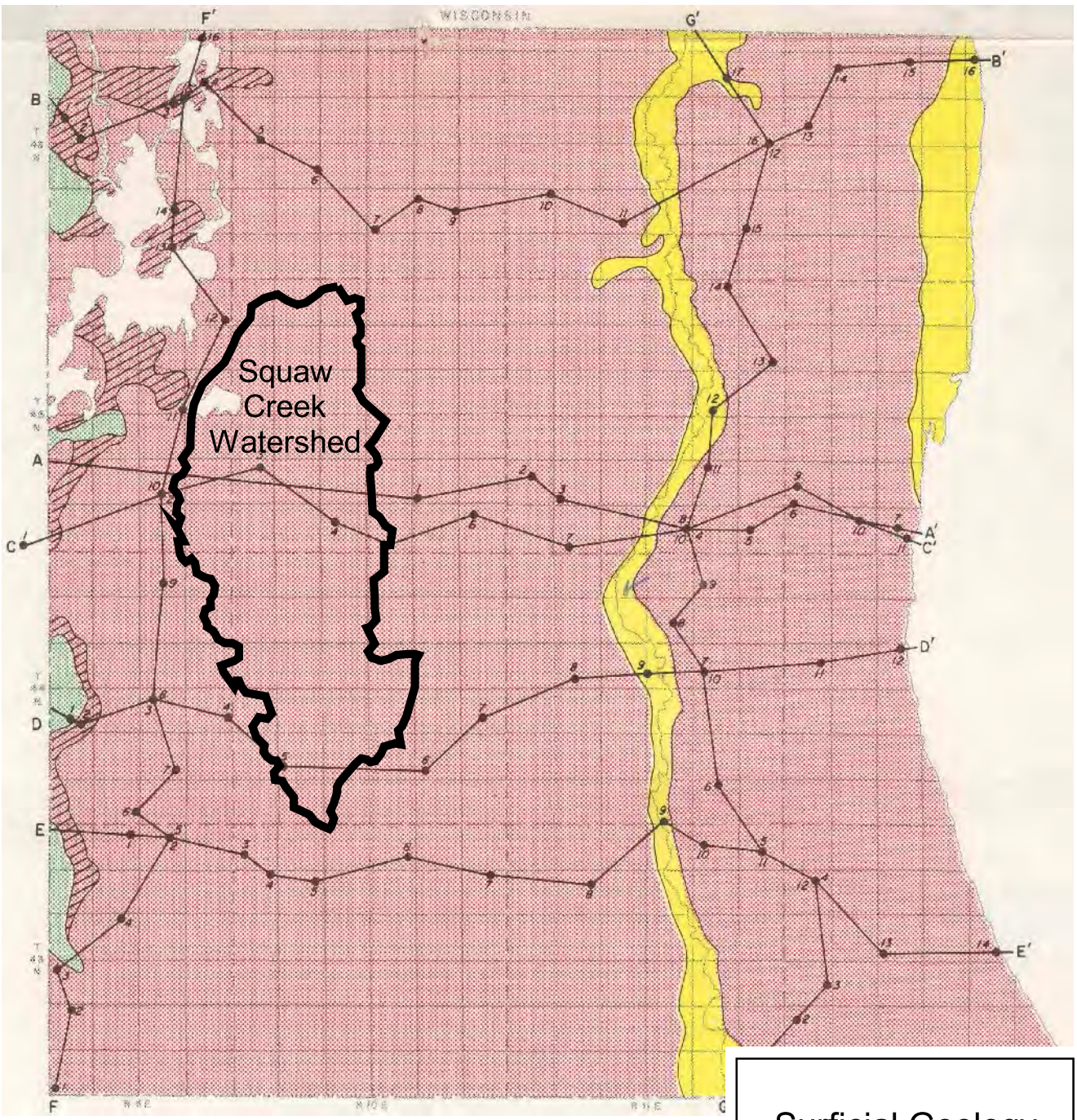
The prairie community included mesic, wet-mesic and wet prairie communities in the central, flatter, plain of the watershed. On areas of higher ground mesic savanna was present. The lowest areas of the watershed were covered by marsh and sedge meadow in the wetland community and by ponds and lakes that are still present. Figure 4-5 presents pre-settlement water resources in the watershed. It shows existing wetlands, ponds and streams but it also shows hydric soils that were wetlands prior to agricultural development. Figure 4-6 shows how these communities were replaced by agriculture throughout the watershed. The improvement of surface drainage by ditches and the addition of drain tiles to drain hydric soils for agriculture has eliminated most of the wet prairie and sedge meadow communities.

Squaw Creek Watershed

Poor aquifers and non-aquifers

Fair to poor aquifers

Good to excellent aquifers



Till and other clayey material

Surficial sand and gravel, 15 to 50 feet thick

Surficial sand and gravel, 50 to more than 100 feet thick

Lines of cross sections

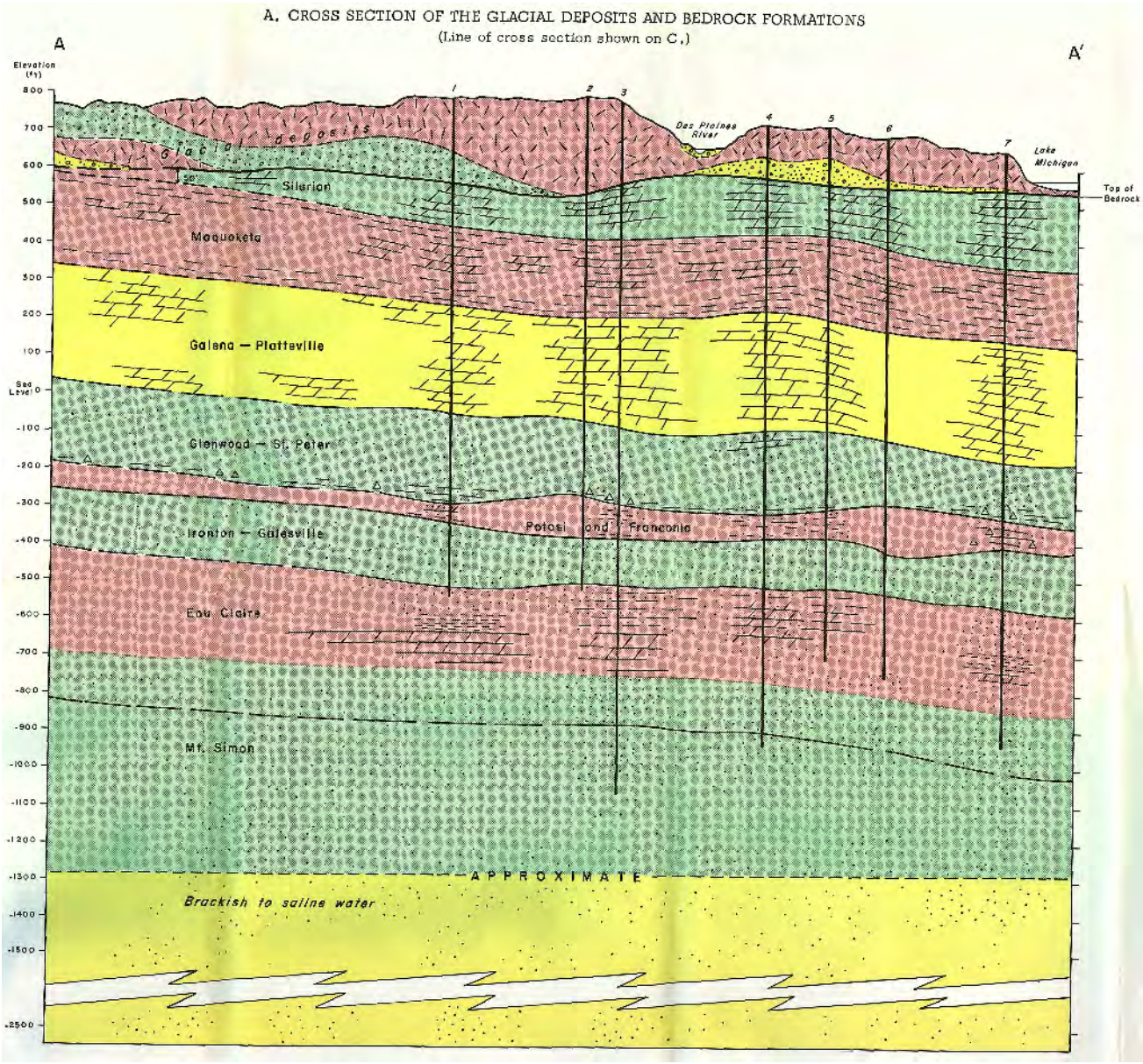
Drained upland sand and gravel

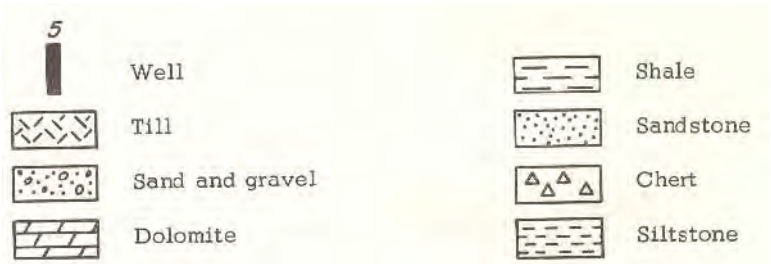
Surficial Geology Cross Section

Figure No. 4-3a

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

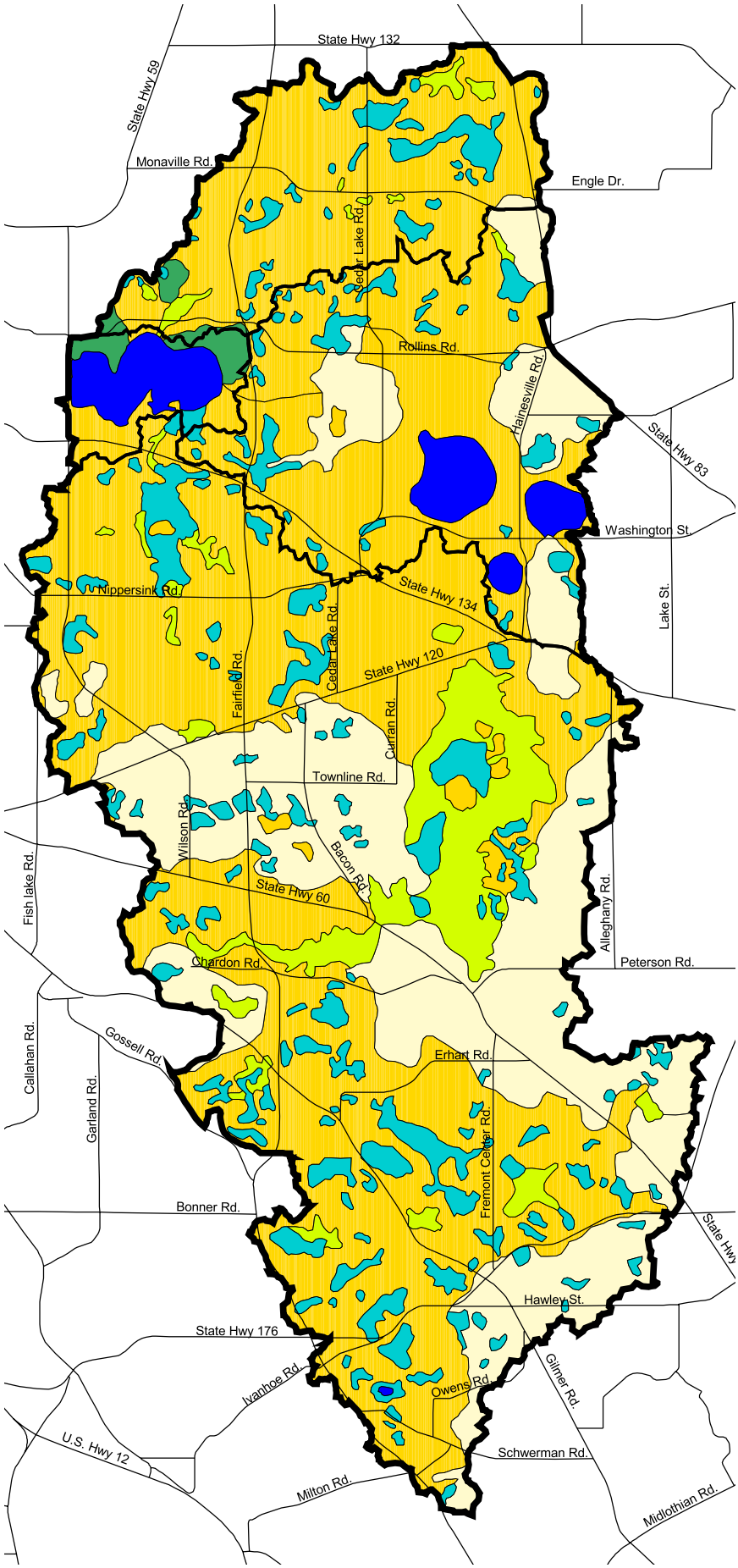




Surficial Geology Cross Section

Figure No. 4-3b

Prepared by: Hey and Associates, Inc. 2003 (kgk)



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

Pre-Settlement Vegetation

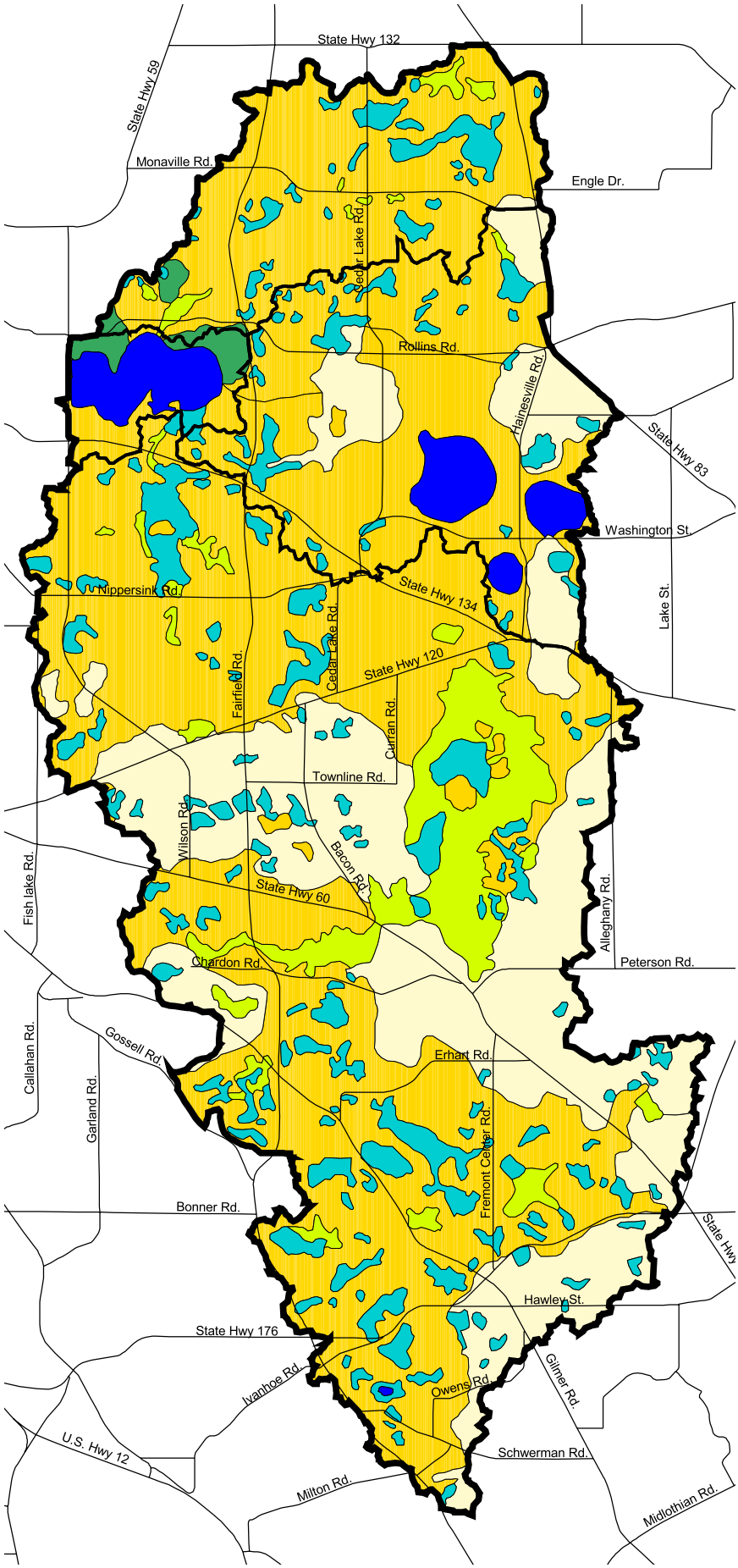
- Dry Mesic Upland Forest
- Marsh
- Prairie
- Savanna
- Water
- Wet Meadow/Prairie

SOURCE: Lake County Forest Preserve District

Pre-Settlement Vegetation

Figure No. 4-4

Prepared by: Hey and Associates, Inc. 2003 (kgk)



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

Pre-Settlement Vegetation

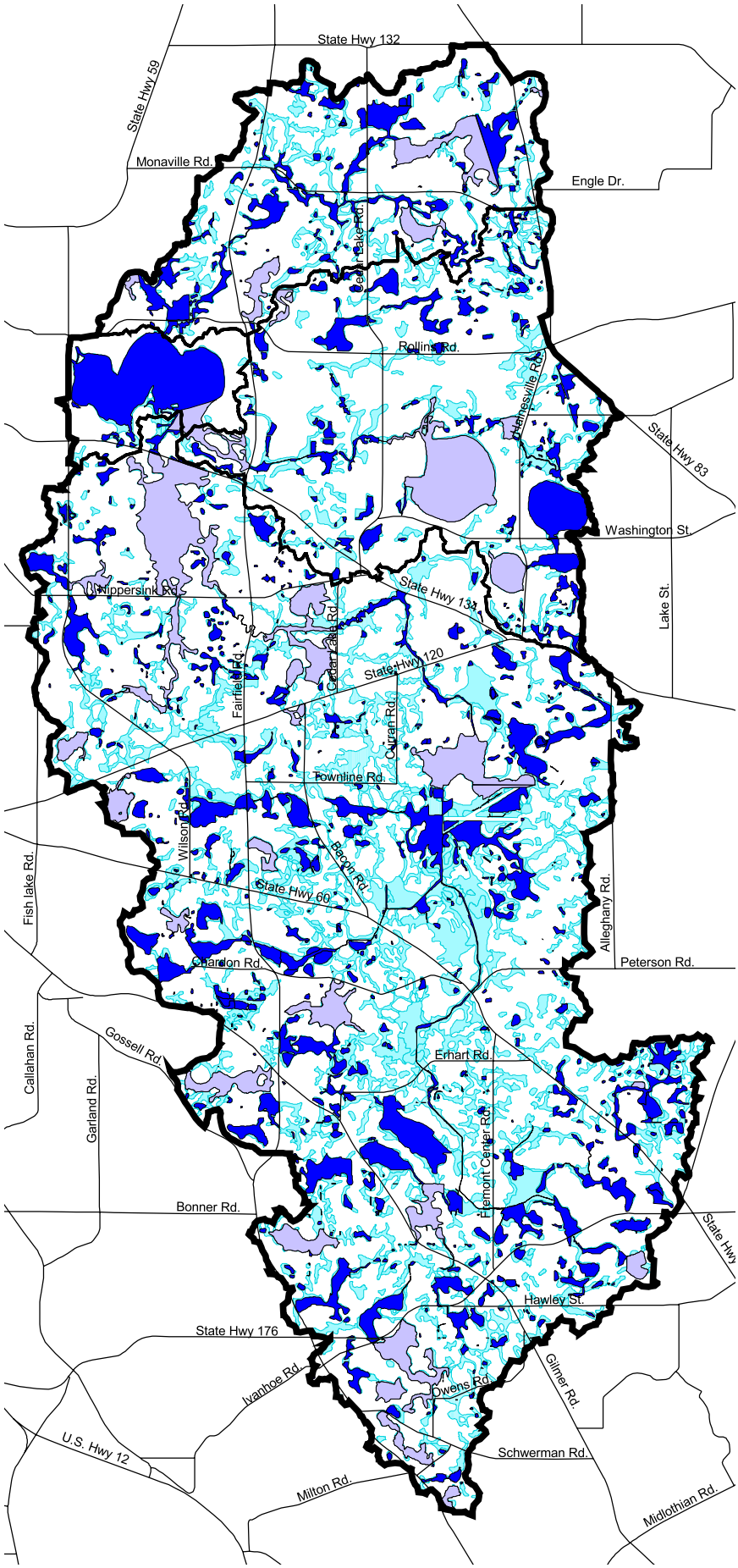
- Dry Mesic Upland Forest
- Marsh
- Prairie
- Savanna
- Water
- Wet Meadow/Prairie

SOURCE: Lake County Forest Preserve District

Pre-Settlement Vegetation

Figure No. 4-4

Prepared by: Hey and Associates, Inc. 2003 (kgk)



Squaw Creek Watershed

0 1 Miles

N

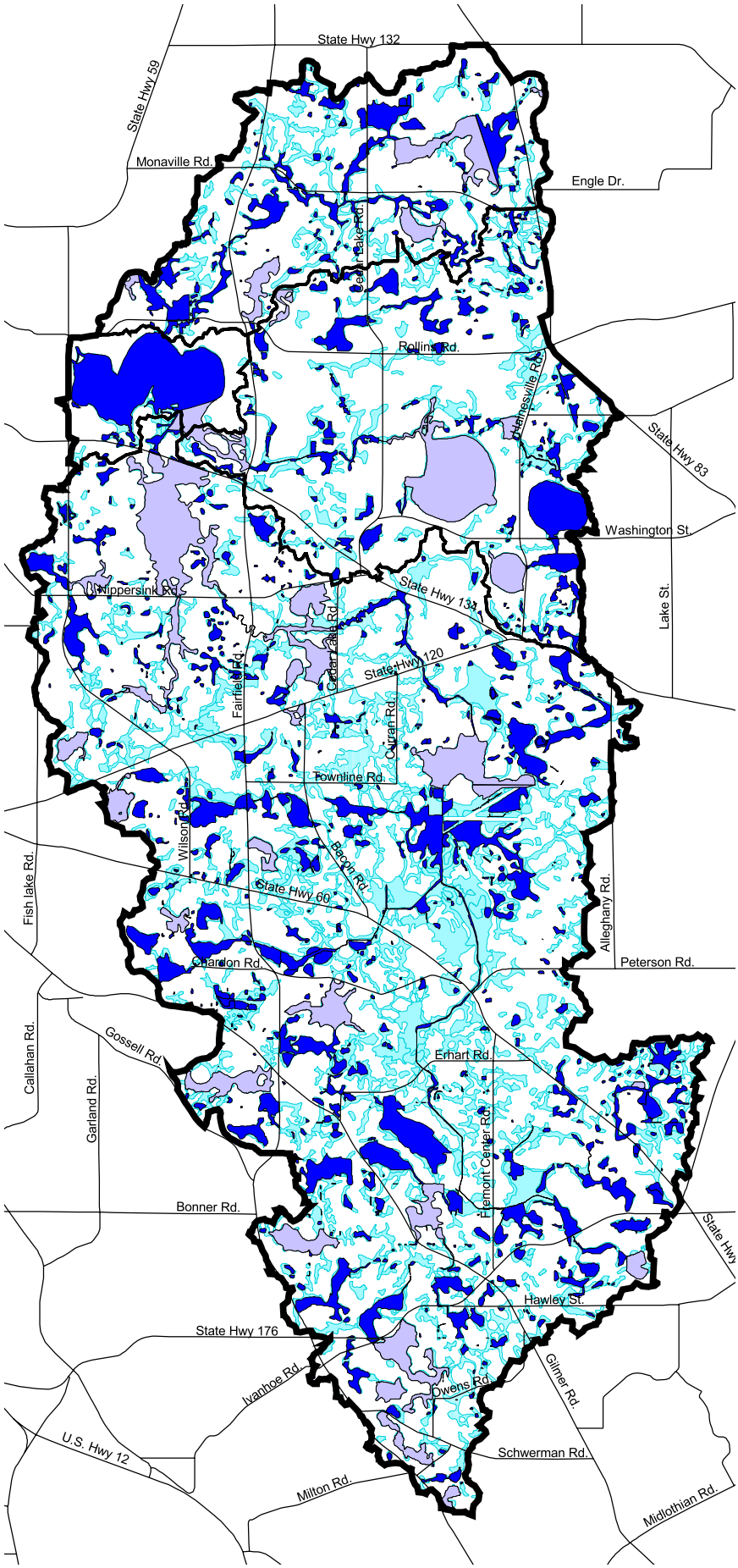
- Watershed Boundary
- Major Roads
- ADID Wetlands
- LCWI Wetlands
- Pre-Settlement Wetlands

SOURCE: Lake County Dept. of Information and Technology

Pre-Settlement Water Resources

Figure No. 4-5

Prepared by: Hey and Associates, Inc. 2003 (kgk)



Squaw Creek Watershed

0 1 Miles

N

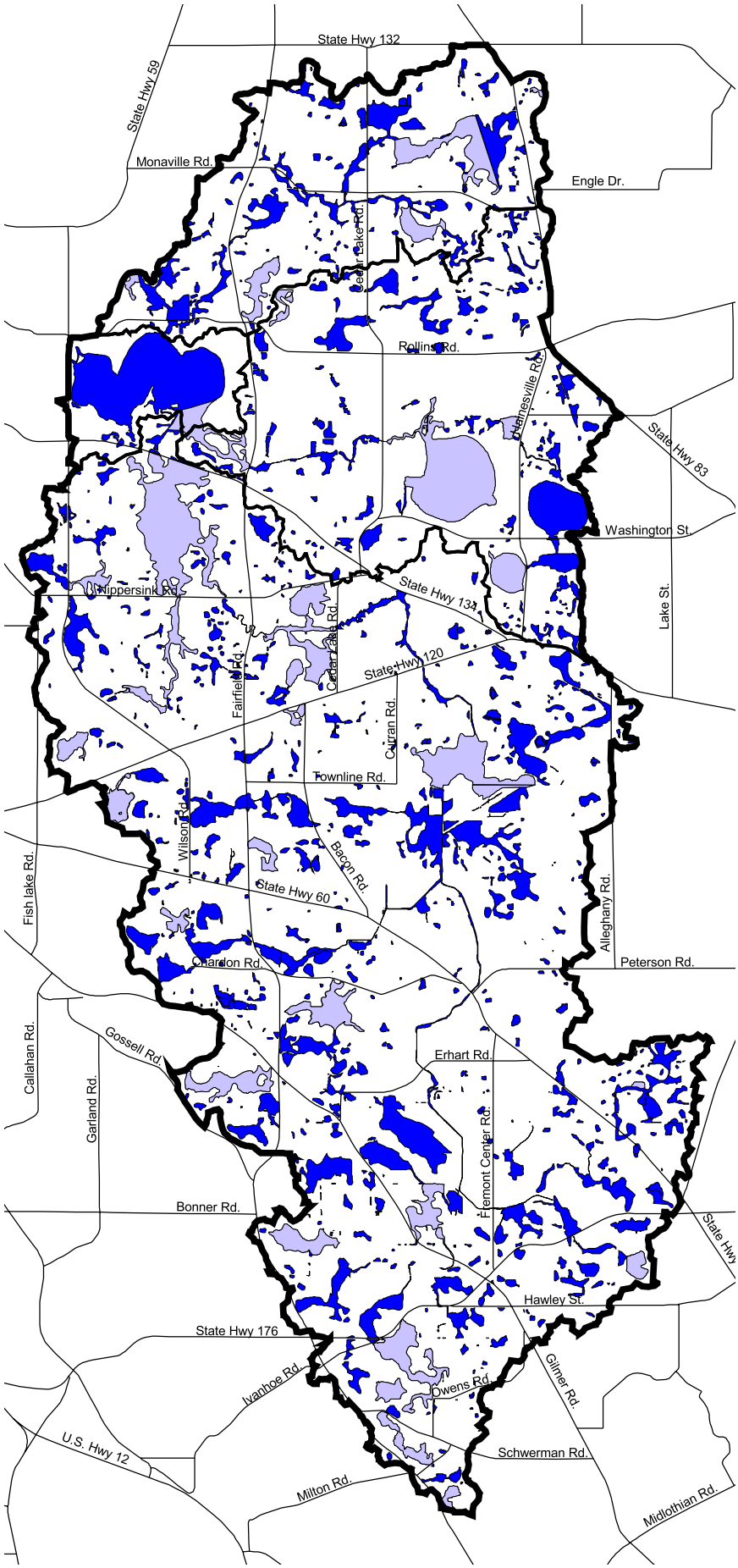
- Watershed Boundary
- Major Roads
- ADID Wetlands
- LCWI Wetlands
- Pre-Settlement Wetlands

SOURCE: Lake County Dept. of Information and Technology

Pre-Settlement Water Resources

Figure No. 4-5

Prepared by: Hey and Associates, Inc. 2003 (kgk)



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

ADID Wetlands

LCWI Wetlands

SOURCE: Lake County Dept. of Information and Technology

Effects of Agricultural Development

Figure No. 4-6

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Logging and suppression of fire has either eliminated the mesic savanna or transformed it into forest patches. The current open space in the watershed largely does not contain vegetation communities representative of the pre-settlement prairie, savanna, or sedge meadow wetland communities. Current open space is largely vegetated with marsh wetland, ponds, overgrown savanna, or farm fields.

4.6 HYDROLOGY

The critical role of hydrology in watershed planning was discussed generally in Chapter 3. All life that exists in a watershed and what types of life are shaped by hydrology. The terms that describe a watershed's hydrology and their values are presented below.

4.6.1 Hydrology Measurements

4.6.1.1 Streamflow

Measurements of Squaw Creek streamflow have been taken by the following sources at the locations indicated as shown on Figure 4-7.

- USGS Crest Stage Gages at Route 60, Route 120, and Route 134,
- ISWS Studies of the Chain of Lakes reported in 1977
- USGS Daily Stream Gage 05547755 at Route 134 from October 1, 1989 to Present
- Baxter Daily Stream Gages from July 18, 2001 through July 10, 2002 at Route 60, Nippersink Road a tributary to the Mainstem at Nippersink Road, Route 134, Fairfield Road, Rollins Road and Long Lake.

A summary of the USGS daily gage and Baxter data appear in Table 4-1.

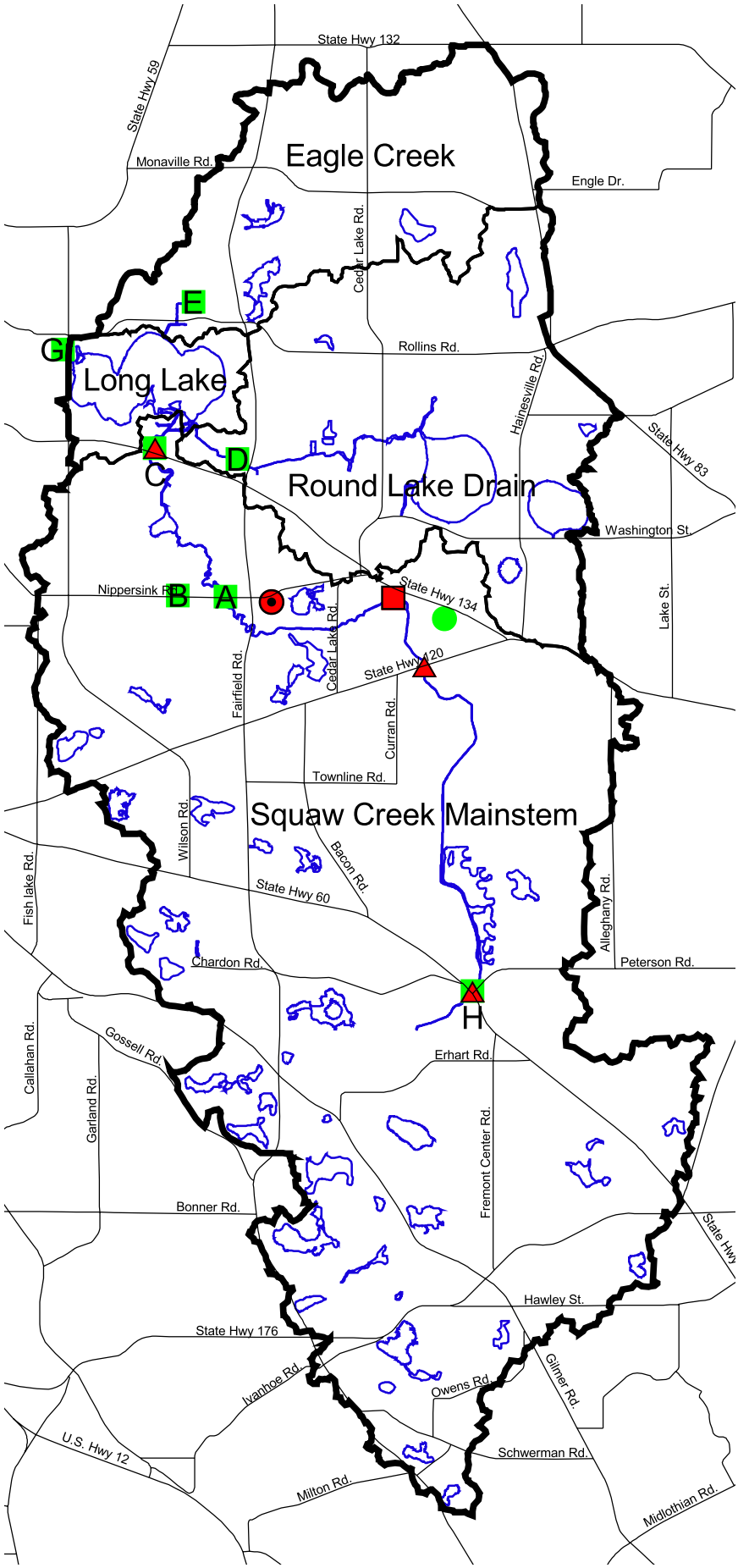
4.6.1.2 Precipitation

Precipitation data are recorded at the Illinois State Climatologist Office Station 114837 at Lake Villa. This site is sufficiently close to the Squaw Creek watershed to provide useful information, and it was the most complete set of climate data available for the general area. Table 4-2 summarizes the average precipitation for the Squaw Creek watershed.

4.6.2 Hydrology Statistics

The hydrology of watersheds is described by key statistics and by means of a water budget as was discussed in Chapter 3 and will be presented later for Squaw Creek. The important statistics for a watershed are listed below.

Yield (inches)	Annual water flow out of a watershed expressed as volume in inches of water over watershed area.
Variability	The range of streamflow and how variable these discharges are on a daily basis.



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

Rain & Stream Gages

USGS Crest Stage Gage

USGS Daily Stream Gage

Baxter Daily Stream Gage

USGS Rain Gage

SMC Rain Gage

Water

SOURCES: USGS, SMC, Baxter

Streamflow Measurement Sites

Figure No. 4-7

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Table 4.1: Stream Flow Measurement Summary

Gage Identification	Location	Average Flow (cfs)	Maximum Flow (cfs)	Minimum Flow (cfs)
USGS 05547755	Squaw Creek at MacGillis Road, Round Lake	15.8	284	0
Baxter A	Squaw Creek at Nippersink Road	19.9	208.8	0.3
Baxter B	Squaw Creek Tributary at Nippersink Road	3.8	25.1	0.6
Baxter C	Squaw Creek at Route 134	23.5	173.5	0.6
Baxter D	Round Lake Drain at Fairfield Village Access Road	4.2	66.4	0.0
Baxter E	Eagle Creek at Al's Place	7.1	148.7	0.0
Baxter G	Long Lake Spillway	34.9	342.4	0.4
Baxter H	Squaw Creek at Route 60	4.9	32.3	0.0

Table 4-2: Climate Data (from Lake Villa Data Station)

Month	Temperature			Precipitation	
	Average High (ºF)	Average Low (ºF)	Average Mean (ºF)	Average Precipitation (in)	Average Snow and Sleet (in)
January	30.4	15.3	22.9	2.17	13.9
February	34.4	18.9	26.7	1.75	9.6
March	44.1	26.9	35.5	2.19	5.3
April	56.4	37.1	46.8	3.75	1.3
May	68.7	47.6	58.2	3.53	0.1
June	78.4	57.5	68.0	4.15	0.0
July	82.3	62.9	72.6	3.44	0.0
August	80.1	62.1	71.1	3.73	0.0
September	72.2	53.5	62.9	3.60	0.0
October	59.7	41.7	50.7	2.67	0.2
November	46.2	30.9	38.6	2.59	3.2
December	34.0	19.9	27.0	1.91	10.3
Average/Total	57.2	39.5	48.4	35.48	43.9

Source: Illinois State Climatologist Office

4.6.2.1 Yield

The total yield of the Squaw Creek Mainstem watershed as measured at Route 134 is 12 inches per year or about 33 percent of annual precipitation. Yields were calculated from daily discharge observations. This yield is higher than, but similar to, other watersheds in Lake County as shown in Table 4-3.

Table 4-3: Annual Yield Comparison

Watershed	Annual Yield (in)
Squaw	12.0
Flint	11.3
Indian Creek	11.3
Mill Creek	10.1
Bull Creek	9.9

Data collected by Baxter Inc. as part of an independent study in 2000-2001, indicated that the yield may vary at different locations in the watershed. The yields for the various subwatersheds measured by Baxter are as follows in Table 4-4.

Table 4-4: Baxter Study -- Yields of Squaw Creek Sub-Watersheds

Subwatershed	Area (mi^2)	Yield 2001-2002 (in)
Mainstem at Nippersink Road	19.7	12.7
Tributary to Mainstem at Nippersink Road	3.47	9.1
Mainstem at Hwy 134	25.4	11.8
Round Lake Drain at Fairfield Road	6.9	8.4
Eagle Creek at Rollins Road	4.4	14.9
Long Lake Outlet	39.45	10.2
Mainstem above Rte. 60	9.42	5.4

The total yield of the subwatersheds as derived from measurements by Baxter provides some insight into the potential future effect of new development on yield. They also provide insight into the effect of agricultural development on current yields. The Squaw Creek mainstem at Route 60 has the smallest yield and also has the least amount of agricultural development. The yield of the Mainstem at Route 134 is 120 percent higher than at Route 60, illustrating the effect of field tiles and channelization.

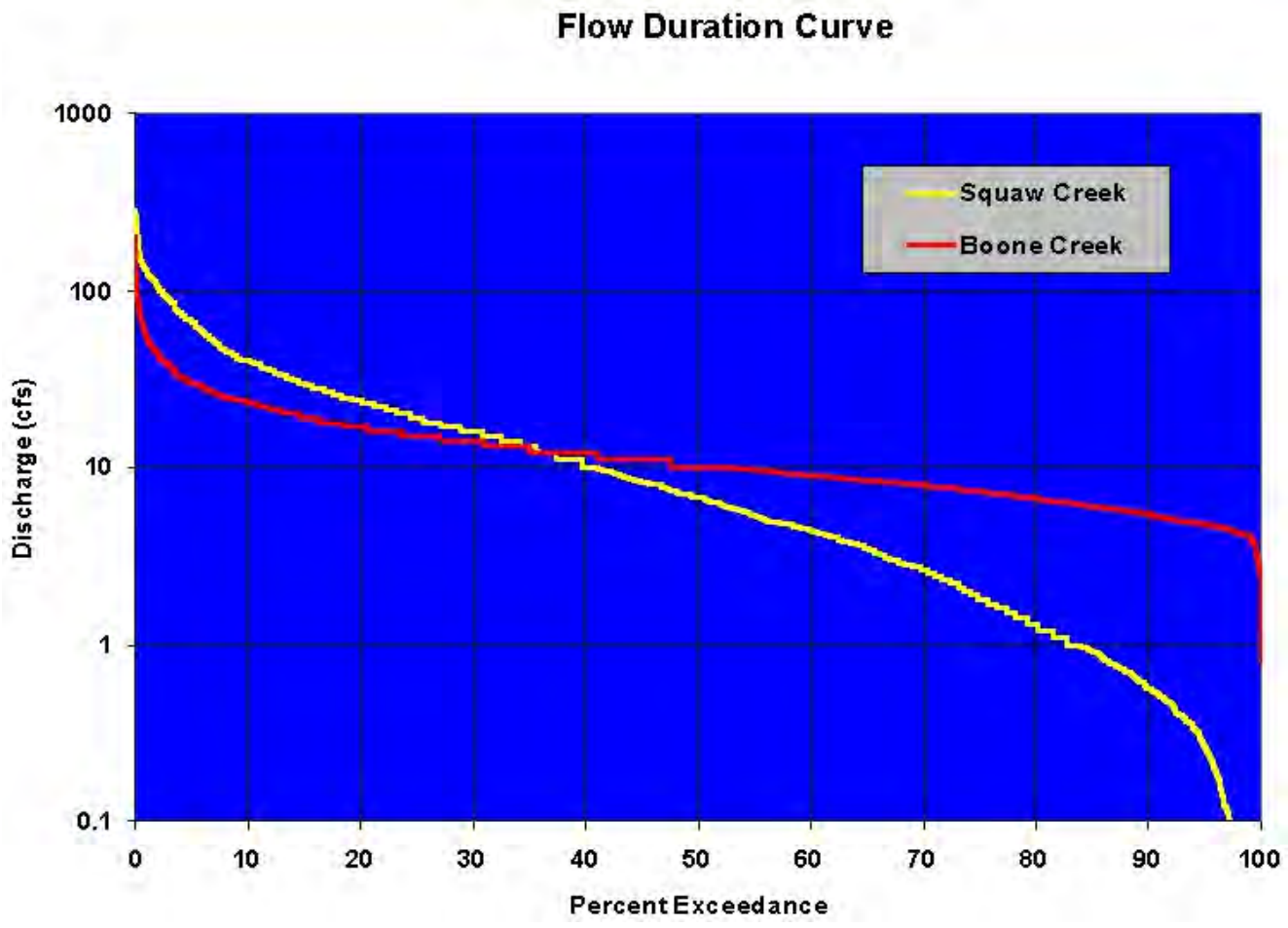
The results of the annual yield calculation at the Eagle Creek and Round Lake Drain gages are interesting. The value of 14.88 inches for Eagle Creek seems high, and the value of 8.4 inches for the Round Lake Drain seems low relative to the Squaw Creek Mainstem. Given the land cover of each watershed, one would expect Eagle Creek yield to be less than the Mainstem and Round Lake Drain more, based on their degree of urbanization. The reported values were calculated using daily Baxter data. However, the Eagle Creek and Round Lake Drain results should be investigated further. It is possible that the presence of Round Lake and Highland Lake in the Round Lake Drain are reducing yields through evaporation.

4.6.2.2 Flow Variability

Variability in streamflows is a good indicator of the permeability of watershed soils, watershed slope, presence of farm tiles, amount of channelization and degree of urbanization and storm sewers. Figure 4-8 illustrates these points by comparing the distribution of flow rates on any day as measured for Boone Creek in McHenry County and Squaw Creek at Route 134. These watersheds are very similar in size (about 17 square miles) at the measurement point. Both have significant agricultural and drainage improvements. The watersheds are different, however, in that Boone Creek has a more permeable surficial geology. Flow data from USGS gages 05547755 (Squaw Creek) and 05549000 (Boone Creek) were used to compare streamflow variability. The coefficient of variation of daily flow rates was used for comparison (Haan, Barfield, and Hayes, 1981). The coefficient of variation for Boone Creek flows was calculated as 0.81, while the coefficient of variation for Squaw Creek flows was calculated as 1.60, indicating that

flow is much more variable in Squaw Creek. Streamflow in Boone Creek is less variable particularly for smaller events. This stability provides a more stable aquatic habitat and less energy to cause streambank erosion.

Squaw Creek Watershed



Squaw Creek Streamflow Variability

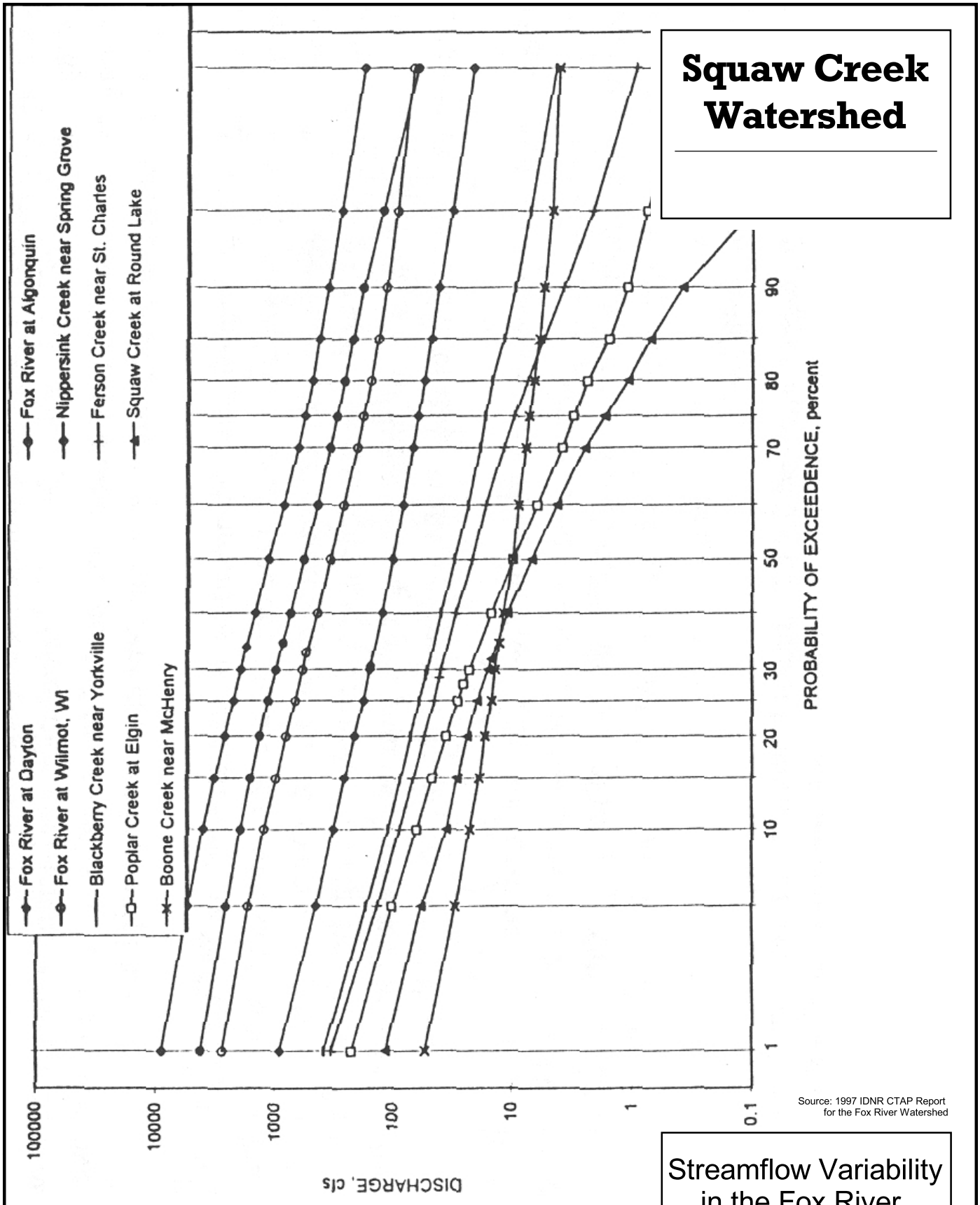
Figure No. 4-8

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Soils in the Squaw Creek watershed have always been relatively impermeable which would typically lead to a higher degree of streamflow variability. However, prior to development, flow in Squaw Creek was stabilized by a lack of defined channels. Water would pool in wetlands and ponds and move slowly toward lakes and the Fox River. Once drainage was improved, a highly variable streamflow regime developed. This variability exists not only for flows at the USGS gage location (as described above), but also in the Round Lake Drain and Eagle Creek watersheds. The coefficient of variation of flow measurements from the Baxter gage at Squaw Creek at Route 60 was 1.81; at Round Lake Drain, 1.51; and at Eagle Creek, 1.63.

The IDNR also has analyzed the variability of streamflow for a number of watersheds in the Fox River Basin (IDNR, 1998). Figure 4-9 is copied from that report and shows that Squaw Creek flows are the most variable of all tributaries to the Fox that were studied. The IDNR felt that this variability was due mostly to the clay soils in the watershed (IDNR, 1998), but the significant drainage improvements for agriculture are likely a part of the reason for this variability as well.

Comparison of flow variability in Squaw Creek and Boone Creek further suggests that the distribution of stormwater among various components of the water budget is markedly different between the two watersheds. Again, the daily flow values from the USGS gages at Squaw Creek and Boone Creek were analyzed, and the proportions of flow occurring from various event magnitudes were examined. The USGS determines the thresholds containing 10 percent, 50 percent, and 90 percent of daily flow values, and this was examined for both creeks. The flow exceedence statistics resulting from this analysis are contained in Table 4-5.



Squaw Creek Watershed

Source: 1997 IDNR CTAP Report for the Fox River Watershed

Streamflow Variability in the Fox River Watershed

Figure No. 4-9

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Table 4-5: Flow Exceedence Thresholds for Squaw and Boone Creeks

Stream	10% of Flows (cfs) Exceeding Value	50% of Flows (cfs) Exceeding Value	90% of Flows (cfs) Exceeding Value
Squaw Creek	40	6.8	0.56
Boone Creek	22.8	9.9	5.5

These results again indicate that flow in Squaw Creek is highly variable compared to another watershed of similar size. Groundwater baseflow appears to be a relatively insignificant contribution to flow in Squaw Creek, based on the small flow that is exceeded 90% of the time and the large spread of values among the 90%, 50%, and 10% flows. If baseflow were a more significant component, as in the case of Boone Creek, flow would be more stable, and the flow values would be clustered more closely together. This is not a surprising conclusion, given the nature of the soils and surficial geology in the Squaw Creek watershed, which limits the amount of infiltration.

4.6.2.3 Precipitation Variability

The frequency, duration and amount of precipitation in relation to interception and surface storage capacity, antecedent soil moisture conditions, and soil infiltration capacity determines the volume and rate of surface runoff. Most precipitation events occurring in this watershed are moderate in duration and quantity. To produce surface runoff, storm events typically must deliver a precipitation depth greater than or equal to about 0.10 to 0.20 inches, in order to fill the available interception and surface storage. This is true even in the case of rain falling on an impervious surface. Approximately 60 such events occur each year in Northeastern Illinois.

Figure 4-10, Storm Runoff Volumes by Land Use, shows that about 90 percent of surface runoff volume annually comes from precipitation events less than 3 inches , the daily rainfall that occurs on average once a year.

The importance of Figure 4-10 is to show that 90 percent of runoff volume and also runoff pollutant loads annually comes from small events. This means that if these frequent small events can be managed, the reduction in pollutant load will be large. It is not necessary to capture and treat large or infrequent runoff events to have a significant effect on water quality.

4.6.3 Water Budget

The concept and importance of water budgets was discussed in Chapter 4. Figure 4-11 is a conceptual presentation of the hydrologic cycle used to prepare a water budget. To evaluate the effect that agricultural and urban development has had on the hydrology of Squaw Creek water budgets were estimated for pre-settlement, agricultural development, 1975 land use, 1990 to current land use and projected 2020 land use. As discussed in Chapter 2 of the Plan, the hydrology of Squaw Creek has been dramatically altered by European settlement beginning about 1820. The rate and volume of runoff was increased by the development of agriculture from 1820 to 1940.

The rate of runoff was increased by new channels dredged through wetlands and by farm tiles placed to drain hydric soils and wetlands to these new channels. The volume of

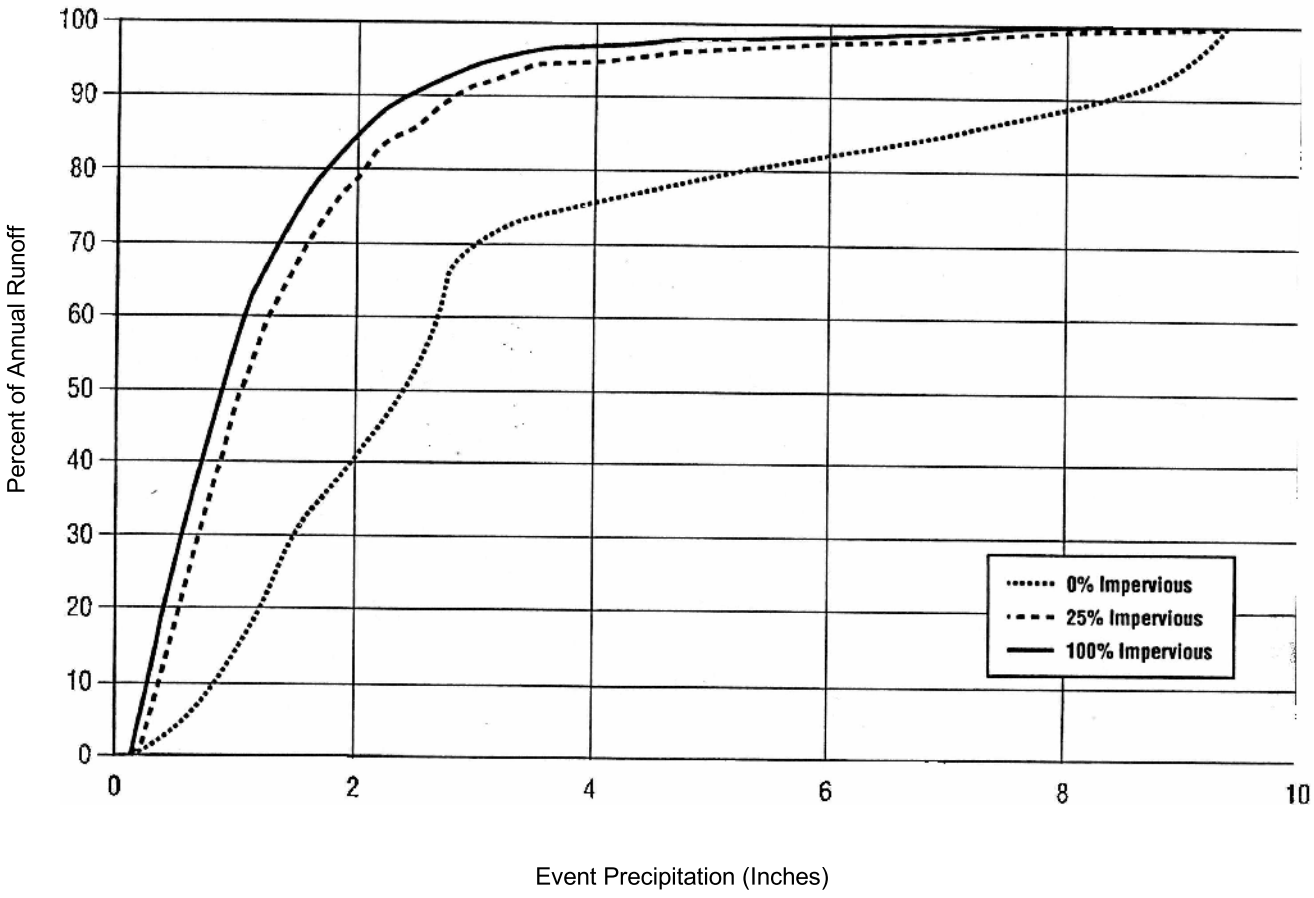
runoff was increased by the replacement of trees and prairie vegetation with corn and oats. This replacement reduced biomass and with it interception storage and evapotranspiration. This resulted in more runoff volume as less water was stored on vegetation and evapotranspirated into the air.

The effect of these changes on the hydrology of Squaw Creek can be seen by examining the estimated annual water budget for the watershed at Long Lake. The water budget was calculated using expected land cover changes based on NIPC population forecasts. Hydrologic factors were taken from USGS and NIPC studies and research on prairie hydrology (Byre, 1997). Appendix I documents the approach in more detail.

Figure 4-12 presents the changes in evapotranspiration for the watershed with changing land use. It shows that evapotranspiration was reduced by an estimated 25 percent based on unit yields for different land covers developed by the USGS and NIPC (USGS, 1995; NIPC, 1996). Shallow groundwater flow in the soil column above surficial geologic formations (interflow) increased because of the installation of farm tiles and channels to receive the flow from these tiles (Figure 4-13). Shallow groundwater flow would be expected to decrease and become surface runoff as development replaces farm fields with impervious cover. Surface runoff was increased 100 percent by agricultural development relative to the pre-agriculture condition. Surface runoff increased 190 percent relative to the agricultural condition as a result of urban development up to the year 2000, and it is expected to increase by another 50 percent with future development over the next 20 years as shown in Figure 4-14.

The overall effect of these changes on total watershed flow reaching Long Lake is shown in Figure 4-15. Development of the watershed for agriculture increased the total annual yield (expressed as inches of water over the entire watershed reaching Long Lake) by about 150 percent. Urban development is ultimately expected to increase runoff volume by approximately 10 percent beyond the agricultural condition. This small additional increase reflects the high yield of agricultural drainage via farm tiles and shallow groundwater flow.

Squaw Creek Watershed



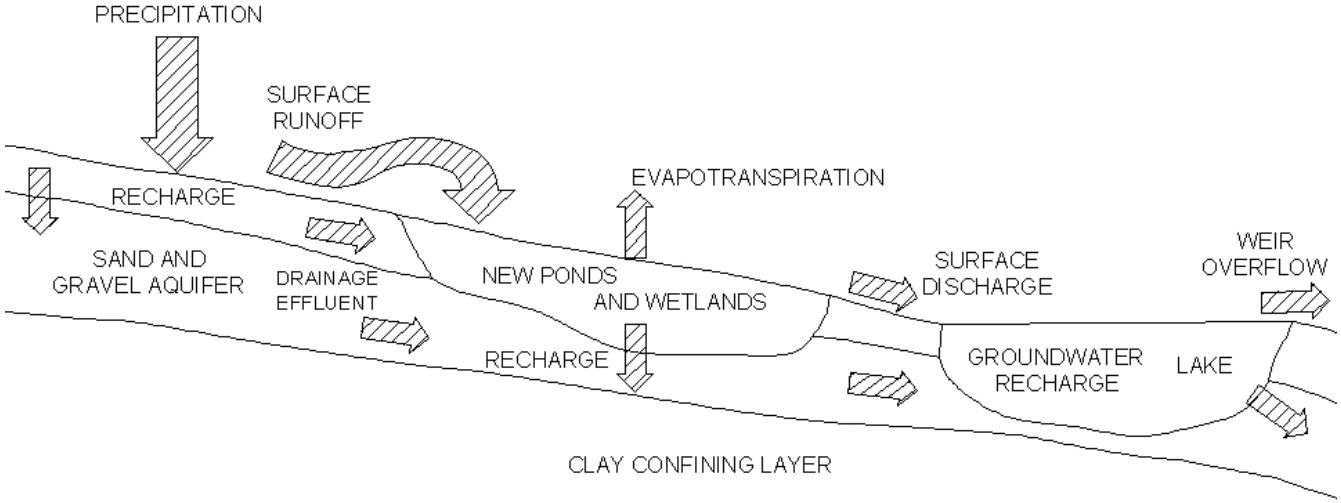
Source: Urban Stormwater Best Management Practices for Northeastern Illinois, January 2000. By: Northeastern Illinois Planning Commission. Assisted by: CH2M Hill

Storm Runoff Volumes by Land Use

Figure No. 4-10

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

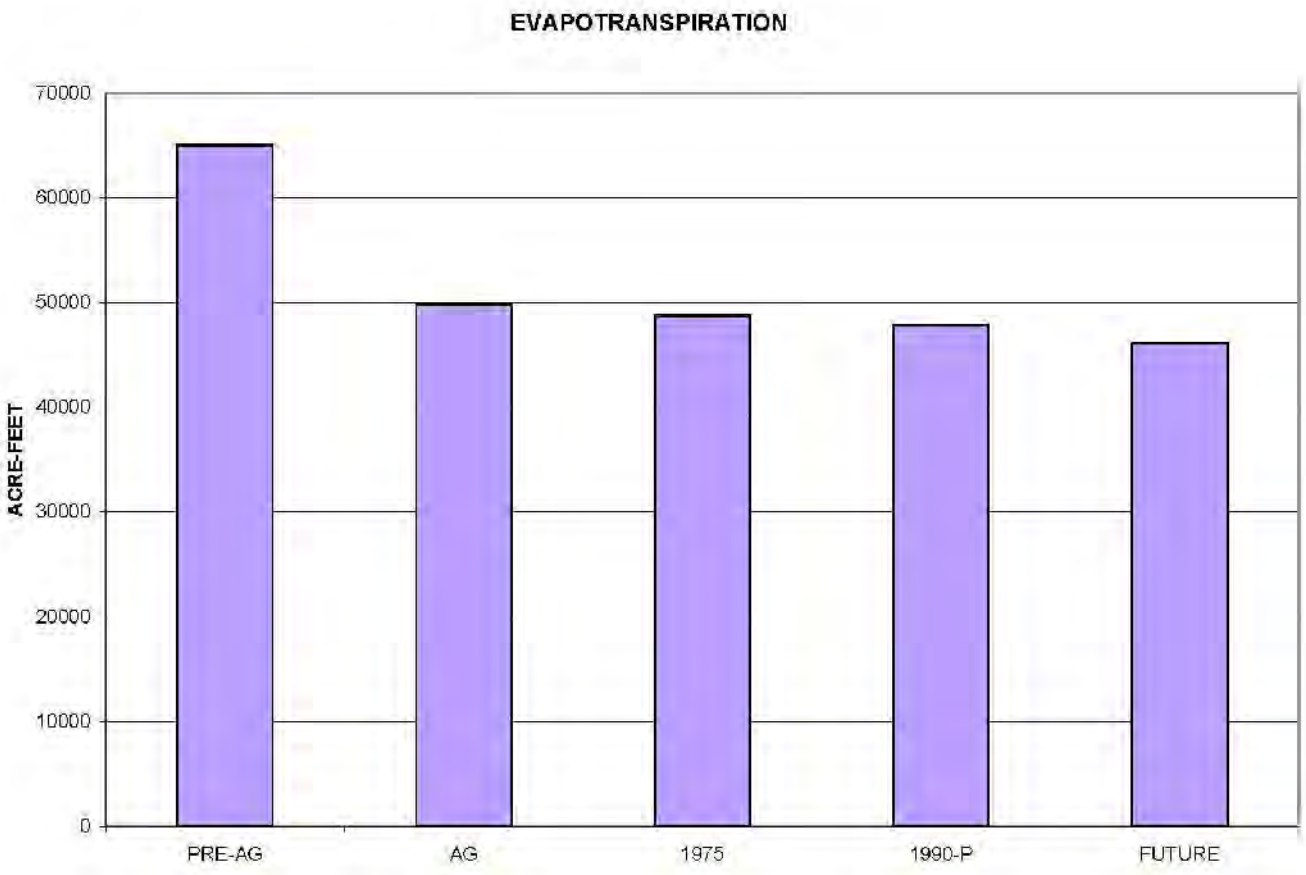


Hydrologic Cycle

Figure No. 4-11

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

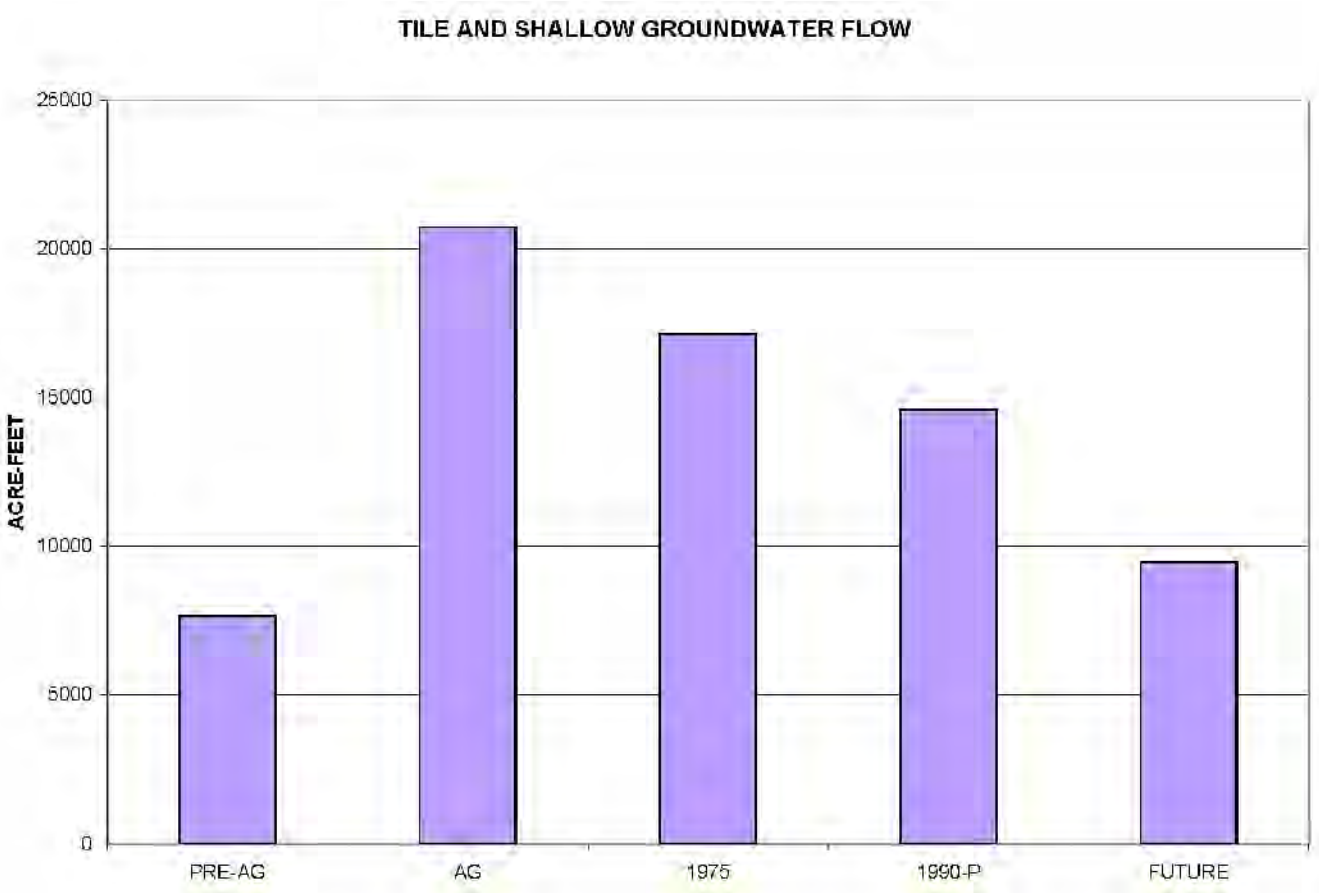


Evapotranspiration Changes Due to Development

Figure No. 4-12

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

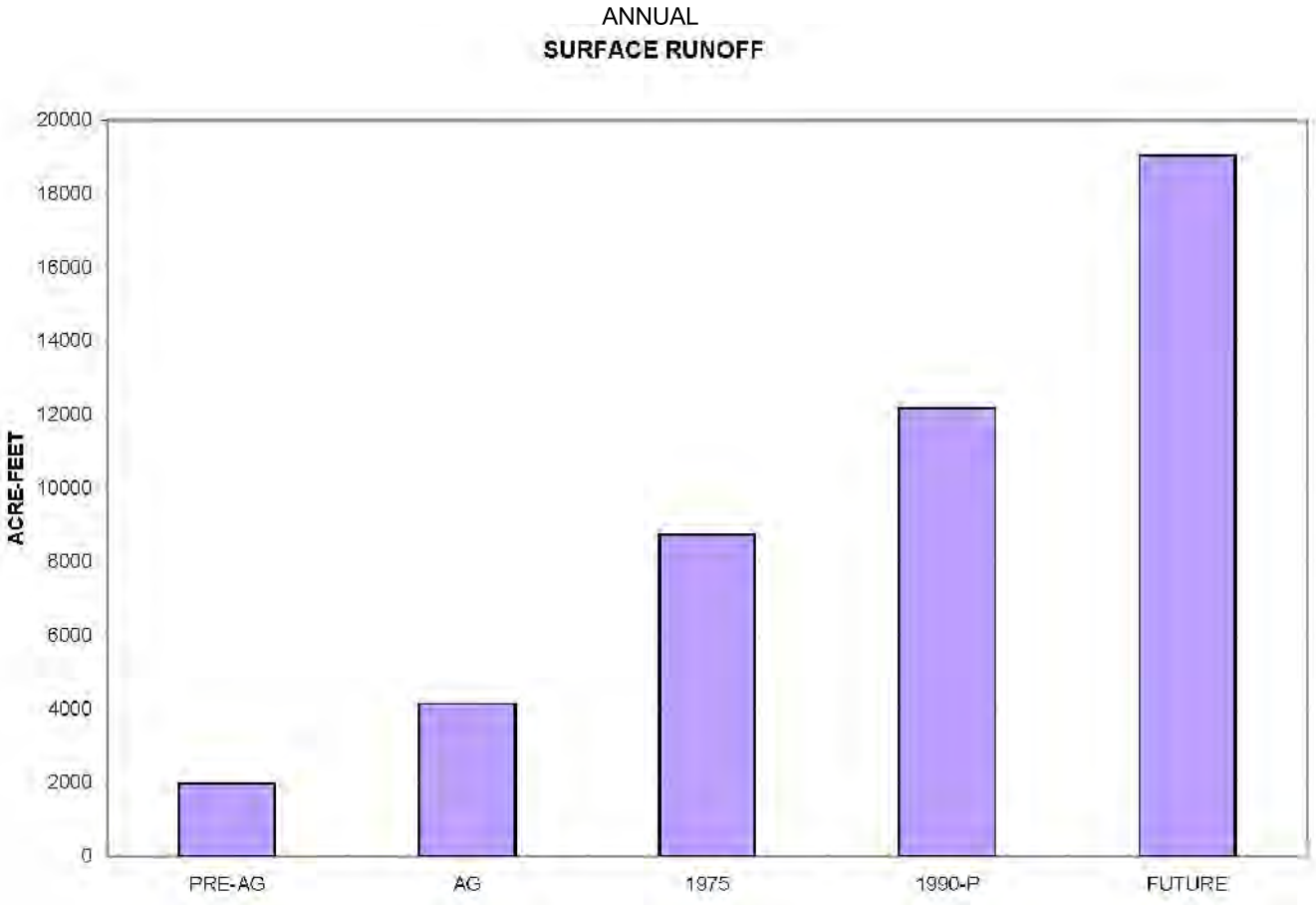


Tile and Interflow Changes Due to Development

Figure No. 4-13

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

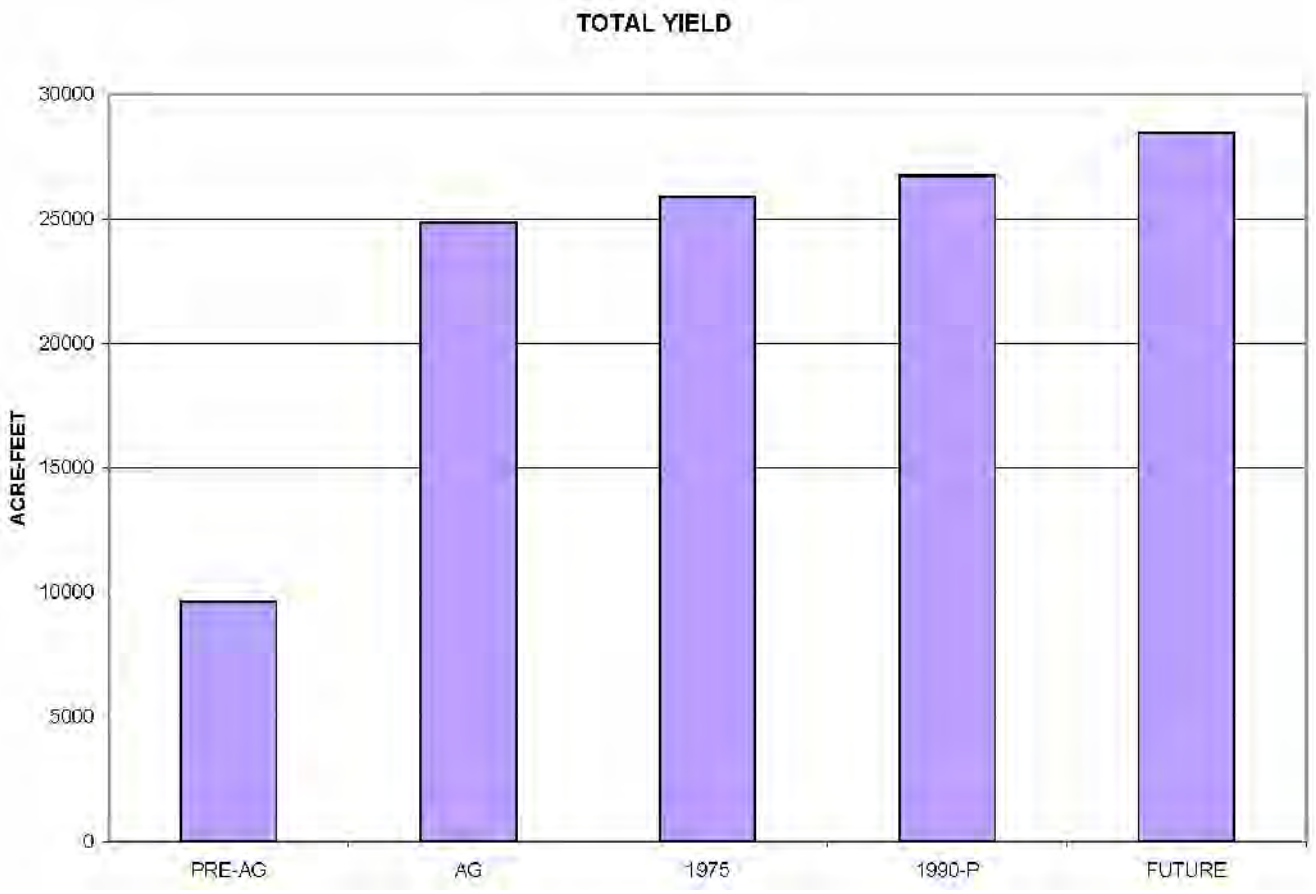


Annual Surface Runoff Changes Due to Development

Figure No. 4-14

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed



Streamflow Yield Changes Due to Development

Figure No. 4-15

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Urban development through the year 2020 is expected to increase the yield by another ten percent. This small additional increase is due to the relatively small amount of direct surface runoff in the annual yield. Most of the yield is developed from interflow (estimated 80 percent in 1975 and an estimated 70 percent in 2020) contributed by tiles and lateral flow through soil.

The water budgets suggest that surface runoff will increase from about 21 percent to about 30 percent of total yield over the next 20 years. The significance of surface runoff suggests that it be carefully managed as a pollutant source.

4.7 LAND USE

General

The land use for the Squaw Creek watershed above Long Lake is significantly different for each of the three contributing watersheds. The Mainstem is still largely agricultural and rural but now is experiencing major residential development particularly north of Route 60. The Eagle Creek watershed experienced development north and south of Monaville Road in the mid-1990s but remains somewhat rural because of floodplain and wetland constraints. The Round Lake Drain was almost completely developed between 1950 and 1990.

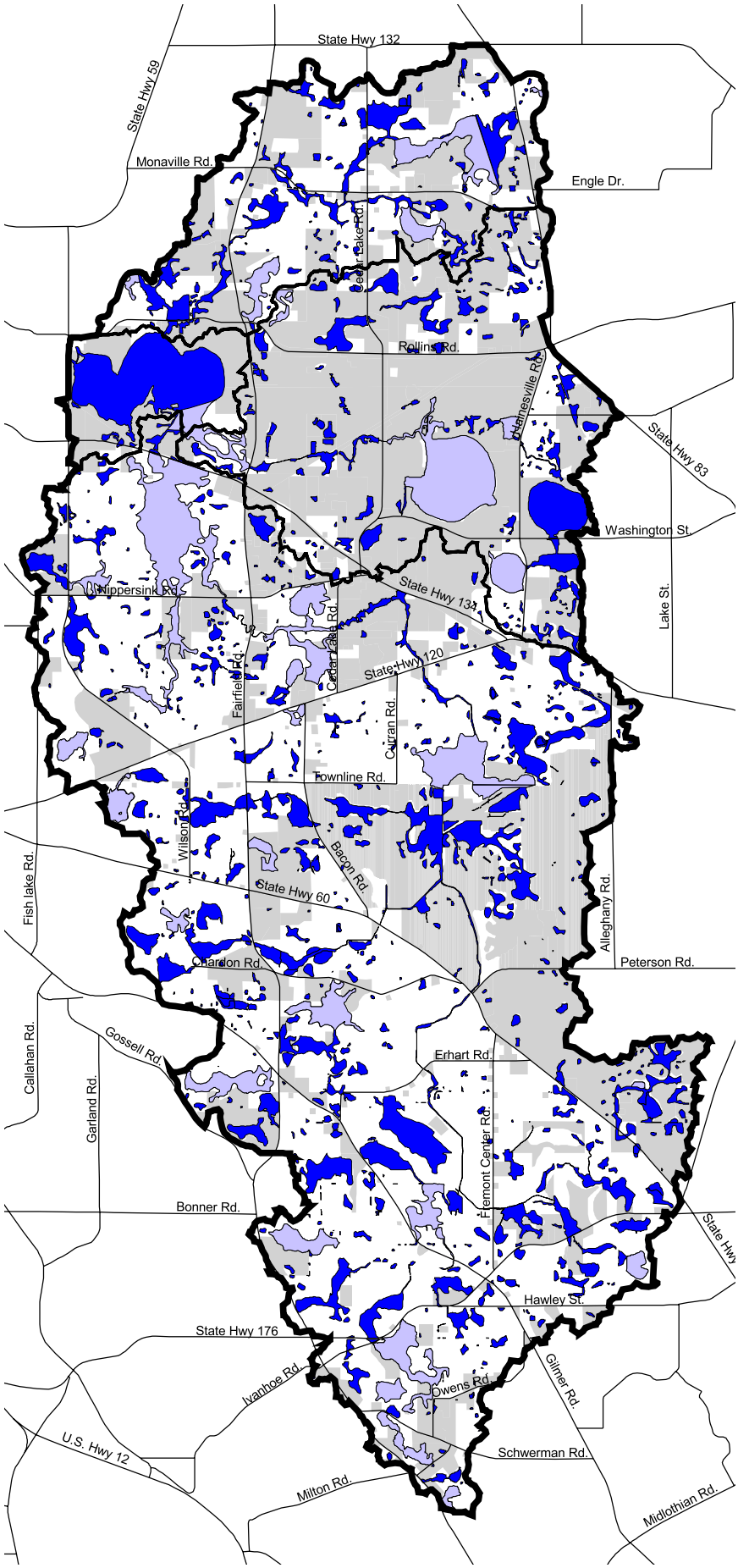
Historic Trends

Development began in the watershed after 1820 with the earliest settlements for agriculture. There was no significant urban development in any of the watersheds prior to World War II (except around the lakes) with the population less than 20,000 or about 500 people per square mile of watershed in 1960. By 1960 the population in the Round Lake Drain watershed had doubled, with Round Lake Beach at 5,011 population and Round Lake Park at 2,536. Growth slowed somewhat in the next decade with only about a 20 percent increase in total population but accelerated again from 1970 to 1980 as shown in Table 4-6 to 16,434 people in Round Lake Beach, 4032 people in Round Lake Park, and 2,644 people in Round Lake.

Table 4-6: Population Trends

Community	1950	1970	Percent Increase 1950-1970	1990	Percent Increase 1970-1990	2000	Percent Increase 1990-2000
Hainesville	154	142	- 7%	134	- 5%	2129	1488%
Round Lake	573	1531	167%	3550	132%	5842	65%
Round Lake Beach	1892	5717	202%	16434	187%	25859	57%
Round Lake Heights	uninc	1144		1251	9%	1347	8%
Round Lake Park	1836	3148	71%	4045	28%	6038	49%
Avon Township	2796	3165	13%	2811	- 11%	2386	- 15%
Fremont Township	1906	4019	111%	4552	13%	5421	19%
Grant Township (part)	3154	6496	106%	7666	18%	8592	12%
Lake Villa (part)	2224	7362	231%	9873	34%	9329	- 5%

Figure 4-5 presented an estimation of pre-settlement water resources features including wetlands based on the extent of hydric soils and open water in the watershed. Figure 4-6 presented the effect that agricultural development had on these water resources. It shows wetlands and open water remaining in 1993 based on the Lake County Wetland Inventory GIS layer. Figure 4-16 shows the extent of urbanization as of 1995 in a gray tone based on Lake County Land Use GIS data. The County currently is updating its land use inventory and database to incorporate 2000 land use. Finally, Figure 4-17 presents the progression of land use change through the watershed from pre-settlement to 1995. The loss of wetlands due to agriculture and the replacement of agriculture with urban development is apparent.



Squaw Creek Watershed

0 1 Miles

N

- Watershed Boundary
- Major Roads
- ADID Wetlands
- LCWI Wetlands
- Urban Landuses

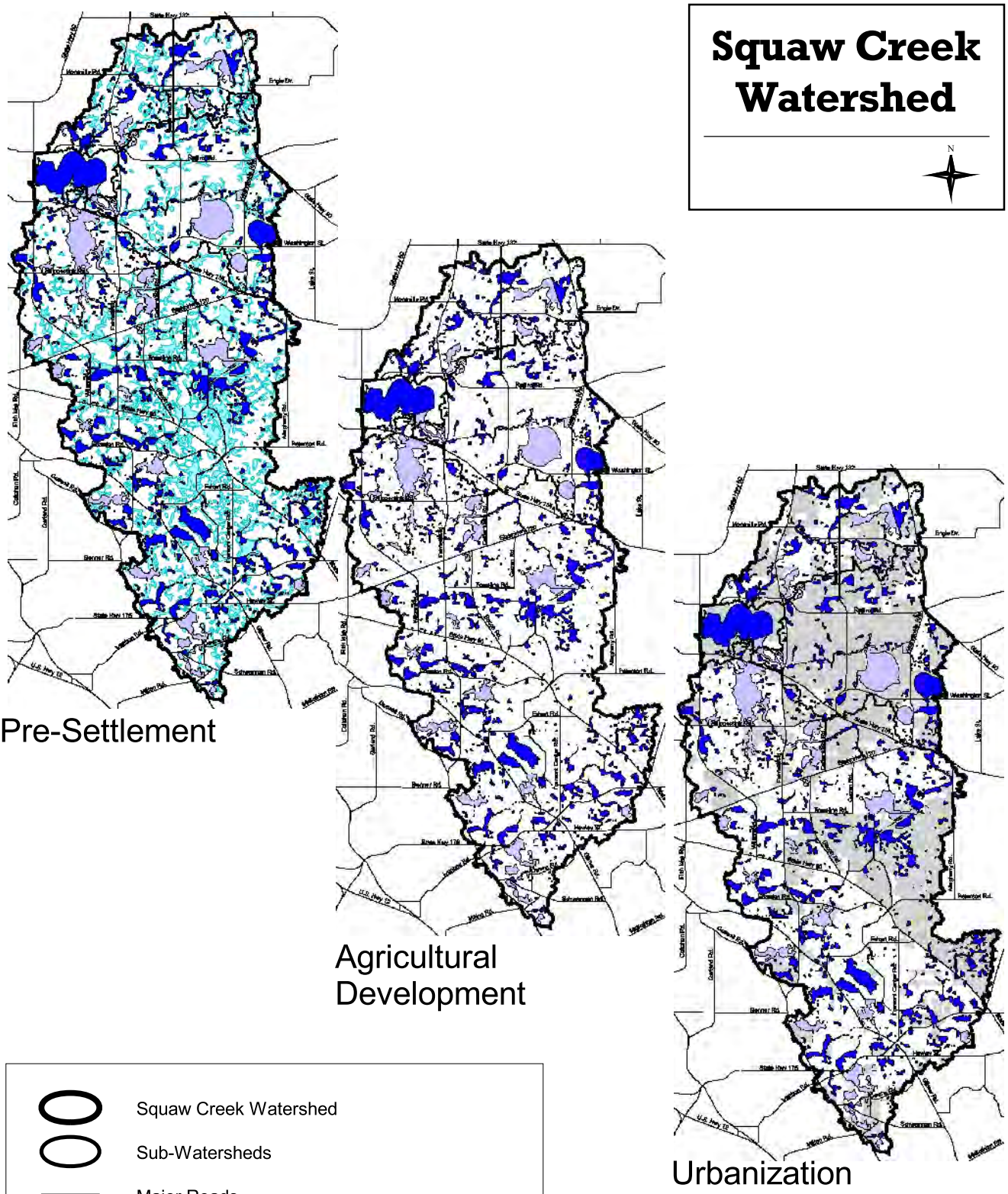
SOURCE: Lake County Dept. of Information and Technology
Northeastern Illinois Planning Commission

Extent of Urbanization

Figure No. 4-16

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed



- Squaw Creek Watershed
- Sub-Watersheds
- Major Roads
- ADID Wetlands
- Lake County Wetland Inventory Wetlands
- Hydric Soils
- Land Already Developed or Under Development

Progression of Landuse Change

Figure No. 4-17

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Current Land Use

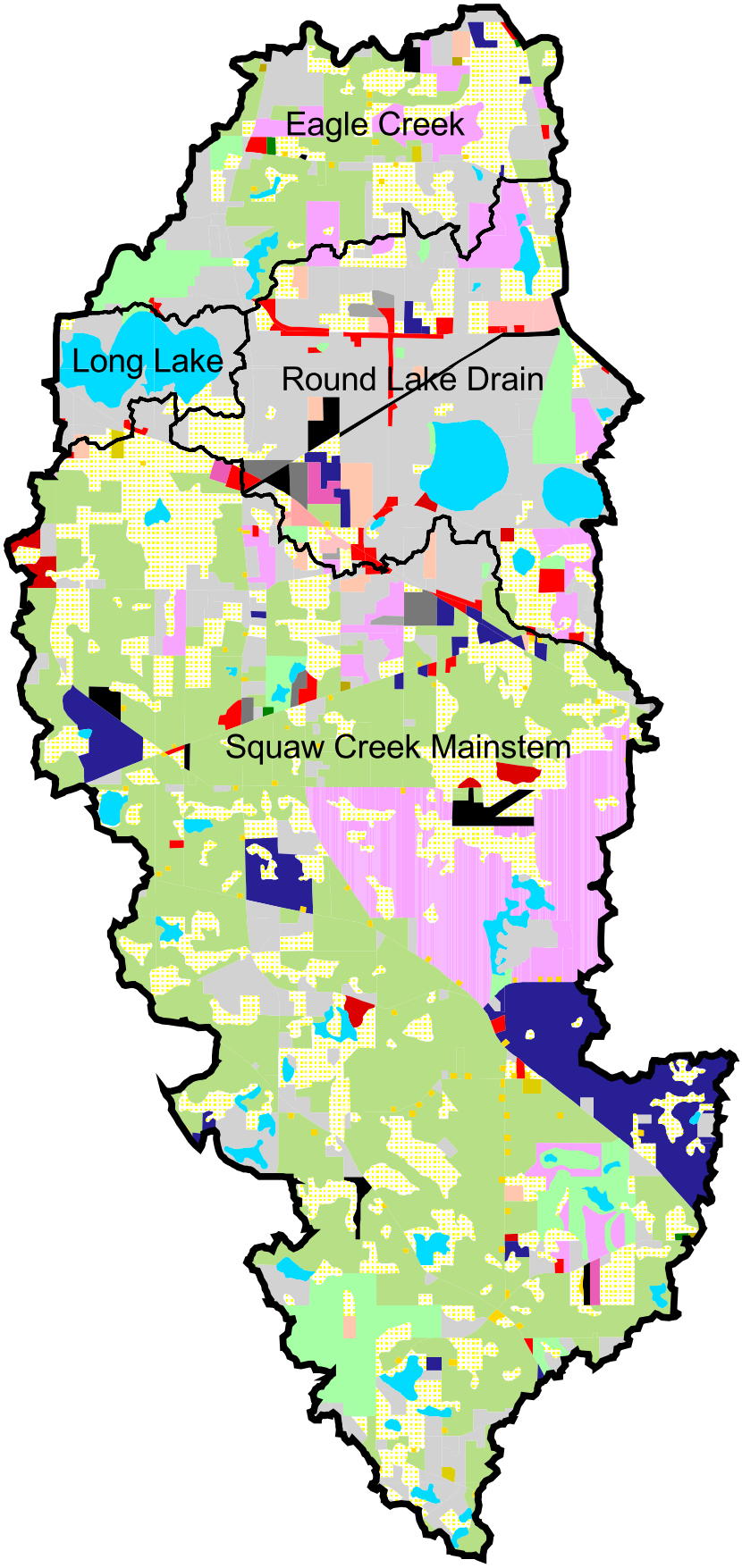
Existing land use data was developed based on 1995 GIS data from Lake County which was the most current available for the entire watershed. Figure 4-17 shows current land use in the watershed. Figure 4-18 shows land use for the Mainstem as updated by LCSMC for its flood study work. Based on these data the watershed land use statistics are presented in Table 4-7 and discussed below.

Table 4-7: Land Use in the Squaw Creek Watershed

1995 Land Use	Mainstem		Round Lake Drain		Eagle Creek	
	Acres	Percent	Acres	Percent	Acres	Percent
Residential	2014	11.9	2274	49.6	845	28.2
Commercial and Services	220	1.3	311	6.8	28	0.9
Institutional	117	0.7	105	2.3	38	1.3
Industrial and Warehousing	1091	6.5	62	1.4	21	0.7
Transportation and Utilities	135	0.8	97	2.1	15	0.5
Agricultural	6831	40.4	69	1.5	794	26.5
Open Space	724	4.3	196	4.3	238	8.0
Vacant and Wetlands	5375	31.8	1079	23.5	971	32.5
Water	385	2.3	395	8.6	42	1.4
Total	16892	100	4588	100	2992	100

Source: 1995 NIPC Land Use

The land use within the Mainstem remains a mixture of agriculture, open space and single family residential with lot sizes ranging from 1/4 acre to several acre estates. Commercial areas within the Mainstem are located east along Route 176. Existing publicly owned open space totals 724 acres or 4.3 percent of the Mainstem. There are another 5760 acres of wetland, open water or identified regulatory floodplain in the Mainstem watershed. The watershed is 21 percent developed. Significant development opportunity is present from Route 120 south to Route 176 based on the comprehensive plans for Round Lake, Round Lake Park, and Wauconda.



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

1995 NIPC Landuse

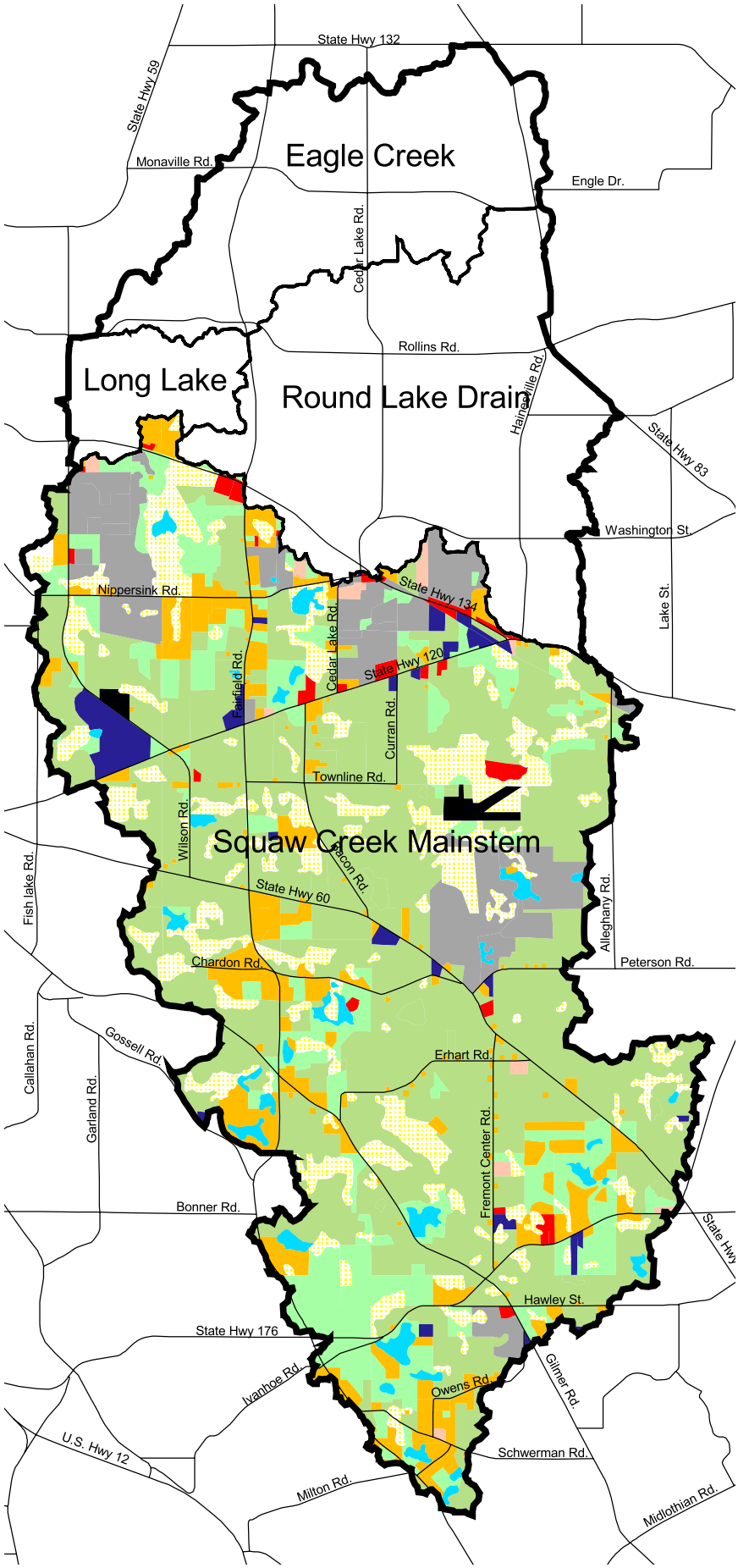
- 1110-Res: Single, duplex, townhouse
- 1120-Res: Farmhouse
- 1130-Res: Multi-family
- 1140-Res: Mobile Home
- 1210-Com: Shopping malls
- 1230-Com: Single structure
- 1243-Com: Suburban mix
- 1250-Com: Cultural, entertainment
- 1320-Ins: Education (< 5 ac. open space)
- 1330-Ins: Education (> 5 ac. open space)
- 1340-Ins: Governmental administration
- 1360-Ins: Religious (< 5 ac. open area)
- 1370-Ins: Religious (> 5 ac. open area)
- 1380-Ins: Cemetaries
- 1420-Ind: Manufacturing
- 1430-Ind: Warehousing
- 1440-Ind: Industrial park
- 1530-Tra: Airport
- 1560-Tra: Utilities
- 2000-Ag: Agricultural
- 3110-OS: Recreational: Parks, arboretums, botanical gardens
- 3120-OS: Recreational: Golf courses
- 3130-OS: Recreational: Other
- 3210-OS: Conservation: parks, arboretums, botanical gardens, forest pres.
- 4110-Vac: Vacant Forested & Grassland
- 4120-Vac: Wetland
- 4130-Vac: Wetlands/Agricultural
- 4210-UD: Residential Development
- 4220-UD: Non-residential development
- 5200-Wat: Lakes, reservoirs, lagoons

SOURCES: Northeastern Illinois Planning Commission

1995 NIPC Landuse

Figure No. 4-18

Prepared by: Hey and Associates, Inc. 2003 (kgk)



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

2002 SMC Landuse

- Agricultural
- Commercial
- Industrial
- Institutional
- Open Space
- Open Water
- Res Sewered
- Res Unsewered
- Transportation/Utilities
- Wetlands

SOURCE: Lake County Stormwater Management Commission

2002 SMC Landuse (Mainstem only)

Figure No. 4-19

Prepared by: Hey and Associates, Inc. 2003 (kgk)

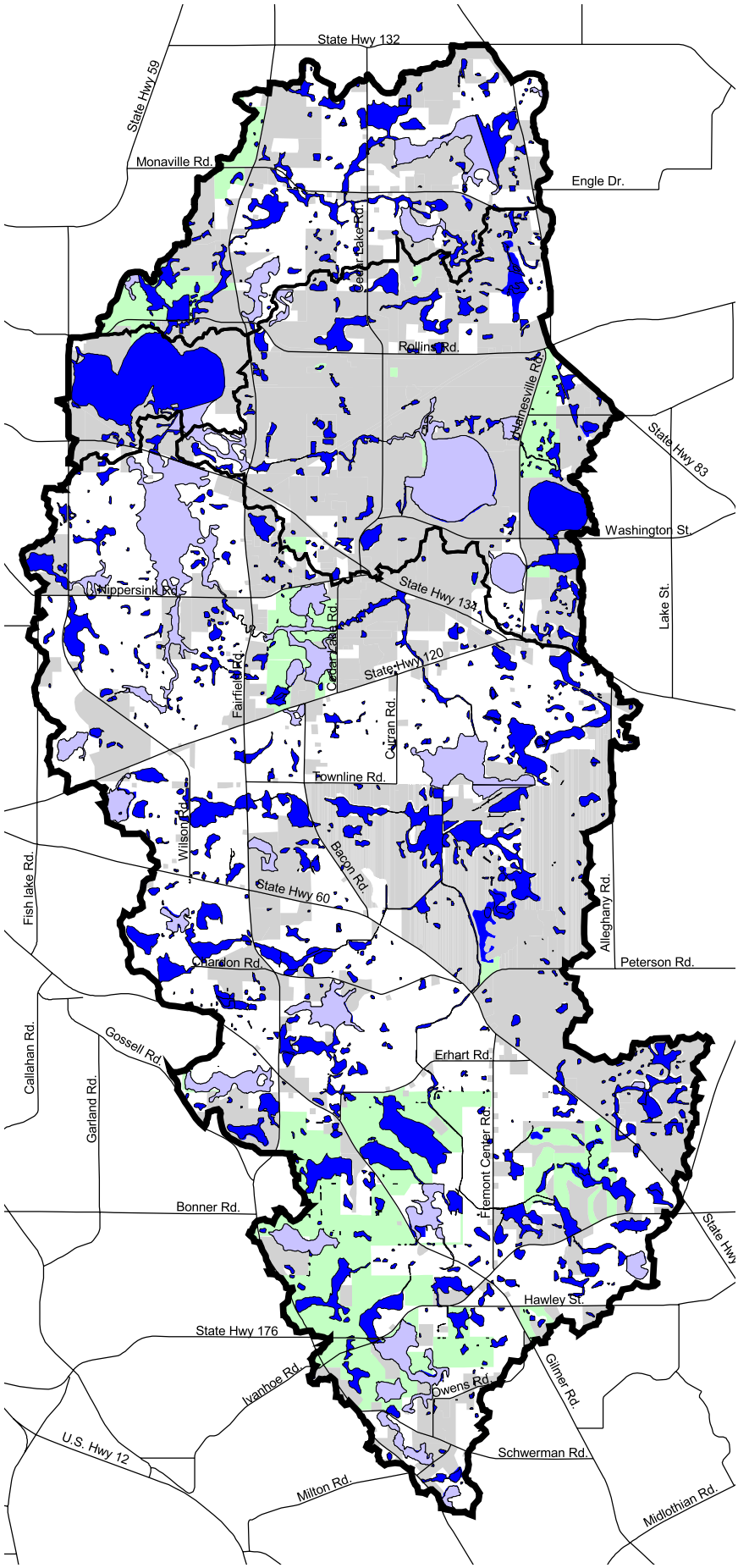
The comprehensive plans for Round Lake and Round Lake Park cover the area from Route 134 to just south of Route 60. They call for a mix of residential and office and commercial space. Significant development opportunity exists in the watershed as shown in Figure 4-20.

The land use within the Round Lake Drain is urban single family residential with lot sizes ranging from 1/8 acre to 1/4 acre. Commercial areas are intermixed along Route 134. Existing publicly owned open space totals 196 acres or 4.3 percent of the Round Lake Drain watershed. There are another 1474 acres of wetland, open water or identified regulatory floodplain in the Round Lake Drain watershed. The watershed is 62 percent developed. The only significant parcel of open space is Renwood Golf Course owned by the Round Lake Area Park District (RLAPD). The RLAPD also owns another 34 small parcels in the watershed.

The land use within the Eagle Creek watershed is a mixture of agriculture, open space and single family residential with lot sizes ranging from 1/4 acre to several acre estates. Existing publicly owned open space totals 238 acres or 8 percent of the Eagle Creek watershed. There are another 1013 acres of wetland, open water or identified regulatory floodplain in the Eagle Creek watershed. The watershed is 31.6 percent developed.

4.8 HYDRAULICS, DRAINAGE, AND FLOODPLAINS

The hydraulics section of the Plan covers the subjects of mapped floodplain, storm-sewered areas, farm tile locations, detention basin locations and character, point source inputs to the streams and significant regional storage locations.



Squaw Creek Watershed

0 1 Miles

N

- Watershed Boundary
- Major Roads
- ADID Wetlands
- LCWI Wetlands
- Open Space
- Developed
- Development Potential

SOURCE: Lake County Dept. of Information and Technology
Northeastern Illinois Planning Commission

Property Remaining for Development

Figure No. 4-20

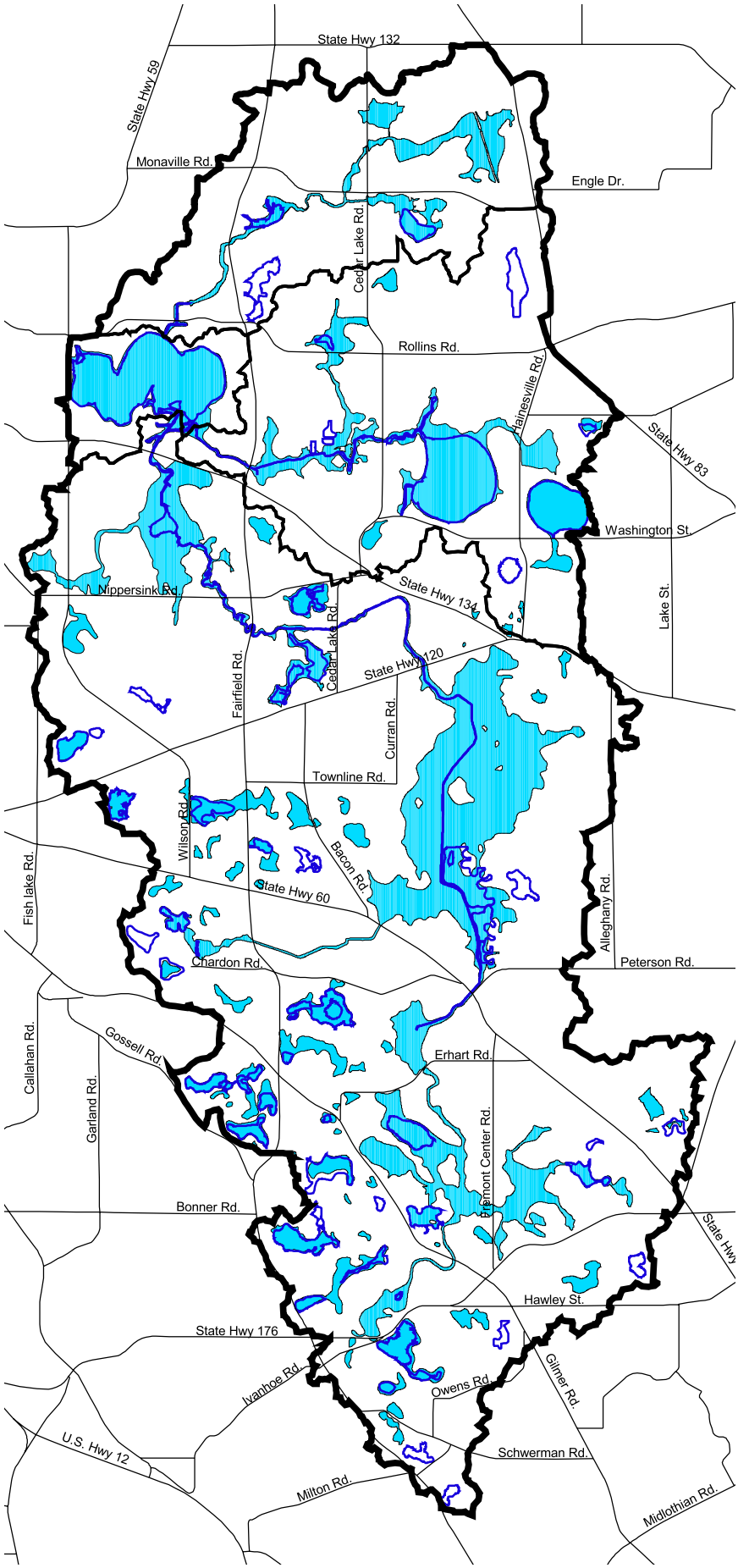
Prepared by: Hey and Associates, Inc. 2003 (kgk)

4.8.1 Floodplain Mapping

The increased efficiency of the drainage network and the addition of impervious areas without detention contributed to increased flood discharges and volumes prior to the adoption of the WDO. Squaw Creek always flooded, even prior to European settlement, as evidenced by early settlers (IDNR, 1998). Most damage associated with this flooding has been the result of poor or uninformed decisions to site structures in flood zones – again, prior to the WDO. Prior to 1966, there was little or no information regarding flood zones in the watershed. In 1966 the U.S. Geological Survey published Hydrologic Investigations for the Antioch, Grayslake and Wauconda quadrangles that documented recorded areas of flooding but not the 100-year floodplain. In the late 1970s Flood Insurance Studies defining the 100-year floodplain were completed for the entire Squaw Creek watershed. Ordinances to prevent siting of structures in the floodplain were not adopted until this time for most communities (NIPC, 1987). The requirement to define depressional floodplains and floodprone areas outside of major stream networks was not mandated until the adoption of the WDO in 1992. Wetlands were not fully protected until the late 1980's by the Corps of Engineers.

Figure 4-21 presents the official floodplain maps for the watershed from the FEMA Flood Insurance Studies (FIS 1979). As a result of a lack of information and also because of deliberate poor decisions, about 20,000 people (about 7,000 houses) were added to the watershed from 1910 to 1990 without knowing with certainty where the 100-year floodplain was located. Today about 600 homes are in the floodplain in the watershed and almost all are older than 30 years.

LCSMC has submitted a revised floodplain study for the Mainstem based on a new, more detailed, model prepared in 2000. This floodplain shown on aerial photography is presented as Figure 4-22. Hey and Associates also used LCSMC's 2-foot topographic data and the FEMA 1979 FIS 100-year event flood profiles for the Round Lake Drain and Long Lake to prepare more detailed floodplain mapping than what appears in the FIS study. Figure 4-23 presents the Hey mapping of the FIS study profile on LCSMC topography for the Round Lake Drain and Figure 4-24 presents Long Lake.



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

Water

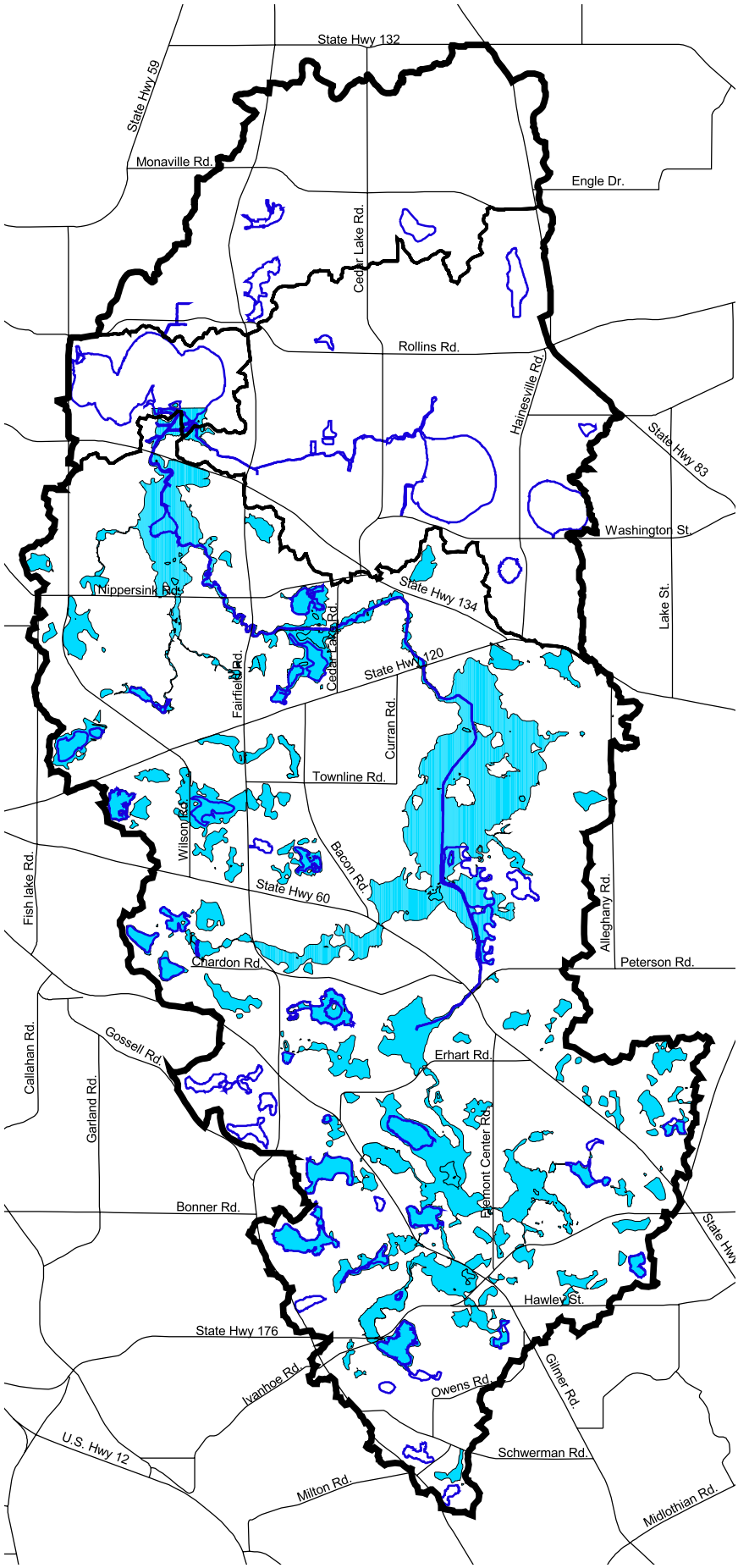
FEMA 100 yr Floodplain

SOURCE: Lake County Stormwater Management Commission

Floodplains

Figure No. 4-21

Prepared by: Hey and Associates, Inc. 2003 (kgk)



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

Water

LCSMC Updated Floodplain for the 100-year Flood

SOURCE: Lake County Stormwater Management Commission

LCSMC
Updated Squaw Creek
Mainstem Floodplain

Figure No. 4-22

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

0 0.5 Miles

N

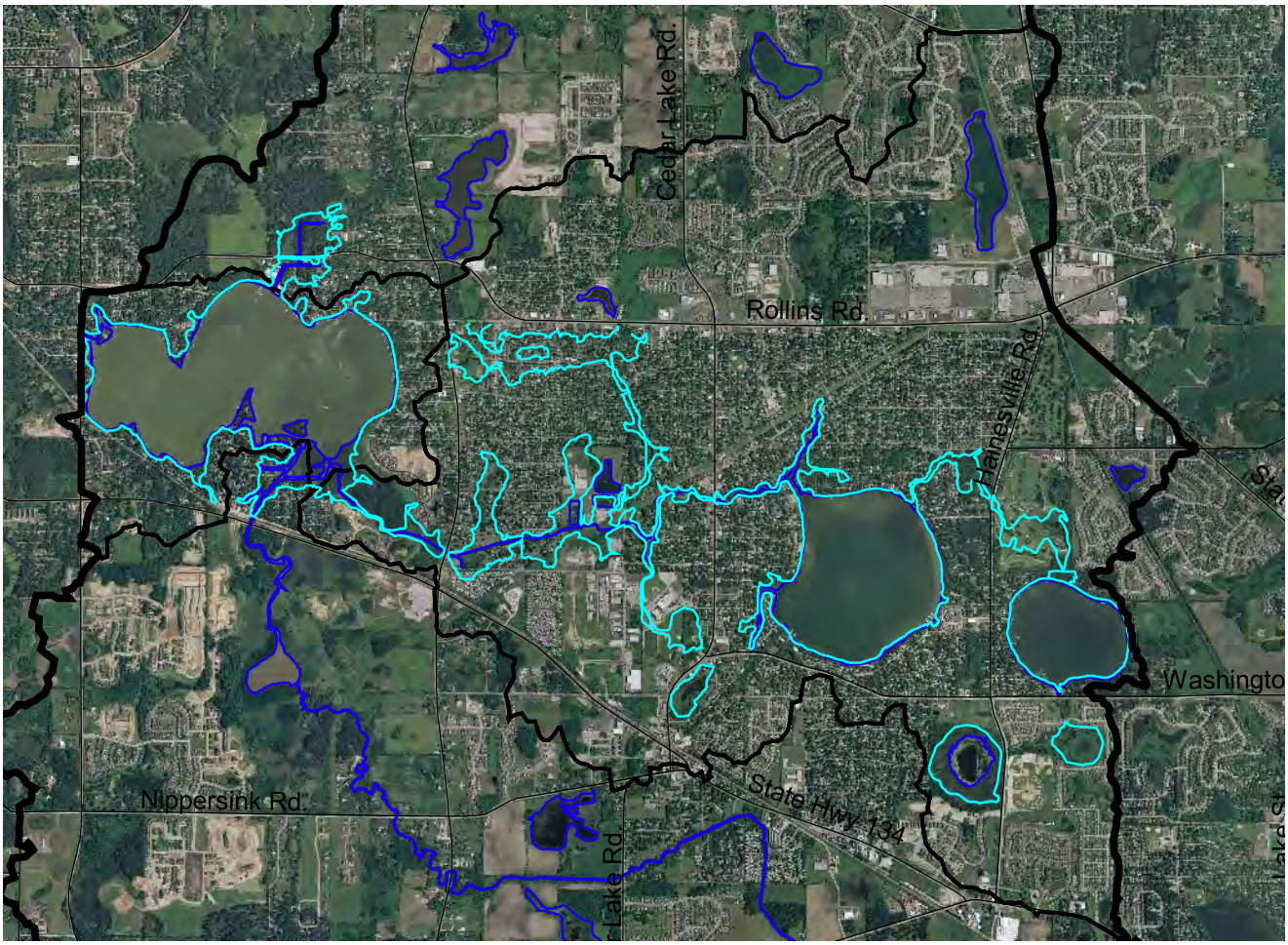
Watershed Boundary

Major Roads

Water

Re-Mapped Floodplain

SOURCE: Lake County Stormwater Management Commission



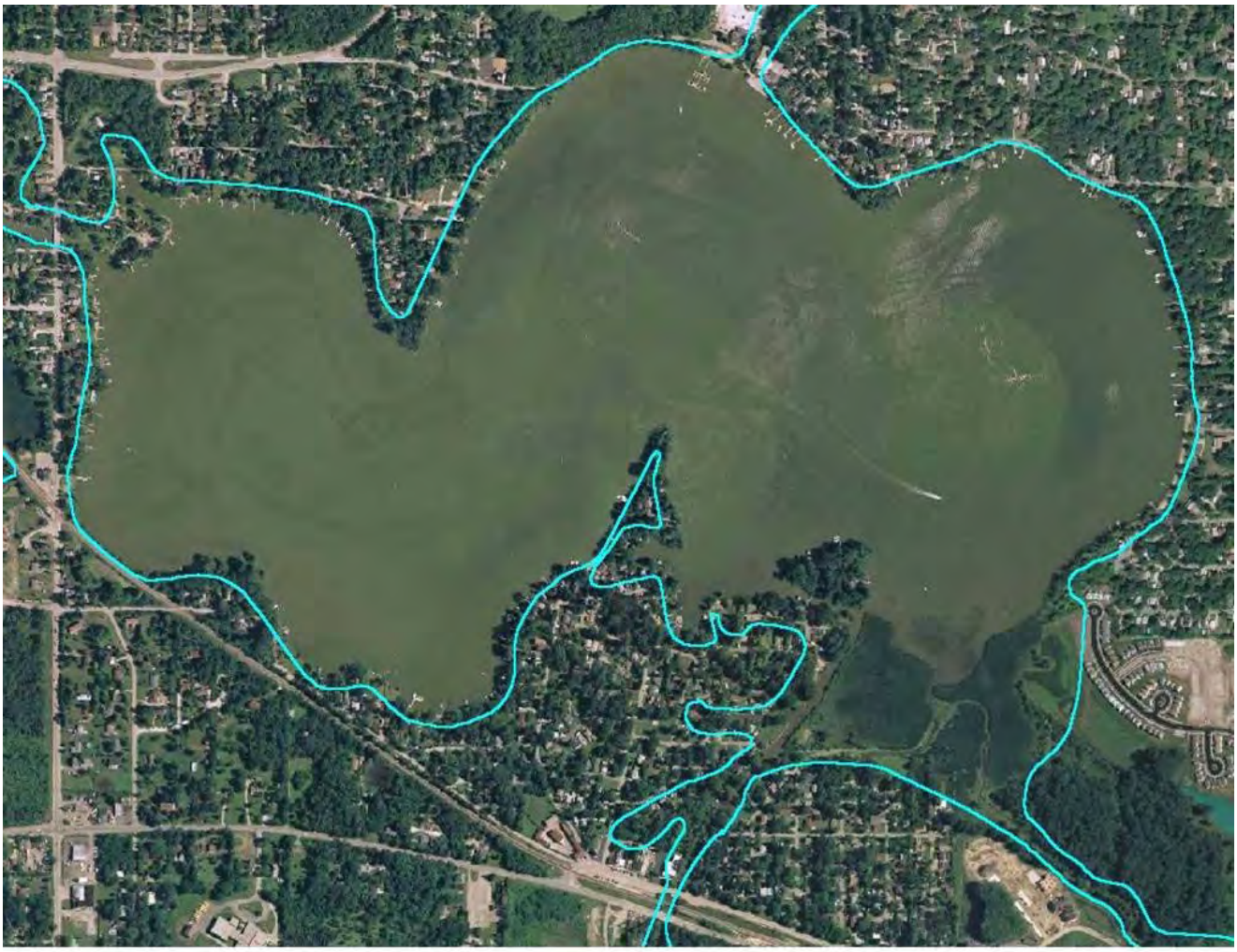
Note: The re-mapping is based on existing FEMA 100-year flood profiles superimposed on 2-foot contour aerial topography flown in 1996. The Existing FEMA floodplain mapping is based on topography that was available in 1979.

Re-Mapping of Round Lake Drain Floodplains

Figure No. 4-23

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed



Note: The re-mapping is based on existing FEMA 100-year flood profiles superimposed on 2-foot contour aerial topography flown in 1996. The Existing FEMA floodplain mapping is based on topography that was available in 1979.

Re-Mapping of Long Lake Floodplain

Figure No. 4-24

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Figures 4-25a and 4-25b presents the FIS profile for the Round Lake Drain and Long Lake and Figure 4-26 presents the profile for Eagle Creek (FEMA, 1979). Table 4-8 presents the current certified flood discharge data for all of the Squaw Creek watershed.

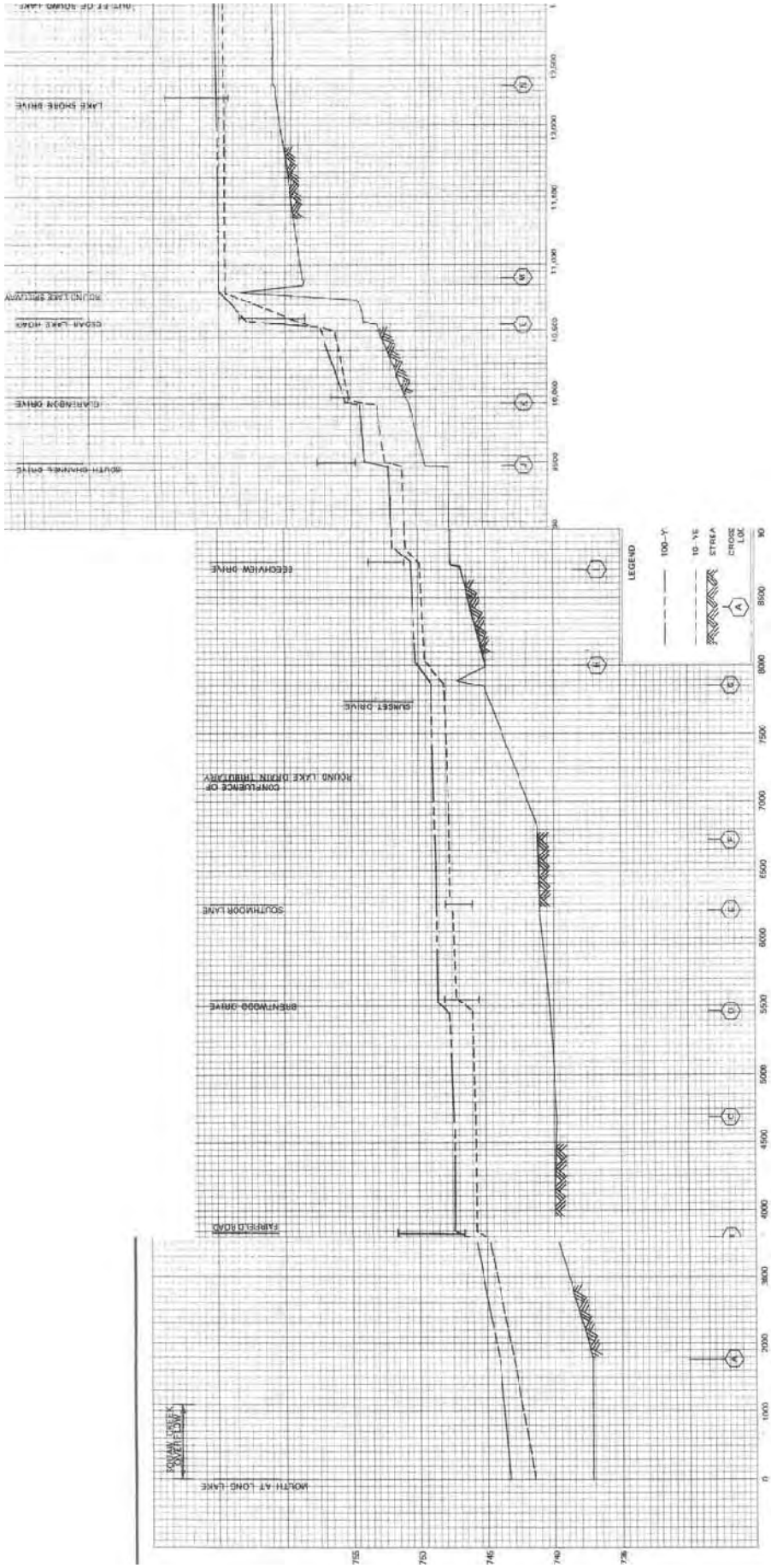
Table 4-8: Flood Insurance Study Data

Watershed	Area (mi^2)	10-year Flow (cfs)	100-year Flow (cfs)
Squaw Creek Mainstem			
At Mouth	47.4	1100	1920
Rollins	33.47	675	1130
Route 120	14.61	599	1041
Town Line	15.20	545	948
Erhart	6.70	344	605
Eagle Creek			
U.S. Monaville	2.4	136	270
Cedar Lake Road	1.5	38	82
Round Lake Drain			
Fairfield Road	7.0	184	308
Cedar Lake Road	4.6	77	143

4.8.2 Reported Flooding

Figure 4-27 presents LCSMC's database of flood problem area mapping for the Squaw Creek Watershed. This database includes reported instances of overbank flooding (similar to FEMA mapping), depressional storage area flooding, local drainage problems and septic system and sewage backups. The flood problem area database indicated two repetitively damaged houses in Round Lake Beach and a total of 44 flood problem areas (LCSMC, 1999).

Squaw Creek Watershed



LEGEND

100–YEAR FLOOD

10–YEAR FLOOD

STREAM BED

CROSS SECTION LOCATION

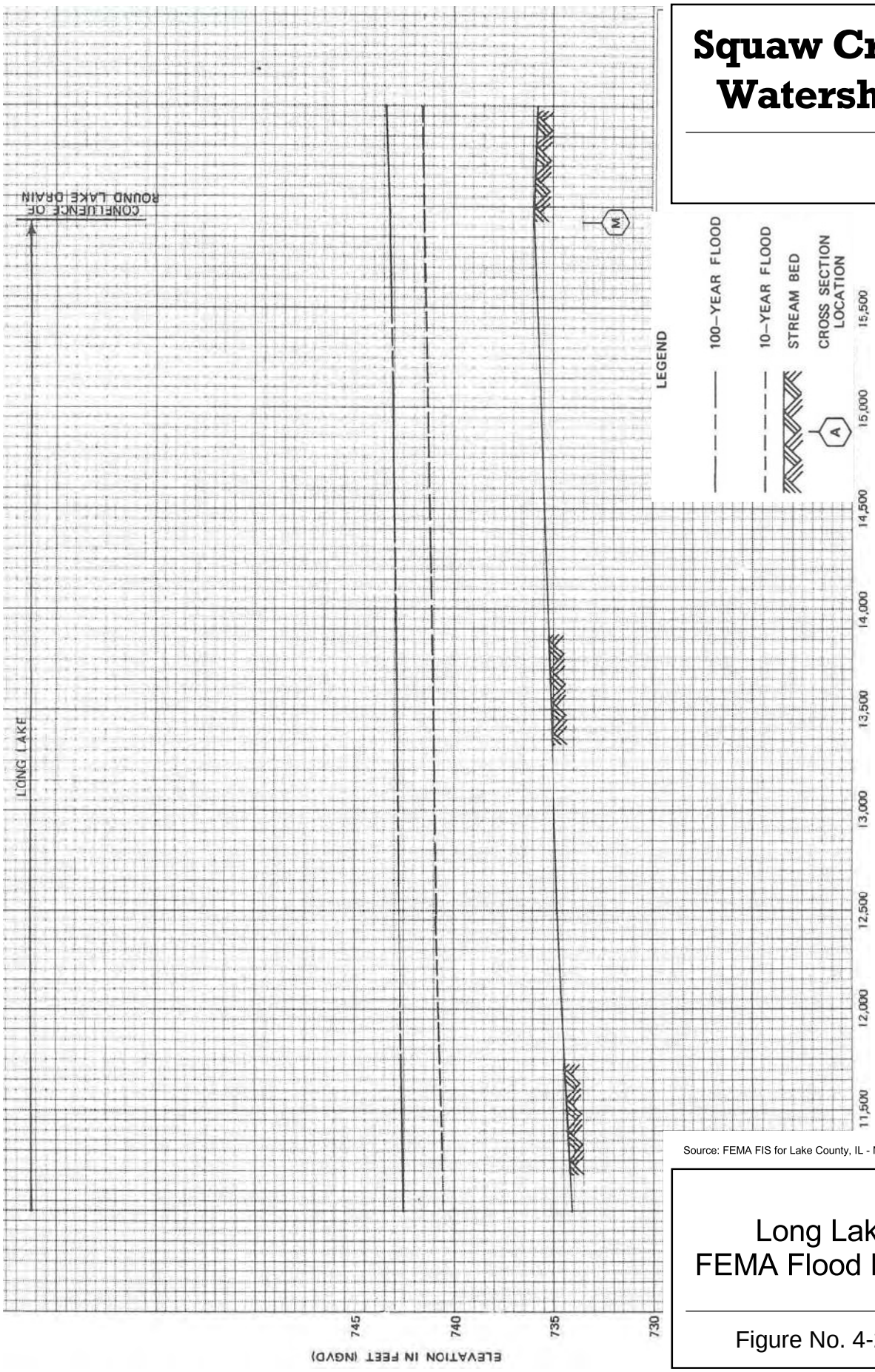
Source: FEMA FIS for Lake County, IL - November 6, 2000

Round Lake Drain
FEMA Flood Profile

Figure No. 4-25a

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed



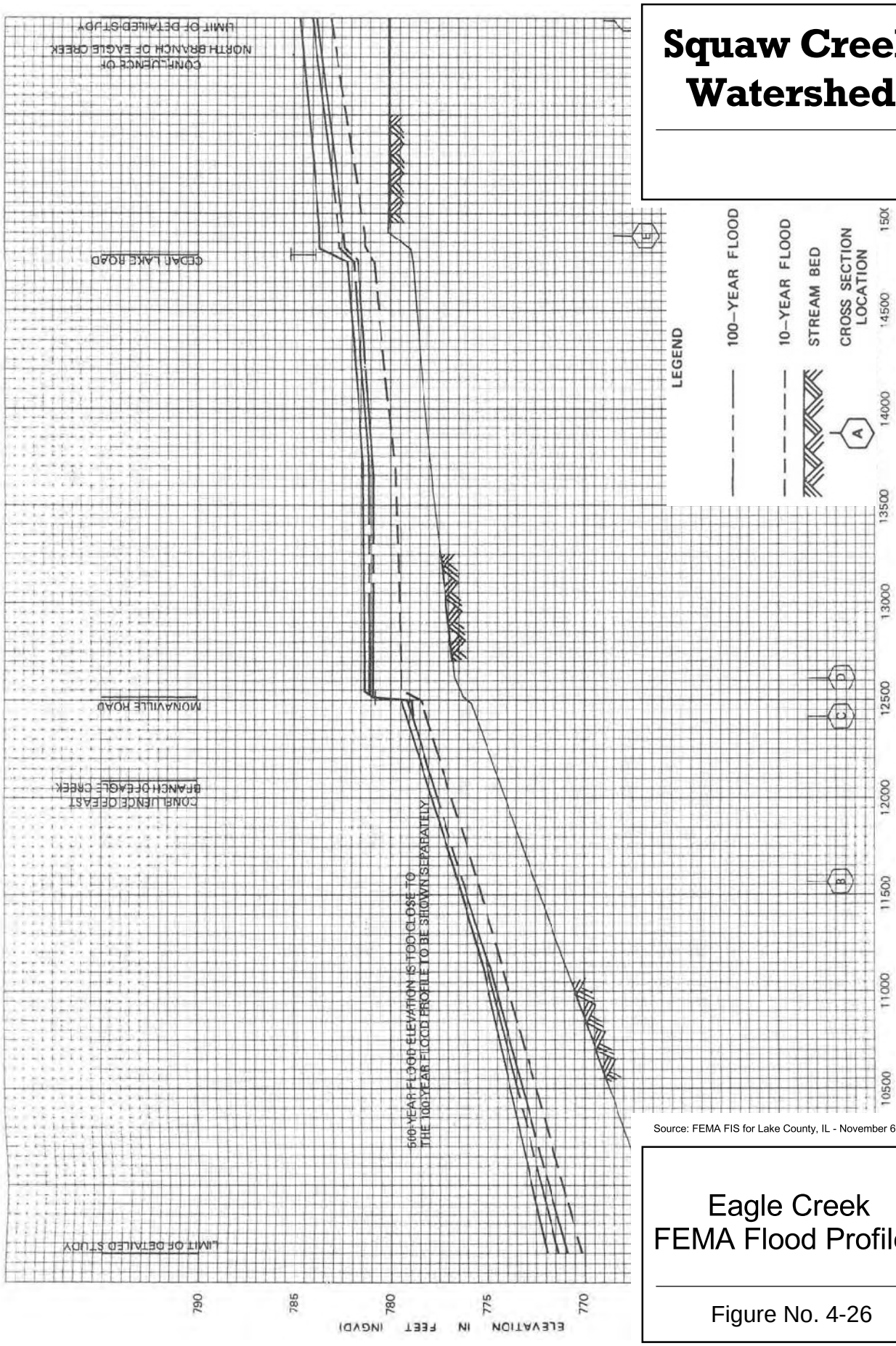
Source: FEMA FIS for Lake County, IL - November 6, 2000

Long Lake
FEMA Flood Profile

Figure No. 4-25b

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

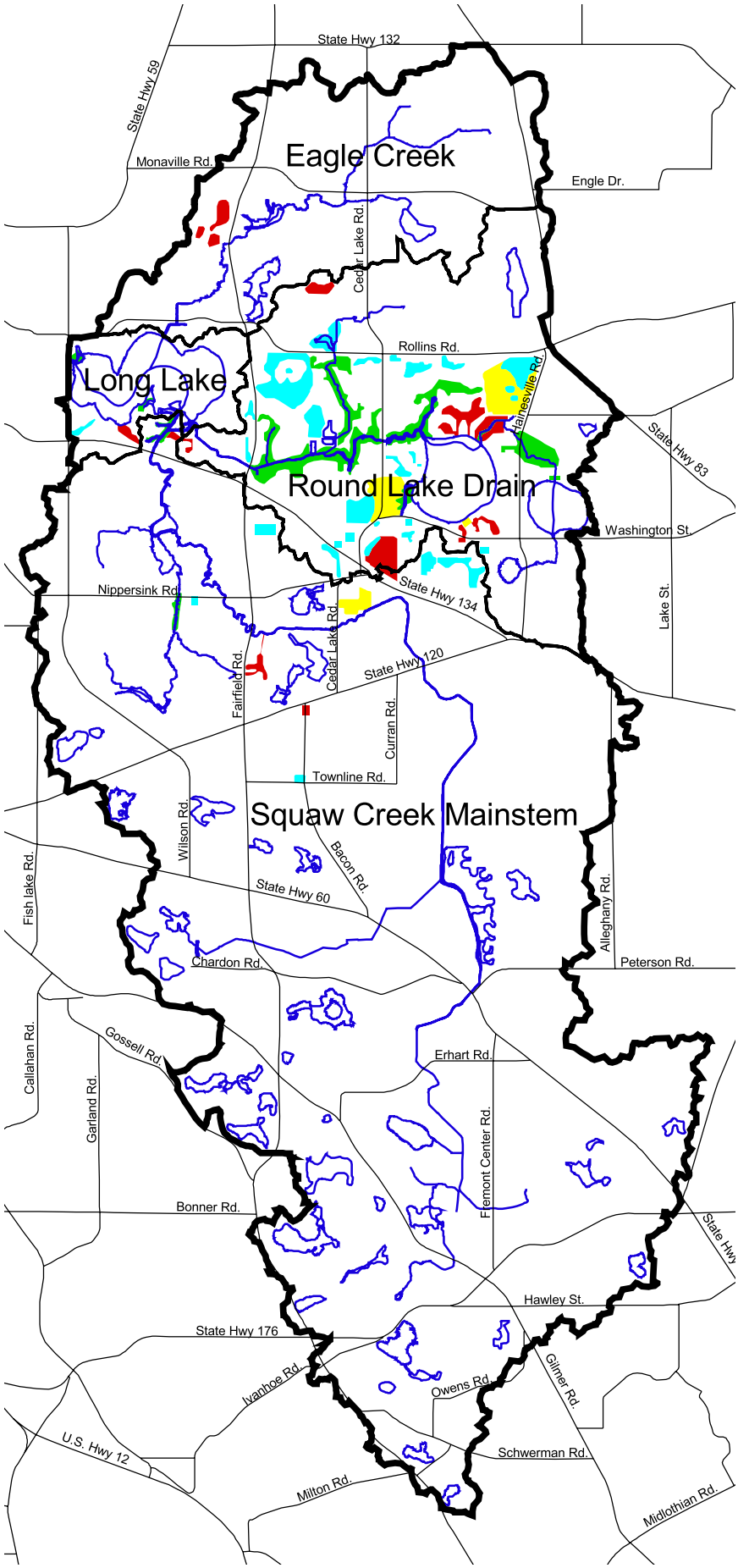


Source: FEMA FIS for Lake County, IL - November 6, 2000

Eagle Creek
FEMA Flood Profiles

Figure No. 4-26

Prepared by: Hey and Associates, Inc. 2003 (kgk)



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

Water

Flood Hazards

Depressional Storage

Local Drainage Problems

Overbanking Flooding

Septic & Sewer Failure

SOURCE: Lake County Stormwater Management Commission

Flood Problem Area Mapping

Figure No. 4-27

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Table 4-9 shows that flooding in the watershed occurs from a number of different sources: overbank flooding; depressional storage flooding and local drainage problems including sewer backups.

Table 4-9: LCSMC Flood Damage Inventory – Estimated Flood Damage Acreage by Classification

	Overbank Flooding	Depressional Storage Flooding	Local Drainage Problems
Mainstem	23 acres	53 acres	77 acres
Round Lake Drain	296 acres	251 acres	110 acres
Eagle Creek	none	none	22 acres

The most recent serious flooding in the watershed occurred as a result of the storm events during 1993. Most of the impacts are on the Round Lake Drain where over 500 buildings and dozens of roads were inundated. (Round Lake Beach and Round Lake Park 1993). The Corps of Engineers estimate that flooding has an estimated recurrence interval of every 2-5 years more on average, or a 20-50 percent chance in any given year (COE, 2000). The majority of these properties were on the Round Lake Drain or its tributaries downstream of Round Lake.

In response to these drainage and flooding problems, Round Lake constructed the Hook's Lake regional storage basin in 1995. Hook's Lake added over 200 acre-feet of storage to address these flooding problems.

4.8.3 Storm Sewered Subwatersheds

As part of Plan preparation each unit of local government was asked to supply information on their current storm sewer systems. Hey and Associates mapped all storm sewers 12-inches in size or larger from this information and the resulting storm sewer map is presented in Figure 4-28. Using the subwatersheds identified for the three watersheds, sewered versus unsewered subwatersheds were identified for each watershed as shown in Figure 4-29. Approximately 6,000 acres of the watershed is sewered.

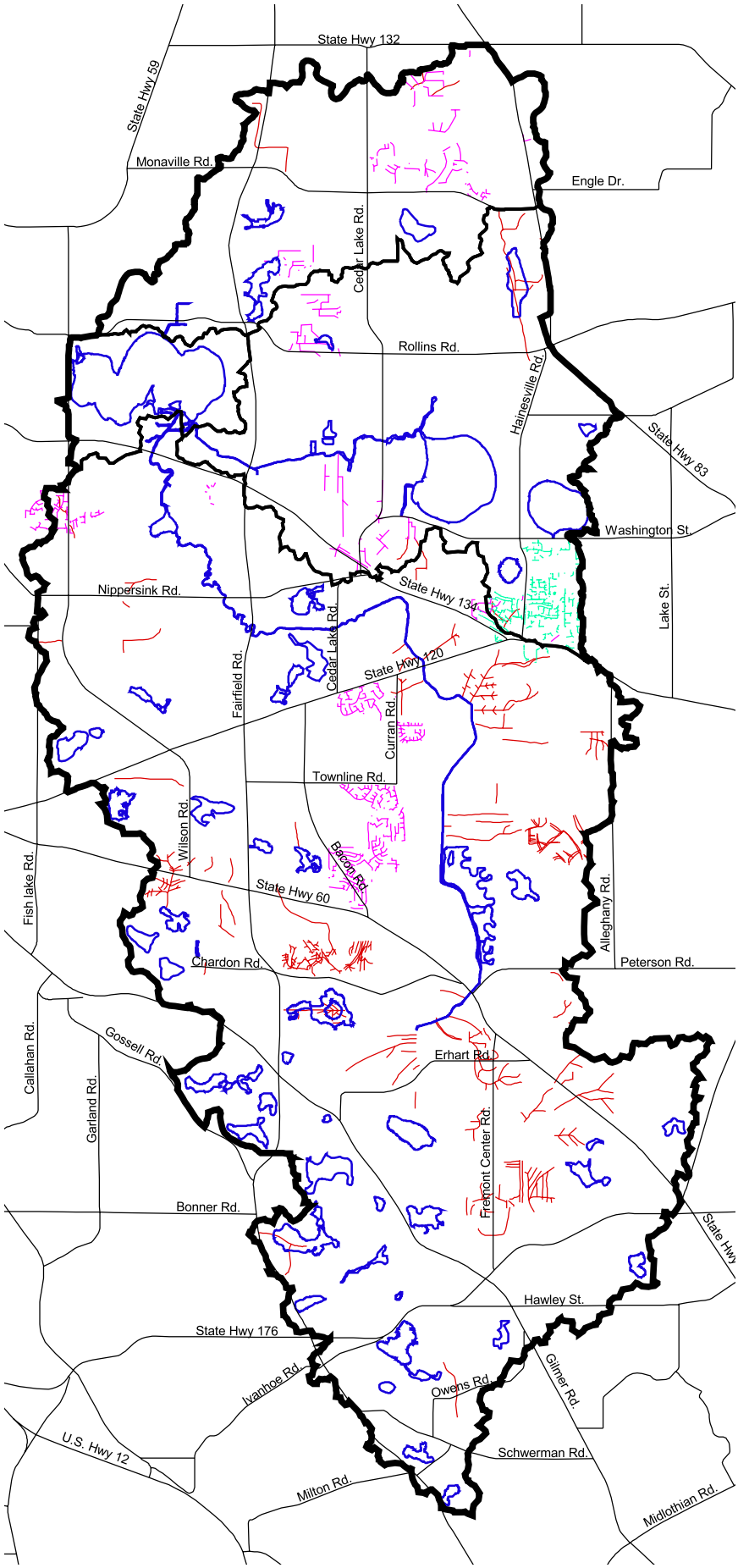
4.8.4 Point Source Discharges

All pipe discharges 12 inches or larger to the Mainstem, the Round Lake Drain, or Eagle Creek were inventoried and mapped. These pipe (or point source) discharges represent farm tiles and storm sewers. There are four sewage treatment plant discharges in the watershed: Baxter Healthcare, Fremont School District 79, College of Lake County's Glenkirk Campus, and Camp Hickory (see Figure 4-30). These point sources are required to have NPDES (National Pollutant Discharge Elimination System) permits that are subject to monitoring and periodic renewal by the Illinois EPA. Baxter has prepared a plan to phase out almost all discharges from this facility which serves the sanitary needs of the working population at the plant. The Baxter plant discharges about 0.25 million gallons per day (mgd) of domestic wastewater. Baxter intends to reuse their treated wastewater for irrigation. The District 79 plant discharges about 0.01 mgd of domestic wastewater. The Glenkirk Campus plant discharges 0.03 mgd of domestic wastewater. Camp Hickory discharges about 0.015 mgd of residential wastewater. Saddlebrook Farm also operates a treatment plant but all of this residential wastewater is land applied.

4.8.5 Farm Tiles

Figure 4-31 presents the location of farm tiles from the Lake County GIS inventory as prepared from the records of the Lake County Soil and Water Conservation District. Information on tile locations is limited. Virtually all hydric soil areas currently in agriculture are tiled to some extent, otherwise, these areas would still be wetlands. The

WDO requires that all new developments map farm tiles before permit approval. Eventually a large data base on tile locations could be developed in GIS.



Squaw Creek Watershed

0 1 Miles

N

- Watershed Boundary
- Major Roads
- Water
- Storm Sewers - Hardcopy Source
- Storm Sewers - Digital Source
- Historic Drain Tiles

SOURCES:
Storm Sewers - Municipal Records
Drain Tiles - Lake County Soil & Water Conservation District

Subsurface Drainage (known)

Figure No. 4-28

Prepared by: Hey and Associates, Inc. 2003 (kgk)

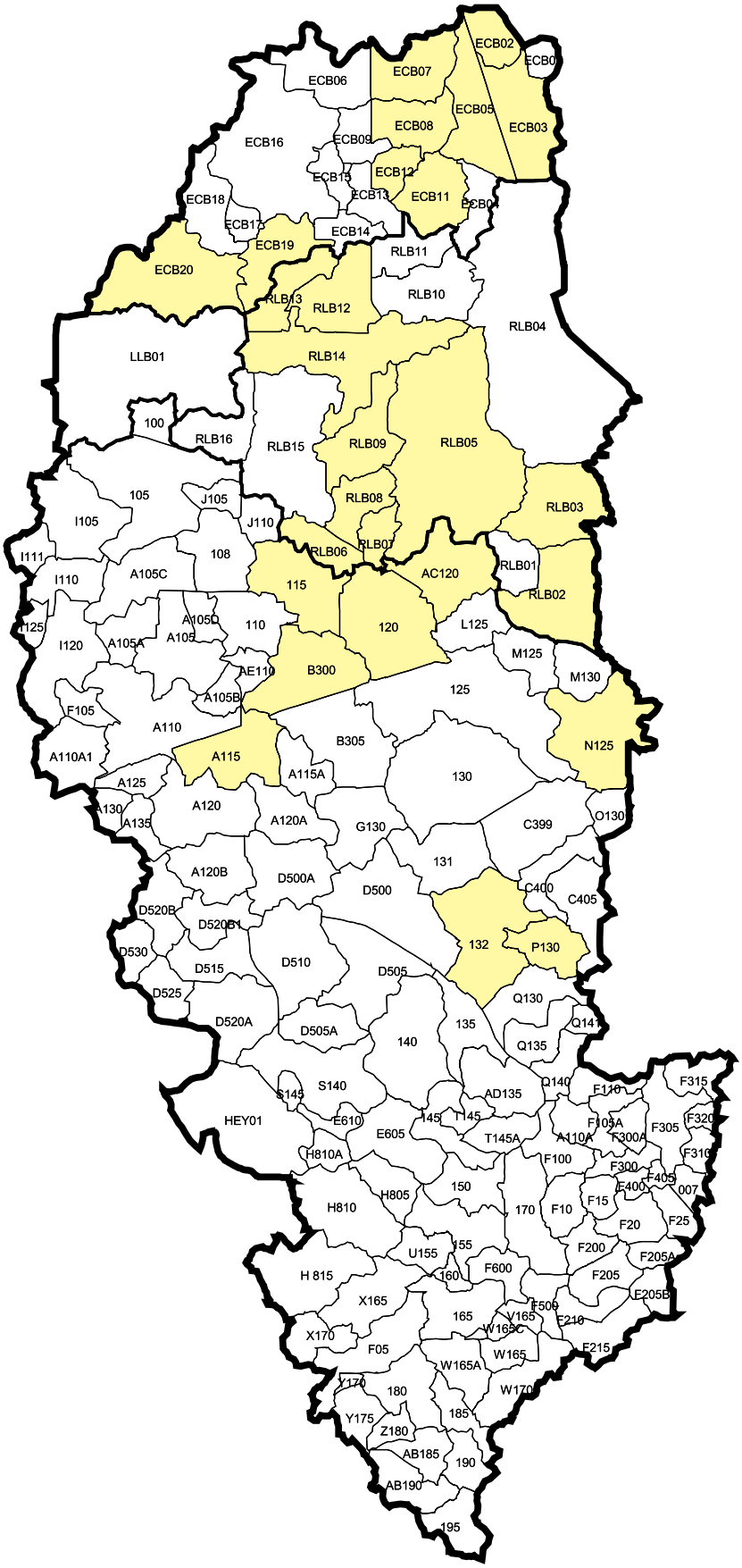
Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

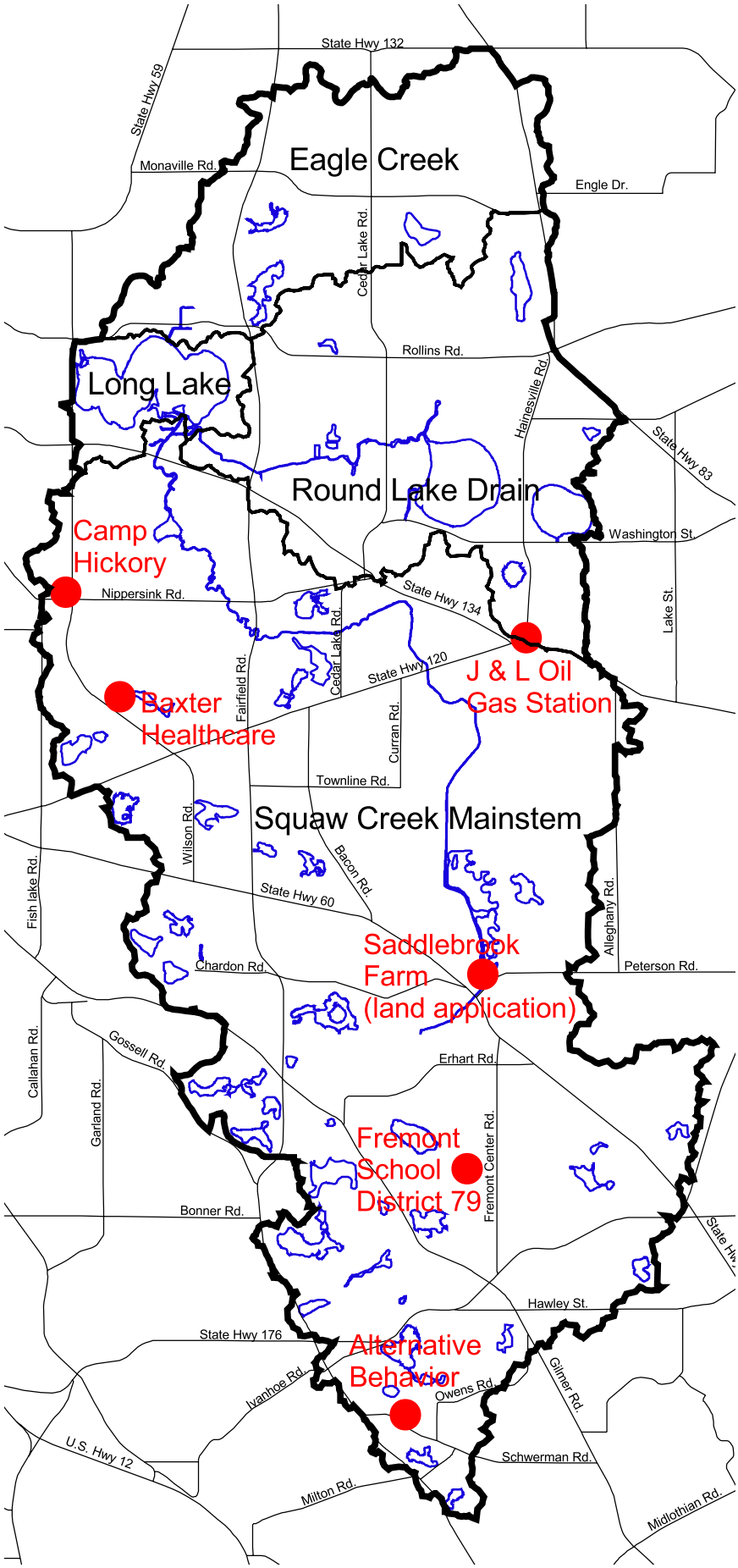
Storm Sewered



Storm Sewered Watersheds

Figure No. 4-29

Prepared by: Hey and Associates, Inc. 2003 (kgk)



Squaw Creek Watershed

0 1 Miles

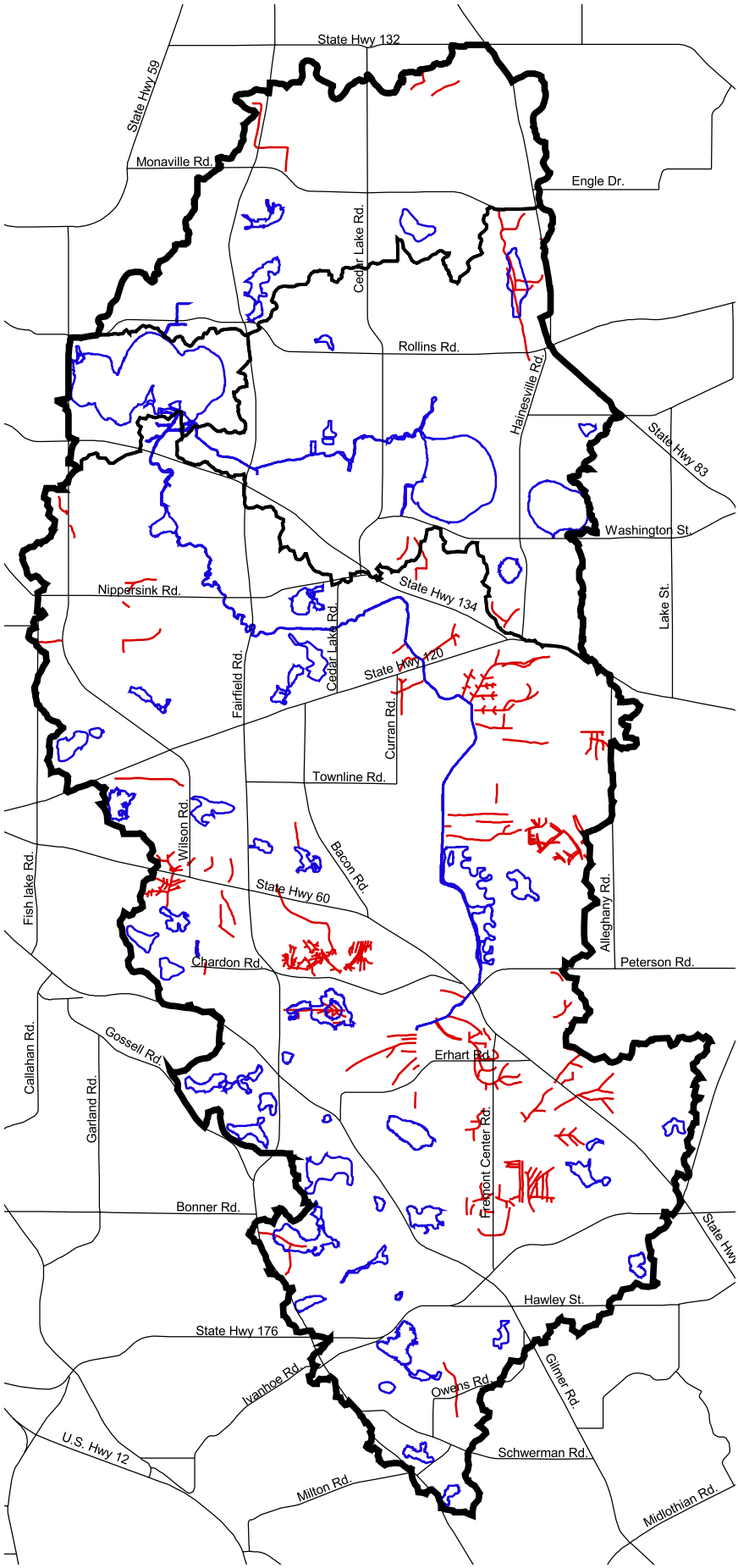
N

- Watershed Boundary
- Major Roads
- Water
- Discharges Points

Active NPDES Permit Facilities in Squaw Creek

Figure No. 4-30

Prepared by: Hey and Associates, Inc. 2003 (kgk)



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

Water

Historic Drain Tiles

SOURCE: Lake County Soil & Water Conservation District

Historic Farm Tiles

Figure No. 4-31

Prepared by: Hey and Associates, Inc. 2003 (kgk)

4.8.6 Regional Storage Locations

The Squaw Creek Watershed has a very large amount of natural flood storage either functioning or potentially available. Figure 4-32 shows subwatersheds with significant natural regional storage. Table 4-10 presents the amount of regional storage in the three watersheds and its equivalent amount of runoff in inches from the watershed.

Table 4-10: Potential Regional Storage

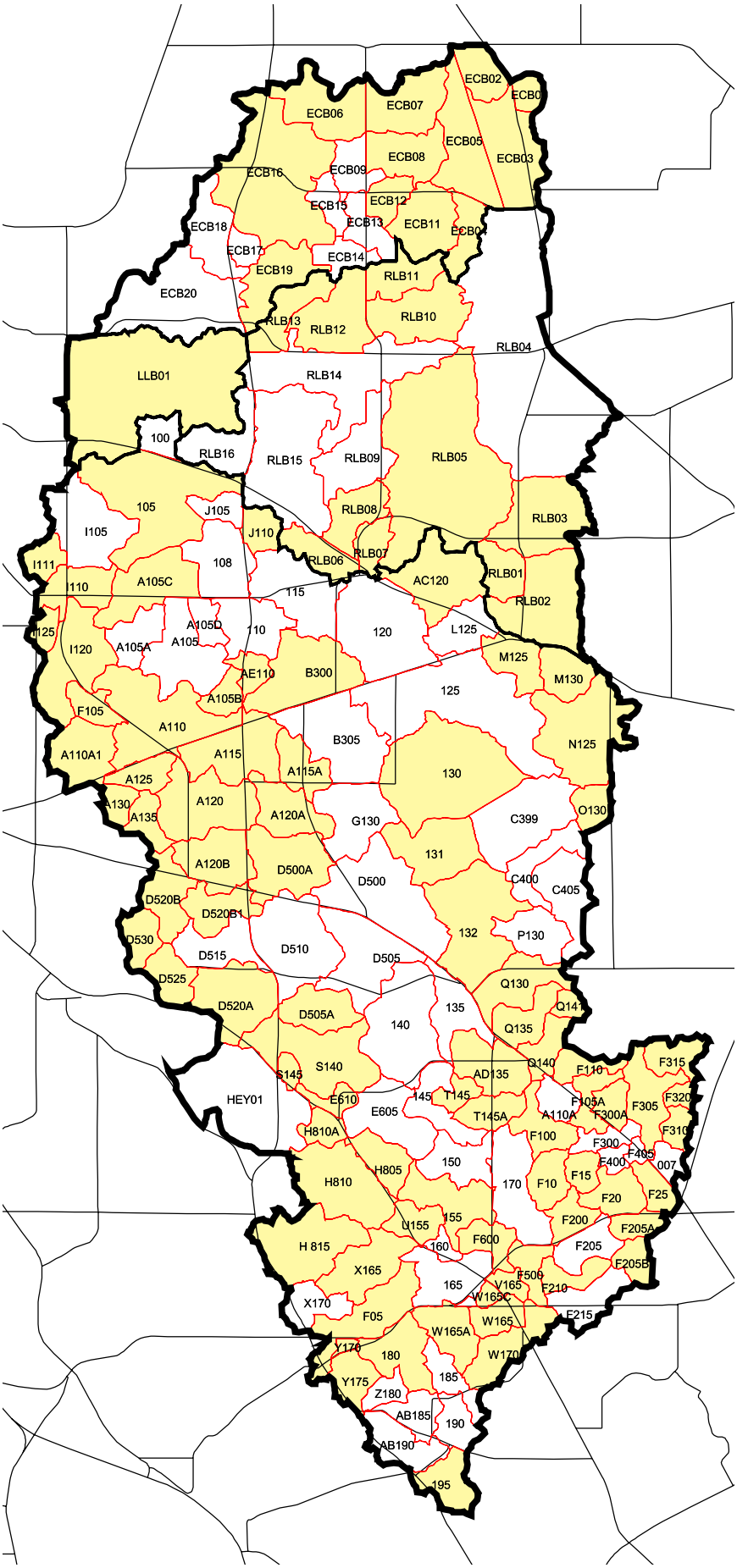
Watershed	Area (mi2)	Total Potential Natural Storage Volume (acre-ft)	Total Potential Natural Storage Depth (in)
Eagle Creek	4.67	1883.4	7.6
Round Lake Drain	7.15	2278.9	6.0
Lower Squaw Creek	27.63	8583.7 *	5.8 *

***** Computed storage does not include an additional 5800 acre-ft of potential wetland storage in the Squaw Creek Mainstream Big Sag.

This storage volume is enough to completely retain the run-off from the 100-year event. However, this storage is not always easily accessible due to its location relative to tributary areas. It also often cannot be used because it would flood properties that rely on the flood conveyance capacity of the ditches that caused the disconnection. This has negated much of its value.

4.8.7 Detention Basins

Figure 4-33 presents the location of detention basins in the watershed. A total of 177 basins were found. For the Squaw Creek and Eagle Creek watersheds most of these basins were designed to meet the WDO. Additional detail on detention basins in the watershed can be found in the Appendix.



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

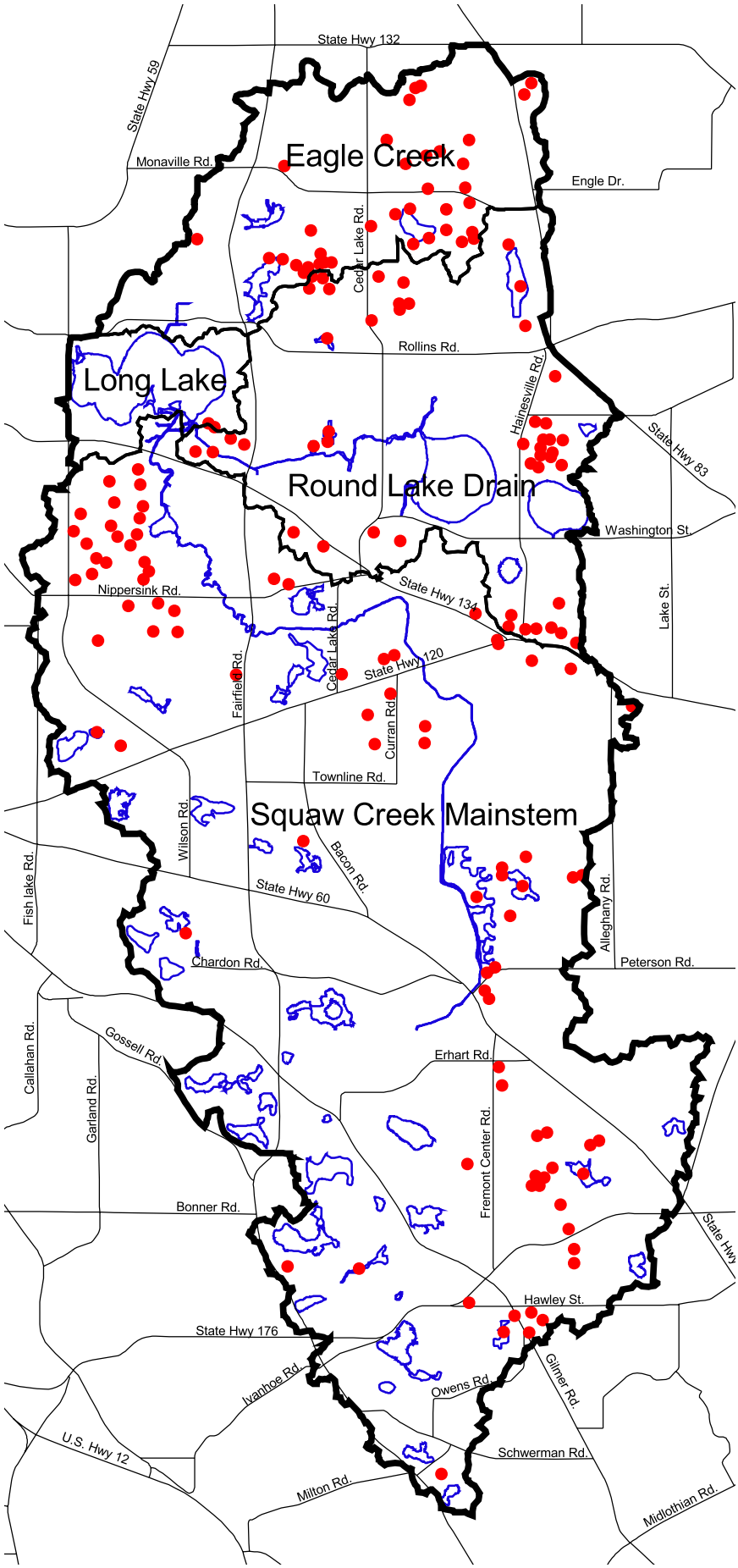
Significant Storage

Major Roads

Regionally Significant Storage Locations

Figure No. 4-32

Prepared by: Hey and Associates, Inc. 2003 (kgk)



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Detention Basins

Major Roads

Water

Detention Basins

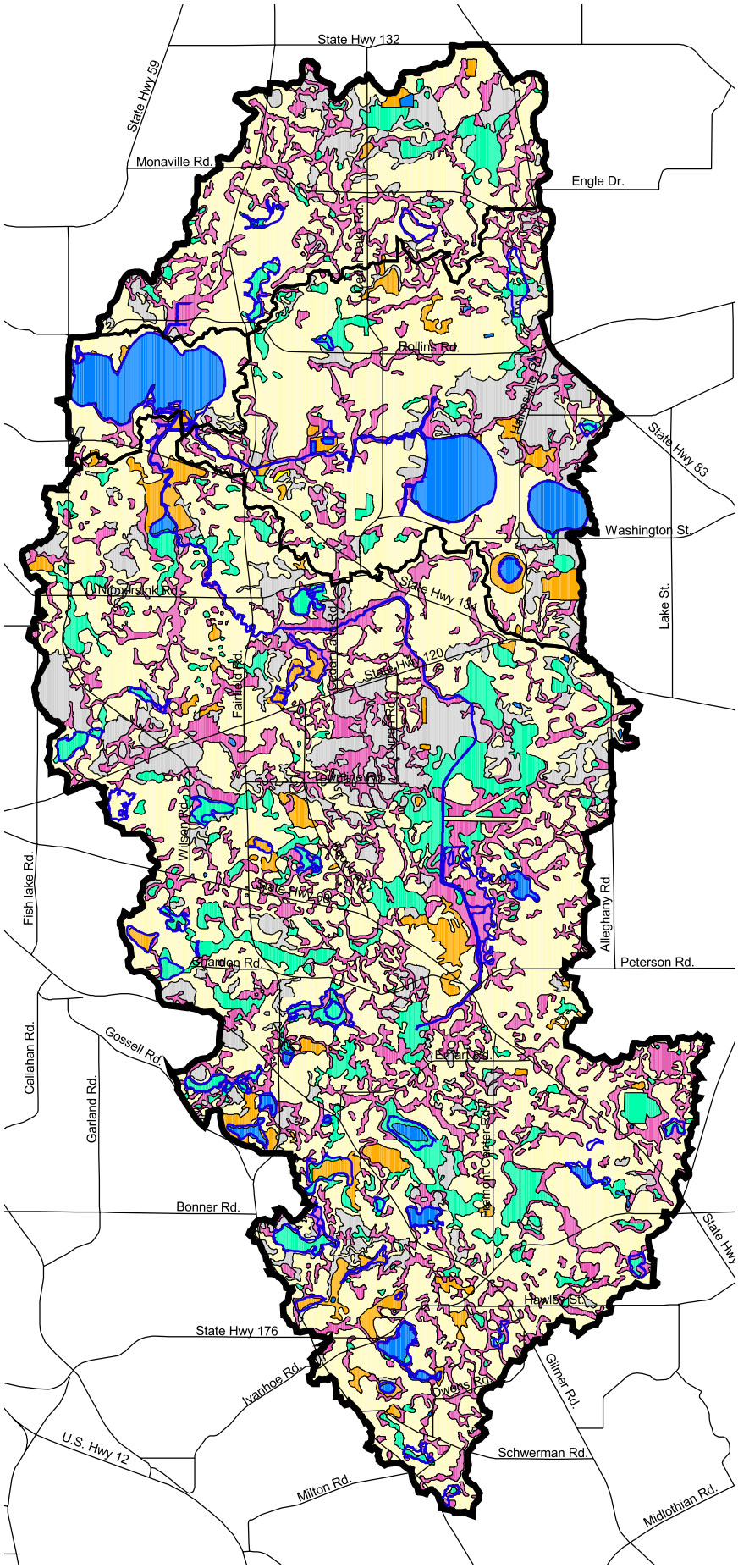
Figure No. 4-33

Prepared by: Hey and Associates, Inc. 2003 (kgk)

The WDO requirements result in about five to ten percent of most new development devoted to detention. In the Round Lake Drain, most of the detention basins were installed prior to the WDO. They typically are much smaller than basins designed to meet the WDO.

4.9 SOILS

Figure 4-34 presents the hydrologic soil groups identified for the watershed by the NRCS. Table 4-11 presents the most common soils throughout the Squaw Creek watershed, along with the corresponding hydrologic soil groups. The NRCS classifies soils by their infiltration capacity with A soils having the highest capacity for infiltration and D soils the lowest. As indicated in Table 4-11, the most common hydrologic soil groups in this area are C and D.



Squaw Creek Watershed

0 1 Miles

N

- Watershed Boundary
- Major Roads
- Water

HSG and Soil Texture

- A - Sand, Loamy Sand or Sandy Loam
- B - Silt Loam or Loam
- C - Sandy CLay Loam
- D - Clay Loam, Silty Clay Loam, Sandy Clay, Silty Clay or Clay
- E - Group A & D
- F - Group B & D
- W - Water

SOURCE: Lake County Dept. of Information and Technology

Hydrologic Soil Groups

Figure No. 4-34

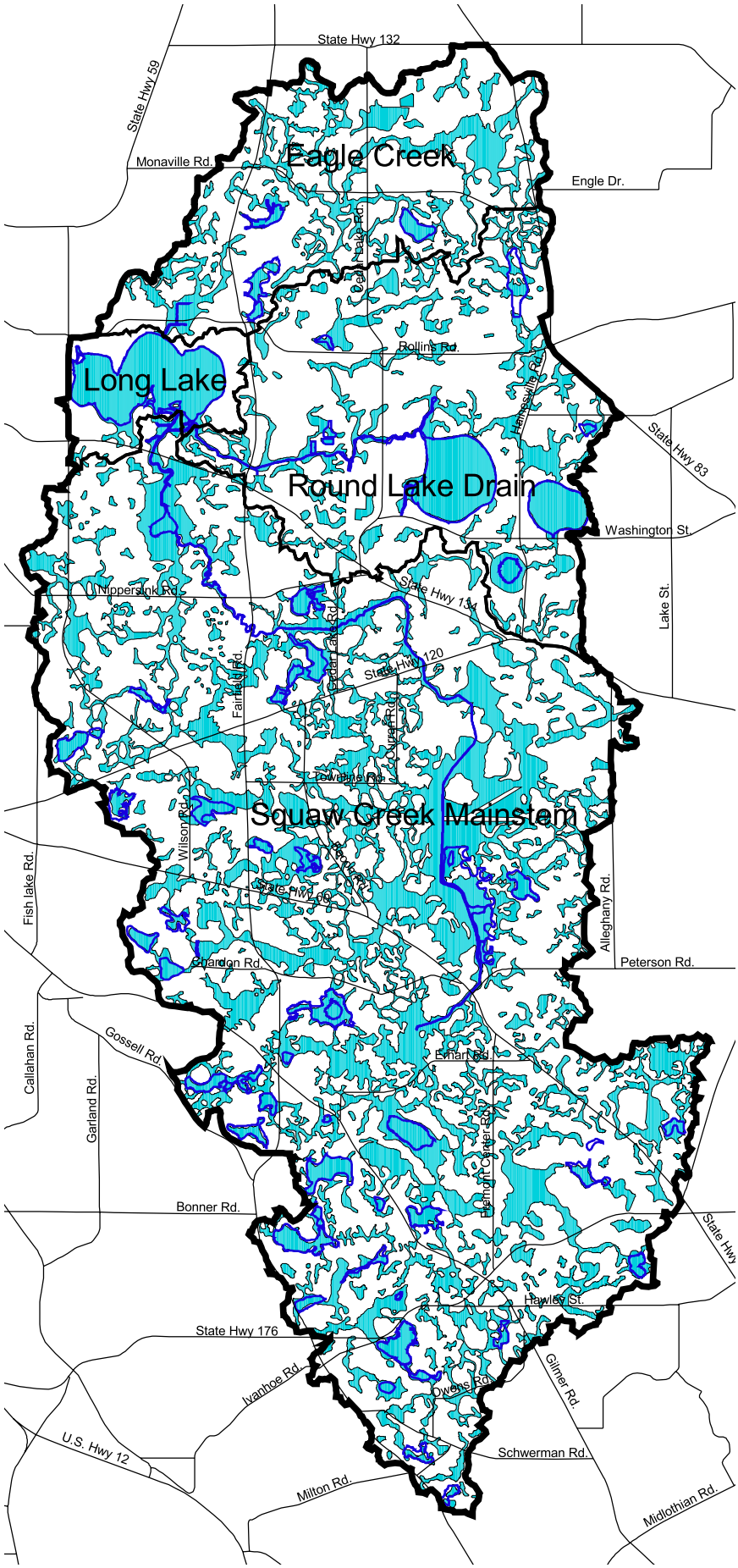
Prepared by: Hey and Associates, Inc. 2003 (kgk)

Table 4-11: Common Watershed Soils (with Hydrologic Soil Group)

Soil Type Prevalence	Entire Watershed (25,249 acres)	Squaw Mainstem (16,892 acres)	Round Lake Drain (4,587 acres)	Eagle Creek (2,992 acres)
Most Common	Morley (C) 7147 acres	Morley (C) 4422 acres	Morley (C) 1374 acres	Morley (C) 1096 acres
| |	Houghton (A/D) 2683 acres	Houghton (A/D) 2133 acres	Markham (C) 467 acres	Beecher (C) 289 acres
| |	Markham (C) 2597 acres	Markham (C) 1999 acres	Beecher (C) 401 acres	Houghton (A/D) 249 acres
| \/	Beecher (C) 1979 acres	Ashkum (B/D) 1409 acres	Grays (B) 389 acres	Peotone (B/D) 226 acres
Least Common	Peotone (B/D) 1809 acres	Peotone (B/D) 1276 acres	Pella (B) 298 acres	Pella (B) 174 acres

Figure 4-35 presents the hydric soils throughout the study area, which comprise about 33 percent of the watershed. This reflects the poor drainage and impermeable soils that were characteristic of the pre-settlement watershed. A comparison of Figure 4-35 with Figure 4-6 shows how these soils were drained for farming. A comparison of Figure 4-35 and Figure 4-28 shows the probable extent of unmapped drain tiles as well. To be able to farm hydric soil, drainage improvements were needed. Even if there is no record of the location of these tiles, it is very likely they are present.

Figure 4-36 presents the extent of highly erodible soils in the watershed. Fortunately the extent of highly erodible soils is not great in the watershed because of its flat topography. Most of these soils are on the outer ridgelines of the watershed. About 25 percent of the watershed are highly erodible soils.



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

Water

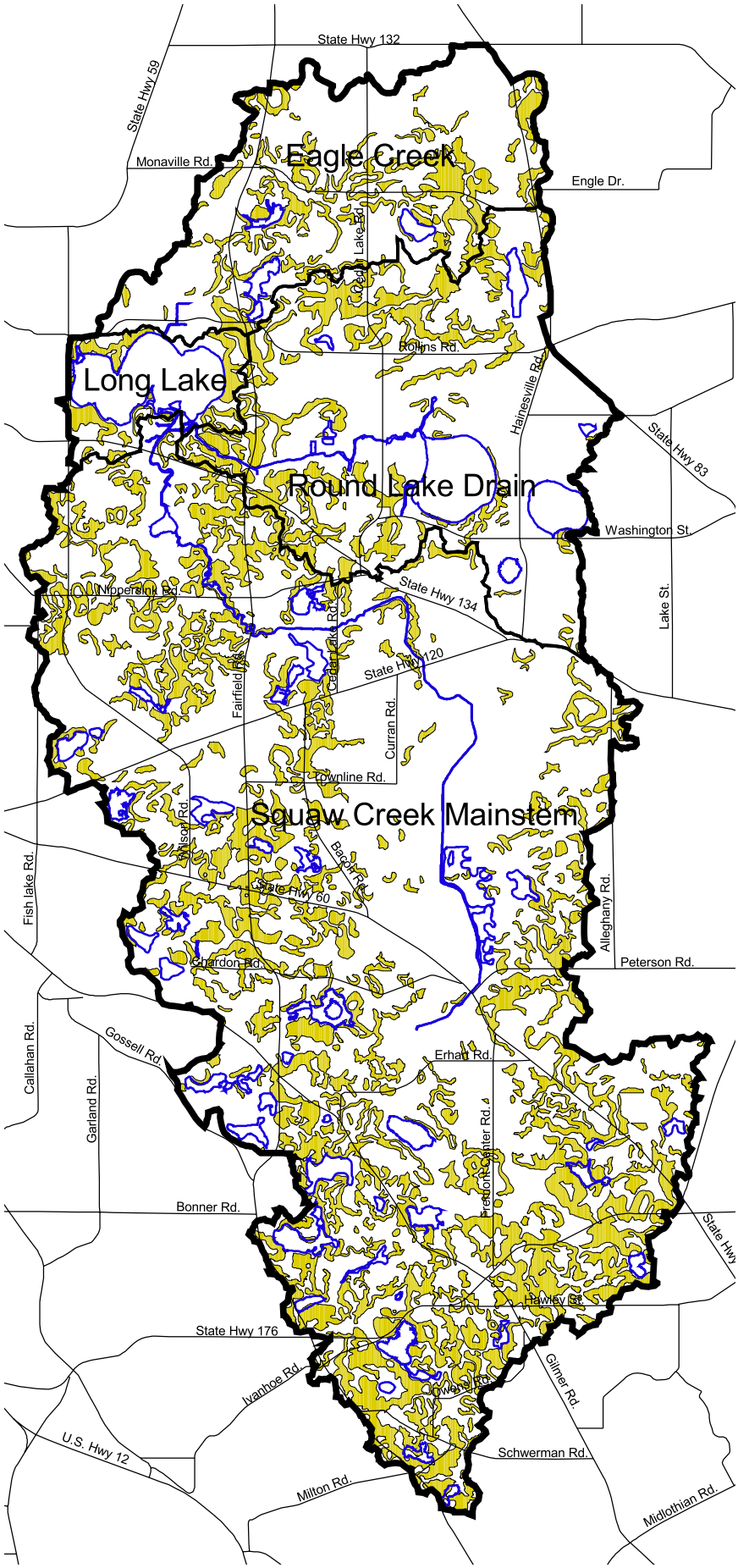
Hydric Soils

SOURCE: Lake County Dept. of Information and Technology

Hydric Soils

Figure No. 4-35

Prepared by: Hey and Associates, Inc. 2003 (kgk)



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

Water

Highly Erodible Land Soils

SOURCE: Lake County Dept. of Information and Technology

Highly Erodible Land Soils

Figure No. 4-36

Prepared by: Hey and Associates, Inc. 2003 (kgk)

4.10 WETLANDS

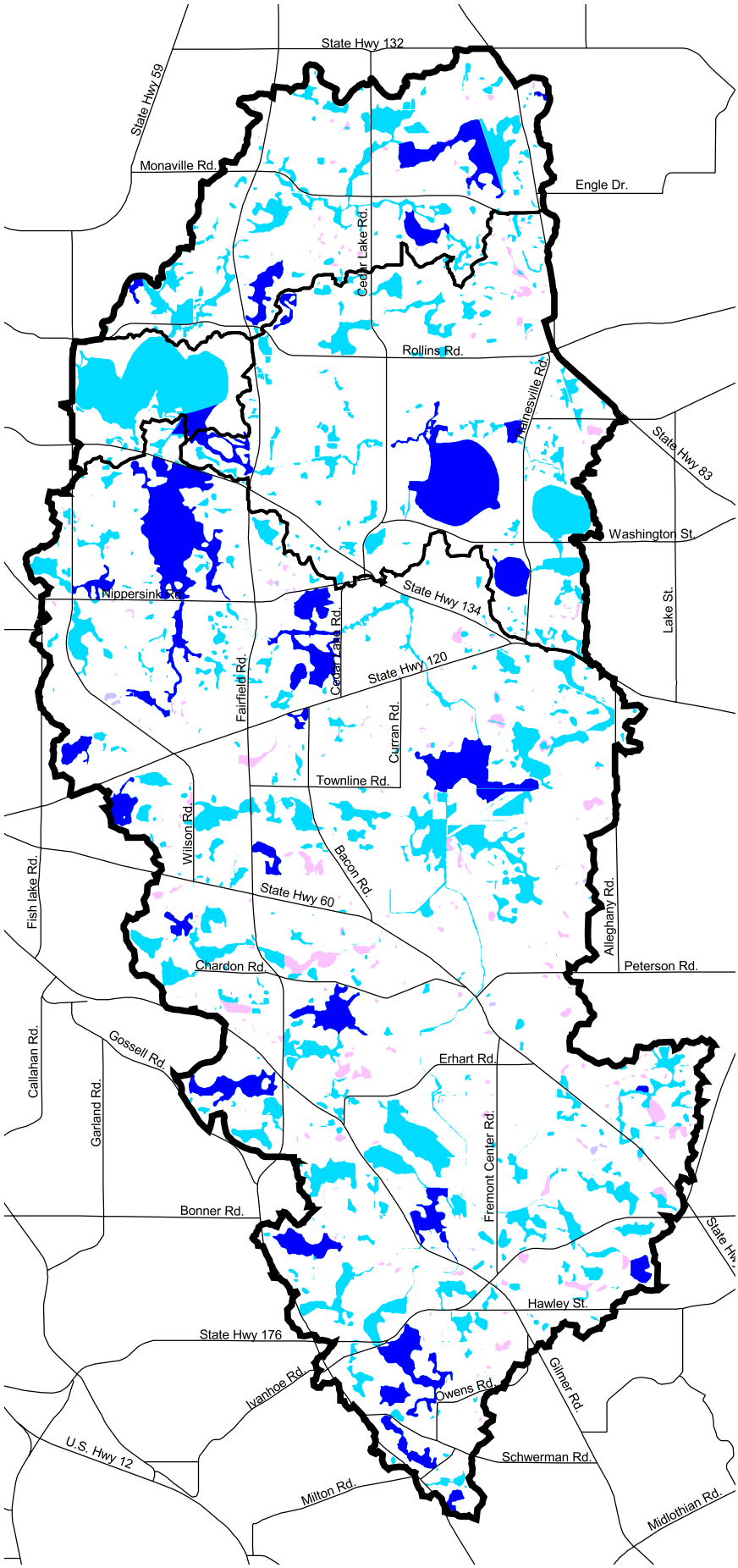
Prior to settlement and agricultural development about 33 percent of the Squaw Creek watershed was wetland. Today about 18 percent of the watershed is wetland. There are 2865 (17%) acres of wetlands in the Mainstem watershed, 843 (18%) acres in the Round Lake Drain, and 552 (18%) acres in Eagle Creek. This translates to a loss of 4,000 acres of wetlands to agriculture. This loss is most apparent in the mainstem where the loss was 50% (3,000 acres). Eagle Creek has lost only 9% or about 300 acres, and the Round Lake Drain has lost about 500 acres or 11% of its wetlands. Figure 4-37 presents the wetlands mapped in the Lake County Wetland Inventory GIS data base. There are 34 Advanced Identification (ADID) wetlands in the watershed. ADID wetlands are the highest functional value wetlands in Lake County.

Table 4-12 presents the functional value of each of the ADID wetlands in the watershed. Current federal and WDO regulations make it very difficult to develop these wetlands (Chicago District COE, 2000).

Many of the other wetlands in the study area provide a variety of beneficial uses, including flood storage, water quality treatment, and fish and wildlife habitat. Uncontrolled stormwater runoff can adversely impact wetlands with sensitive native plant species or wildlife habitat that depends on stable water levels. However, wetlands with many less sensitive native species can tolerate pollutant inputs better and work to improve water quality by assimilating sediment and nutrients.

Table 4-12: Functional Values of ADID Wetlands in the Squaw Creek Watershed

	Biological Values							Water Quality / Hydrology Values			
ADID Site Number	High Quality Stream	Presence of State Threatened or Endangered Species (FISH)	Presence of State Threatened or Endangered Species (BIRD)	Presence of State Threatened or Endangered Species (PLANTS)	Designated Illinois Natural Area Inventory Site	High Quality Wildlife Habitat	High Quality Plant Community	Stormwater Storage	Shoreline / Bank Stabilization	Sediment / Toxicant Retention	Nutrient Removal / Transformation
41						X	X	X	X	X	
42						X		X		X	
49				X	X		X			X	X
50			X			X		X	X	X	
51						X	X			X	X
57									X	X	X
58						X		X		X	
59		X							X		
68							X		X	X	X
69								X		X	X
74						X				X	X
75								X		X	X
76			X					X Partial		X	X Partial
77						X		X			
82						X	X	X		X	
83	X							X		X	X
84						X		X		X	
85						X		X		X	
86			X								
87								X		X	X
92						X	X	X		X	
102									X	X	X
103			X					X		X	
112							X	X		X	
118			X					X	X	X	
119									X	X	X
120								X	X	X	
124								X	X	X	
125								X	X Partial	X	X
139								X	X	X	X
141								X	X	X	X Partial
193			X							X	X
199			X							X	X
203						X		X		X	



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

ADID Wetlands

Artificial Wetland

Farmed Wetland

Wetland

SOURCE: Lake County Dept. of Information and Technology

Wetlands

Figure No. 4-37

Prepared by: Hey and Associates, Inc. 2003 (kgk)

The presence of significant existing wetland resources in close proximity to streams along with the potential for wetland restoration on drained hydric soils offers an opportunity to reintegrate wetlands into streamflow in the Squaw Creek watershed. Figure 4-38 presents an overview of the location of drained hydric soils that could be restored to wetlands in relation to existing streams, wetlands and open spaces. This would stabilize flows and improve water quality in the Eagle Creek and Mainstem watersheds and to a lesser extent in the Round Lake Drain.

4.12 SANITARY SEWER CAPACITY

Sewer service controls the density of development in a watershed. The future development patterns in a watershed are a direct reflection of the availability and cost of sanitary sewer service. Sewer service in the Squaw Creek watershed is provided as follows.

- The southwest portion of the Mainstem is served by the Village of Wauconda. The Village is currently expanding its service for developments north of Gilmer Road.

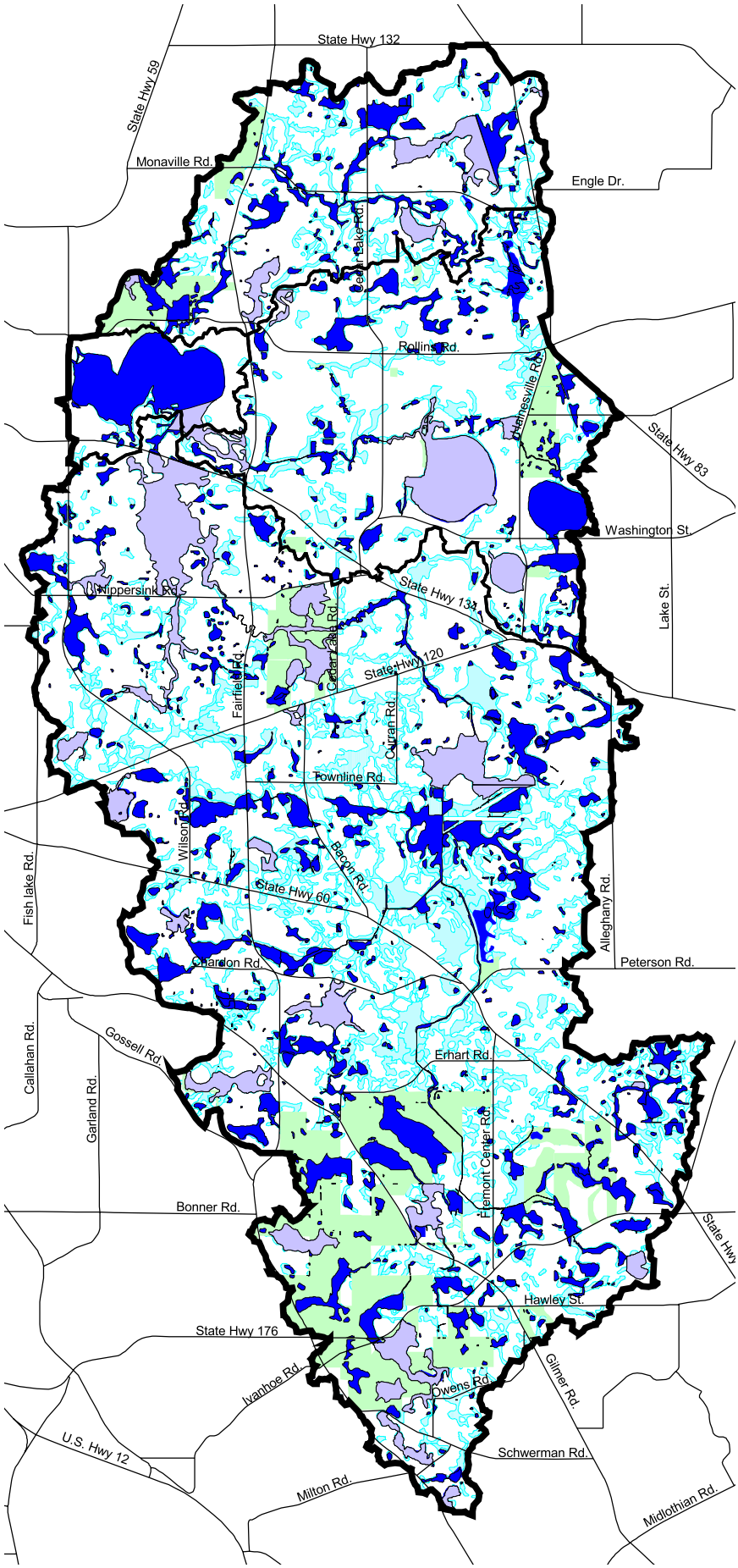
- Service is available in the northern part of the Mainstem and in the Round Lake Drain through the Round Lake Sanitary District.

- Service in the Eagle Creek Watershed is available through Lake Villa.

- The Lake County Public Works Department provides interceptor sewers and pump stations to convey wastewater from the Round Lake Sanitary District and Lake Villa to the Fox Lake Regional Wastewater Treatment Plant as shown on Figure 4-39.

- The Villages of Round Lake, Round Lake Beach, Round Lake Heights, Hainesville, and Round Lake Park also own and operate local collector sewers.

Growth in the Squaw Creek watershed ultimately is limited by the capacity of the Wauconda and Fox Lake wastewater treatment plants, by the capacity of the LCPWD



Squaw Creek Watershed

0 1 Miles

N

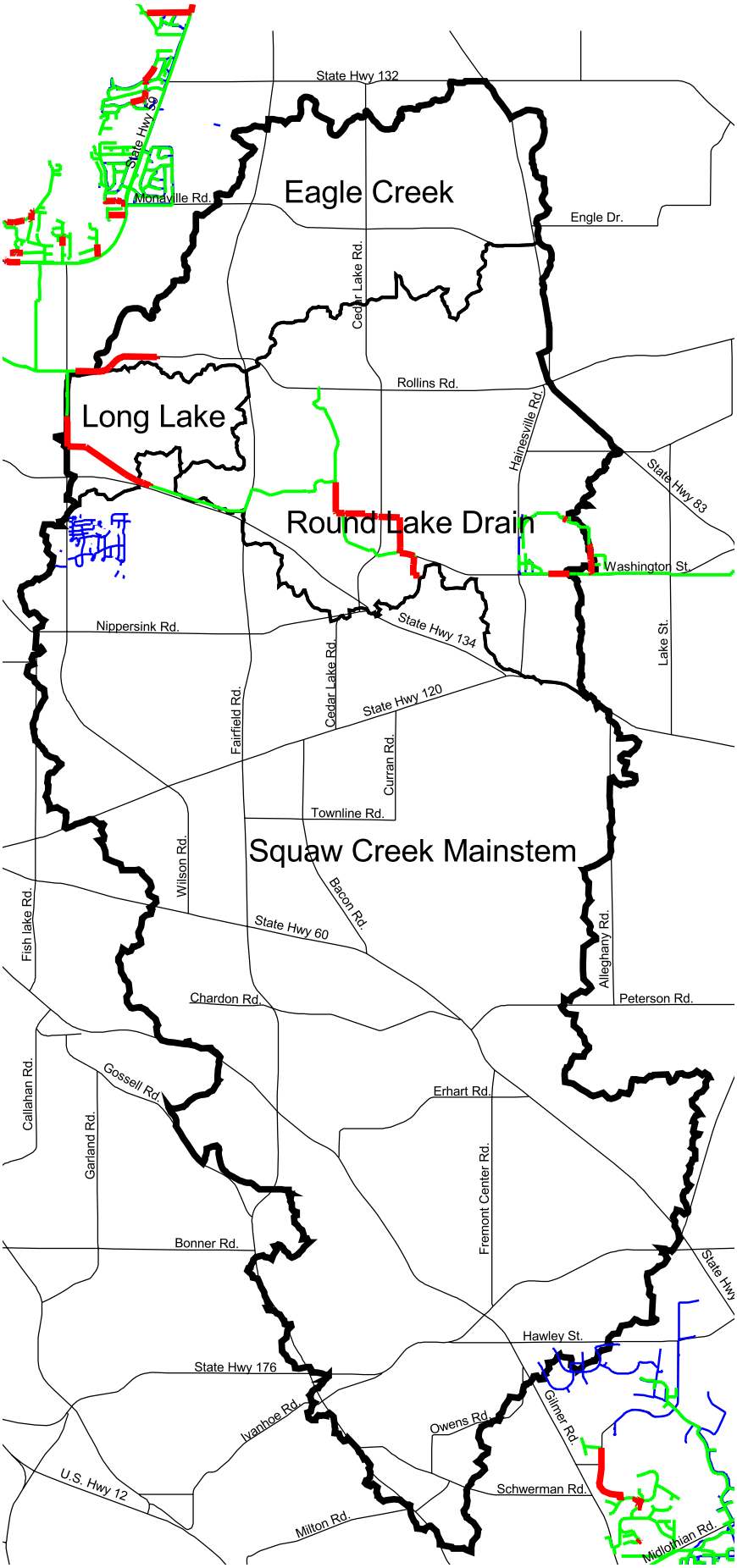
- Watershed Boundary
- Major Roads
- ADID Wetlands
- LCWI Wetlands
- Open Space
- Hydric Soils

SOURCE: Lake County Dept. of Information and Technology
Northeastern Illinois Planning Commission

Restoration Potential

Figure No. 4-38

Prepared by: Hey and Associates, Inc. 2003 (kgk)



Squaw Creek Watershed

0 1 Miles

N

LCPWD Sanitary - Forced Main

LCPWD Sanitary - Gravity

LCPWD Water Supply

Watershed Boundary

Major Roads

SOURCE: Lake County Public Works Department (LCPWD)

Sewer & Water Availability

Figure No. 4-39

Prepared by: Hey and Associates, Inc. 2003 (kgk)

interceptor sewers and pumping stations, and the capacity of the Round Lake S.D. pumping station and sewers and the Lake Villa sewer system. It appears that at least one wastewater treatment plant will need to have its capacity increased to accommodate the growth projected to occur by the year 2020.

4.13 WATER SUPPLY

Most of the water supply for the Squaw Creek watershed is obtained from Lake Michigan through the Central Lake County Joint Areawide Water Agency (CLCJAWA).

The CLCJAWA obtains water from Lake Michigan from intakes at Lake Bluff and distributes it to the watershed communities of Round Lake, Round Lake Beach, Round Lake Park, and Round Lake Heights. Other communities in the watershed obtain potable water supplies from a combination of municipal and private groundwater wells. The sources of groundwater are, in general order of depth below land surface, the sand and gravel, the Cambrian Ordovican Dolomite, and the St. Peter sandstone aquifers. Most of the potable groundwater water supply for Squaw Creek is pumped from the Cambrian Ordovician aquifer.

4.14 WASTE DISPOSAL SITES

The IDNR has identified a number of active and inactive waste disposal sites in the watershed. There is no evidence to suggest that any of these sites are influencing surface water quality in the watershed. Additional detail on these sites is presented in the Appendix.

4.15 OPEN SPACE

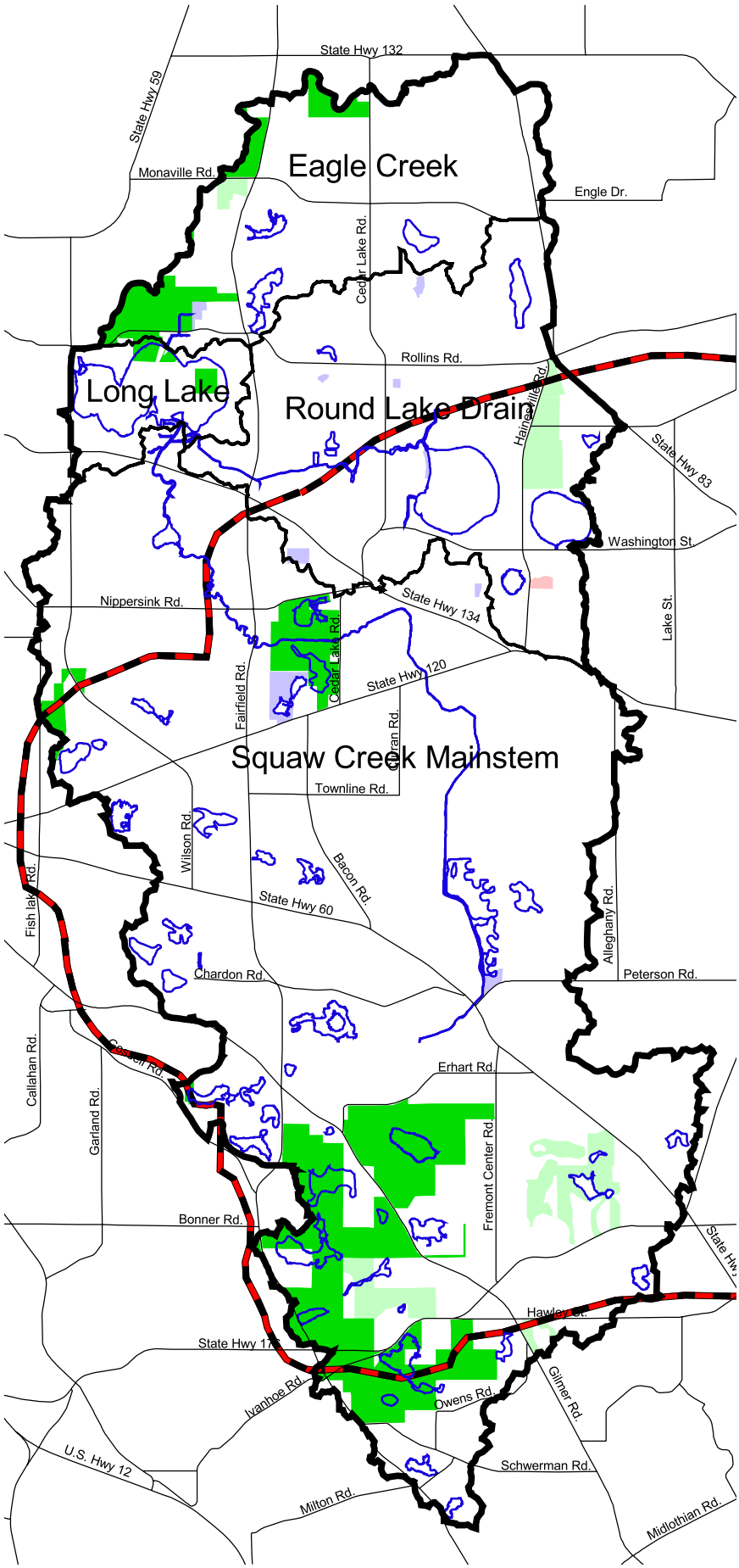
Existing public open space in the watershed is shown on Figure 4-40. Most of the public open space is in the Squaw Creek Mainstem watershed. Throughout the study area, a total of approximately 1,940 acres of open space is owned by the Lake County Forest Preserve District (LCFPD). A significant current and future LCFPD project in the watershed is the Millennium Trail portions of which have been completed or are under construction (Figure 4-40). Open space in the Round Lake Drain watershed is owned by the Round Lake Area Park District, which owns 35 sites including Renwood Golf

Course. Most of these sites are small, active recreation. The Eagle Creek watershed has the Grant Woods holding of the LCFPD. Table 4-13 presents the major open space holdings and their acreage for the Squaw Creek watershed.

Table 4-13: Major Open Space Holdings

Open Space	Size (acre)
Renwood Golf Course (RLAPD)	158
Grant Woods (LCFPD)	357
Nippersink Marsh (LCFPD)	226
Ray Lake (LCFPD)	407
Lakewood (LCFPD)	1,017
Marc Flat (LCFPD)	55

Additional "effective" open space exists in the watershed in the form of wetlands, floodplains, lakes, their buffers and portions of the Big Sag Wetland that have been dedicated to wetland banks. These areas total about 6,500 acres or 25 percent of the watershed.



Squaw Creek Watershed

0 1 Miles

N

- Watershed Boundary
- Major Roads
- Water
- Millenium Trail
- Forest Preserves

1995 NIPC Landuse

- Recreational: Parks, arboretums, botanical gardens
- Recreational: Golf courses
- Recreational: Other
- Conservation: Parks, arboretums, botanical gardens, forest pres.

SOURCES: Northeastern Illinois Planning Commission
Lake County Forest Preserve District

Publicly-Owned Open Space

Figure No. 4-40

Prepared by: Hey and Associates, Inc. 2003 (kgk)

4.16 STREAM INVENTORY

A detailed stream inventory was performed for the Mainstem, the Round Lake Drain, and Eagle Creek. The major stream characteristics that were assessed were as follows:

- extent of channelization, sinuosity, pool and riffle development,
- stream and bank erosion problems and armoring,
- streambank vegetation,
- debris accumulations and source,
- hydraulic structures such as cross-channel bridges and culverts,
- point discharges into the stream,
- land use and vegetative cover instream and in the riparian corridor, and
- channel substrate, substrate stability and degree of sedimentation.

Figure 4-41 presents the inventory reaches for the Squaw Creek Mainstem; Figure 4-42 for the Round Lake Drain; and Figure 4-43 for Eagle Creek. All data are in GIS format.

Tables 4-14 through 4-18 presents summary results for each watershed for channelization, erosion, sedimentation, pool-riffle development, and in-stream cover for fish.

Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

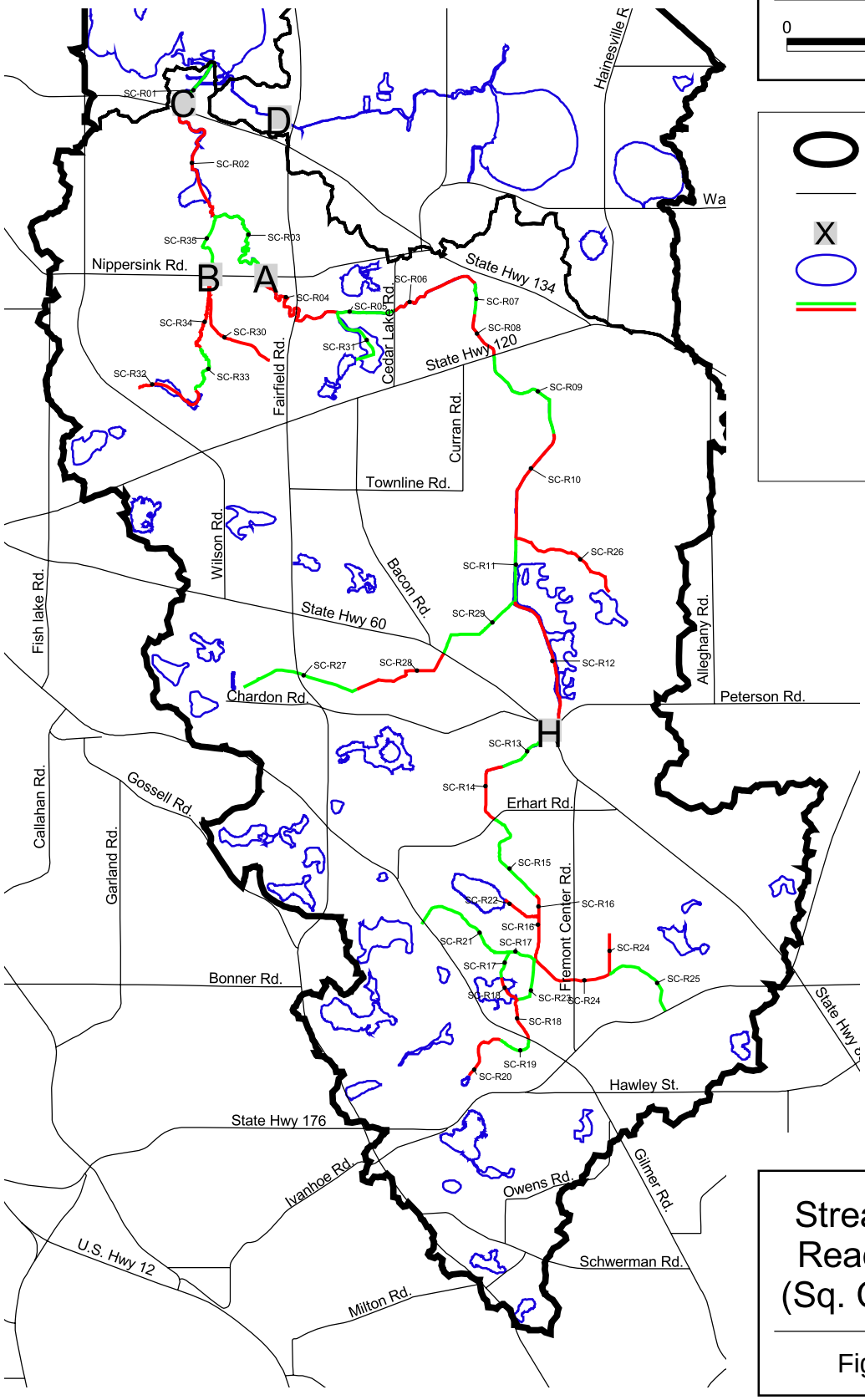
Major Roads

Baxter Stream Gages

Water

Stream Reaches *

* Alternating colors are only used to illustrate where individual stream reaches begin and end. The colors are not indicative of reach quality.



Stream Inventory Reach Locations (Sq. Cr. Mainstem)

Figure No. 4-41

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

0 4000 Feet

N

Watershed Boundary

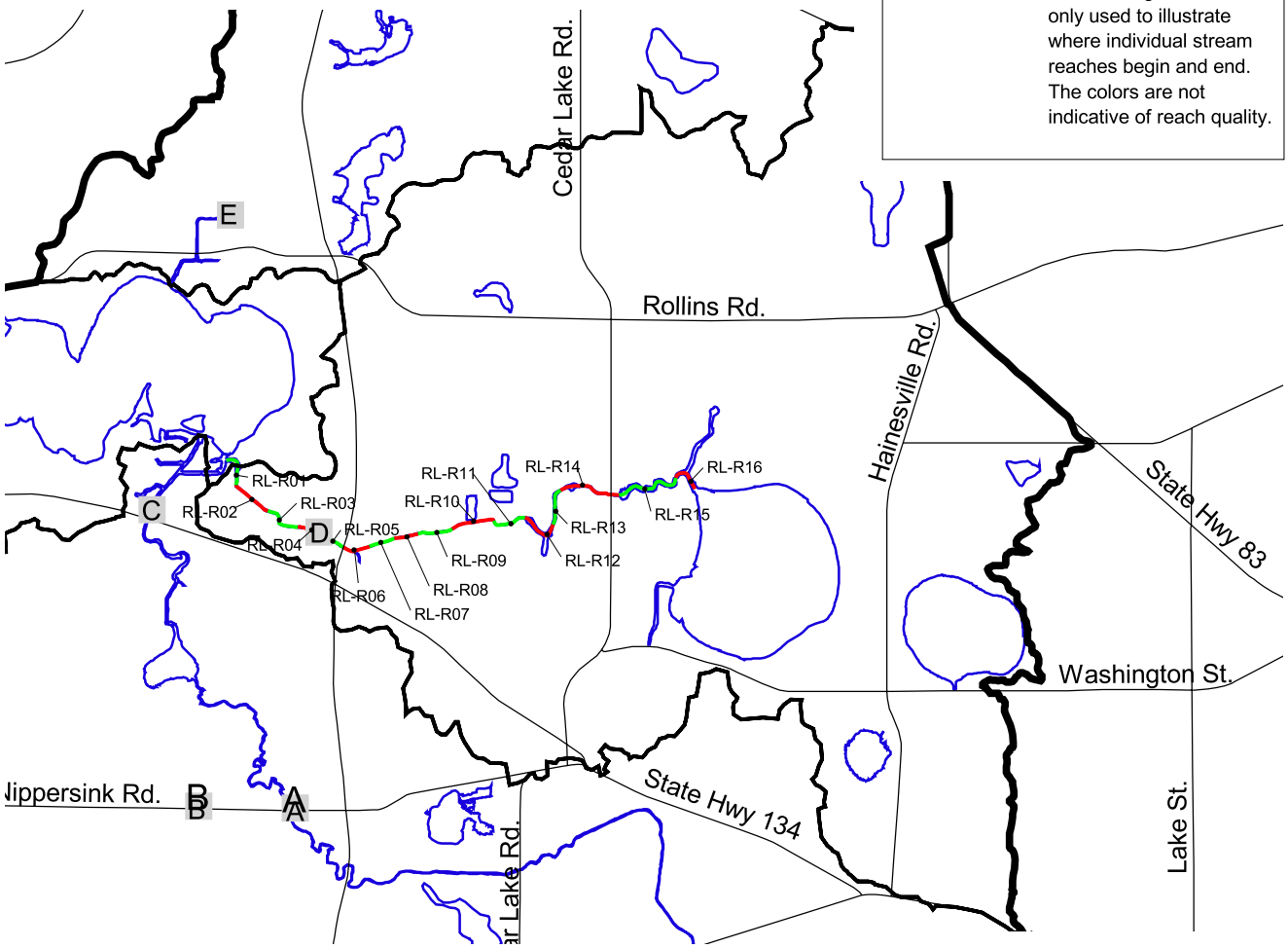
Major Roads

X Baxter Stream Gages

Water

Stream Reaches *

* Alternating colors are only used to illustrate where individual stream reaches begin and end. The colors are not indicative of reach quality.



Stream Inventory Reach Locations (Round Lake Drain)

Figure No. 4-42

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

0 4000 Feet

N

Watershed Boundary

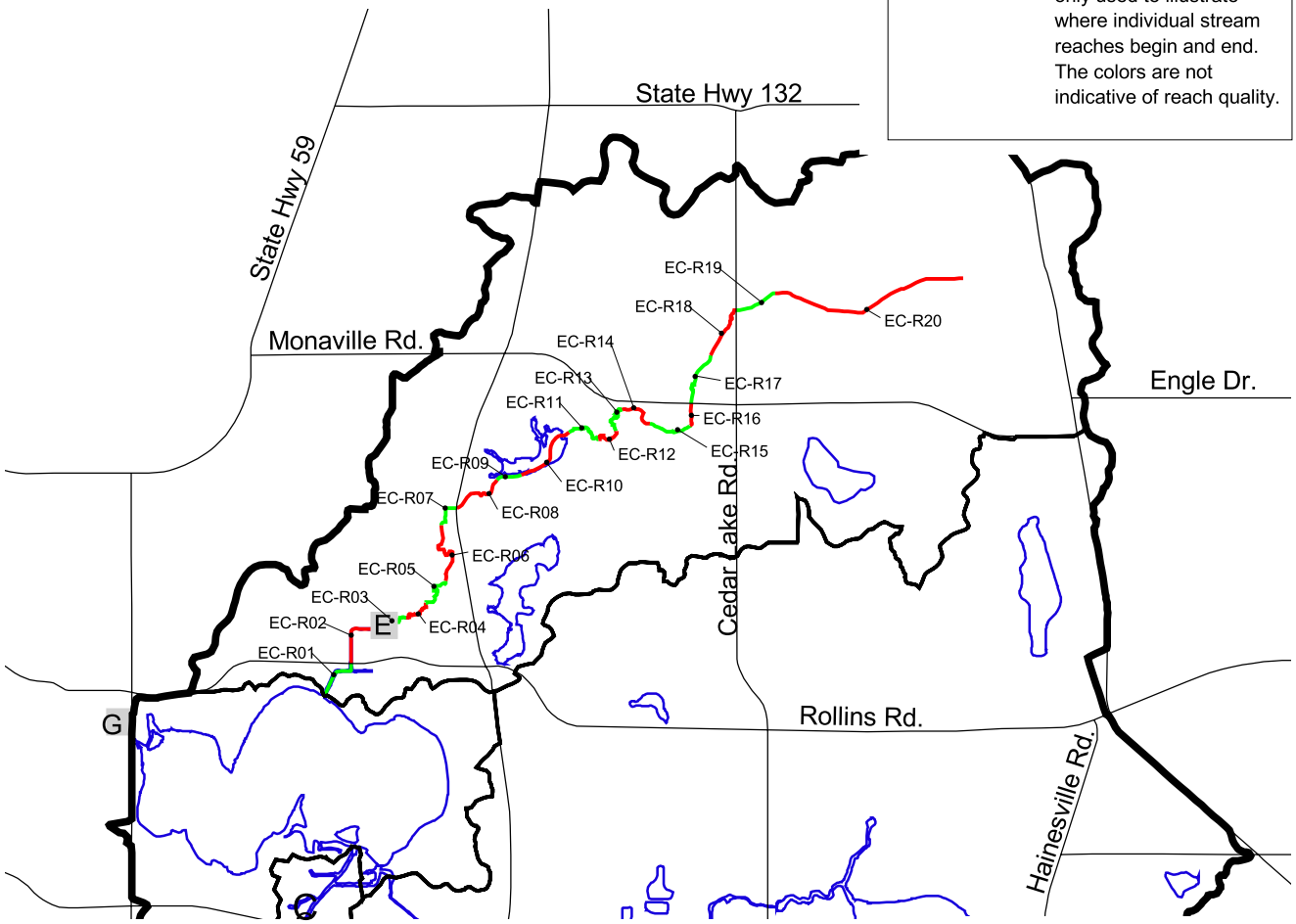
Major Roads

X Baxter Stream Gages

Water

Stream Reaches *

* Alternating colors are only used to illustrate where individual stream reaches begin and end. The colors are not indicative of reach quality.



Stream Inventory Reach Locations (Eagle Creek)

Figure No. 4-43

Prepared by: Hey and Associates, Inc. 2003 (kgk)

4.16.1 Channelization

Channelization (Table 4-14) refers to channel modifications performed by humans. 'None' refers to a reaches that have never been channelized or have recovered and regained their former, natural characteristics. 'Channelization with Recovery' refers to channelized streams that are in the process of regaining their former, natural characteristics. Recovery also applies to reaches that were channelized long ago but that still have poor channel characteristics. 'Channelization without Recovery' refers to reaches that were recently channelized or those that show no significant recovery of natural channel characteristics such as meandering.

Squaw Creek had the highest amount of channelization without recovery (54%). The stream is in a much less channelized condition north of IL Route 120 where there are several reaches with no apparent channelization or the reaches are in a state of recovery. Round Lake Drain is nearly 40% channelized without recovery. The majority of the Drain is within residential areas so there is little chance that any of the channelized reaches could recovery fully. Eagle Creek is in the best condition of the three reaches with regards to channelization with 80% of the reaches in a state of recovery.

Table 4-14: Channelization (Length in approximate feet and Percent of Stream per Category)

Survey End Point	None	Channelization with Recovery	Channelization without Recovery
Squaw Creek at Nippersink Road	6400	9600	28,800
	14.3%	21.4%	64.3%
Squaw Creek Tributary at Nippersink Road	9600	3200	0
	75%	25%	0%
Squaw Creek at Route 134	6400	3200	3200
	50%	25%	25%
Squaw Creek at Route 60	0	12,800	28,800
	0%	31%	69%
Squaw Creek (total)	22,400	28,800	60,800
	20%	26%	54%
Round Lake Drain at Fairfield Village's Access Road	1600	6400	4800
	12.5%	50.0%	37.5%
Eagle Creek at Al's Place	2200	17,600	2200
	10%	80%	10%

Figures 4-51, 4-52, and 4-53 present these results for the Mainstem, Round Lake Drain, and Eagle Creek, respectively.

4.16.2 Bank and Shore Erosion

Severe bank erosion (Table 4-15) is a significant concern for Lake County's stream and rivers. Severely eroded banks have exposed soil on nearly vertical banks extending from the top of bank to the low water mark so erosion is constantly occurring. Highly eroded streambanks contribute heavy loads of sediment and erode during times of higher flows. Active slumping and sloughing may be apparent where fresh, moist, loose soil and other signs of recent bank movement such as exposed tree roots or suspended fences extending into the stream are found. Eroded areas are prevalent in the outer edges of bends and meanders.

Bank erosion was identified as high in only 6% of Squaw Creek and 18% of Round Lake Drain. This is a result of the highly channelized condition of the streams and the absence of bends and meanders. Eagle Creek, which has several bends and meanders, has a couple of high bank erosion areas. Reach 8, east of Fairfield Road, was area of severe bank erosion with undercut trees.

The Lake County Health Department's Lake Management Unit has evaluated the severity of shore erosion at several lakes in the watershed as part of the Unit's extensive lake assessment program.

For each lake evaluated, the shoreline along the land/water interface on each parcel was observed from a boat and various parameters were assessed. Shorelines were first identified as developed or undeveloped. The type of shoreline was then determined and length of each type was recorded based on the land parcel map or was estimated.

The degree of shoreline erosion was categorically defined as none, slight, moderate, or severe.

- **Slight** Minimal or no observable erosion; generally considered stable;
- **Moderate** Recession is characterized by past or recently eroded banks; area may exhibit some exposed roots, fallen vegetation or minor slumping of soil material;
- **Severe** Recession is characterized by eroding of exposed soil on nearly vertical banks, exposed roots, fallen vegetation or extensive slumping of bank material, undercutting, washouts or fence posts exhibiting realignment;

Table 4-15a provides an assessment of the shore erosion on the principal lakes in the watershed.

Table 4-15a: LCHD Assessment of Lake Shoreline Erosion*

Lake	Erosion Severity	Linear Feet Affected	Percentage
Highland Lake	None	7,522	91.2
	Slight	355	4.3
	Moderate	178	2.2
	Severe	191	2.3
	Total	**8,246**	**100**
Lake Holloway	None	752	14.9
	Slight	3,243	64.2
	Moderate	1,057	20.9
	Severe	0	0
	Total	**5,052**	**100**
Long Lake	None	29,278	73.8
	Slight	8,065	20.3
	Moderate	1,856	4.8
	Severe	455	1.1
	Total	**39,656**	**100**
Round Lake	None	15,471	64.7
	Slight	7,088	29.6
	Moderate	1,061	4.4
	Severe	287	1.2
	Total	**23,909**	**100**

*Davis, Owens and Cranberry Lakes were not assessed for shoreline erosion since the entire perimeters of these lakes consist of cattails.

Squaw Creek Watershed

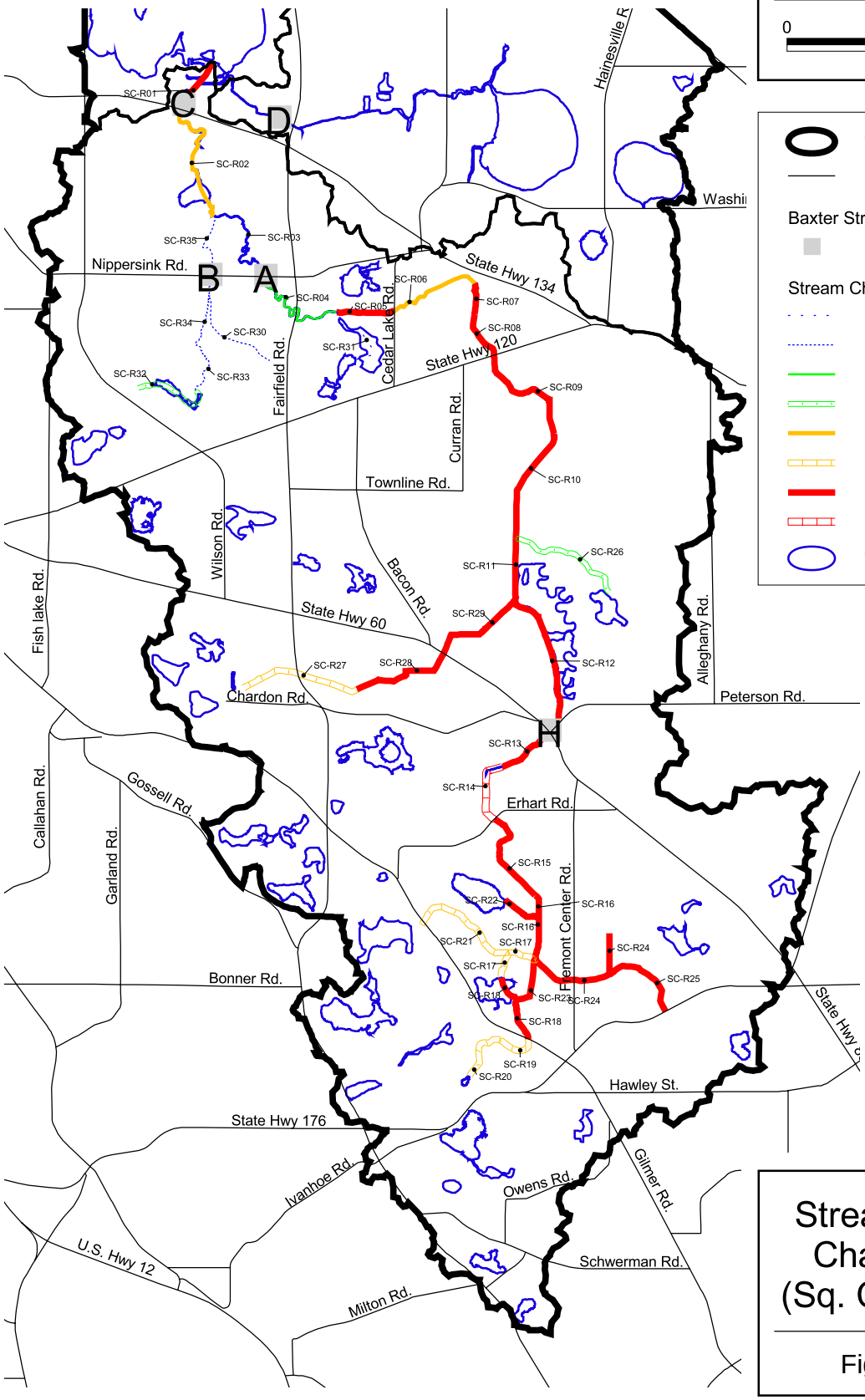
0 1 Miles

N

Watershed Boundary
Major Roads

Baxter Stream Gages
Baxter Daily Stream Gage

Stream Channelization
N/A
None
None & Recovering
None & Recovering/Pilot Channel
Recovering
Recovering/Pilot Channel
No Recovery
No Recovery/Pilot Channel
Water



Stream Inventory Channelization (Sq. Cr. Mainstem)

Figure No. 4-44

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

0 4000 Feet

N

Watershed Boundary

Major Roads

Baxter Stream Gages

X Baxter Daily Stream Gage

Stream Channelization

N/A

None

None & Recovering

None & Recovering/Pilot Channel

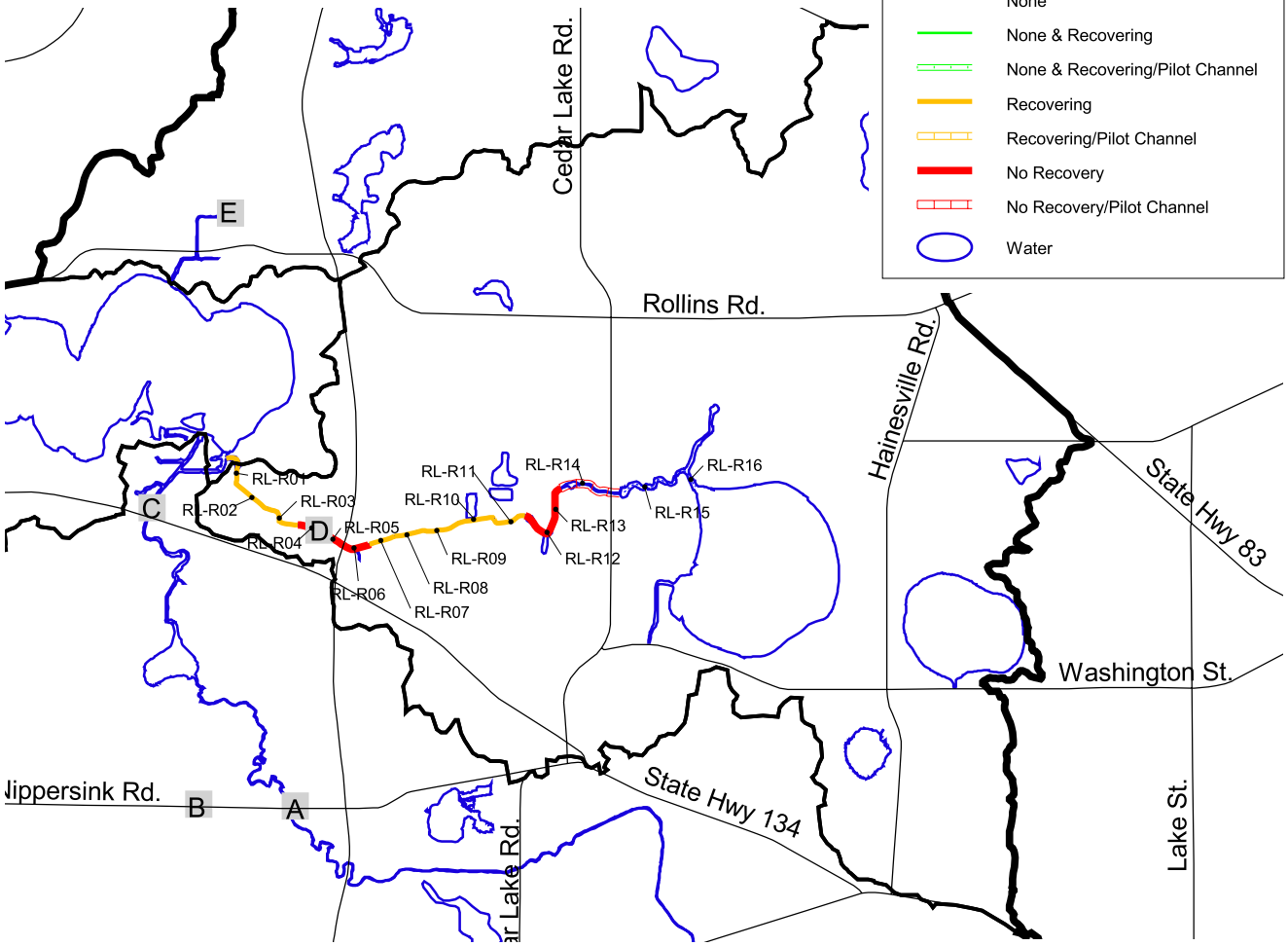
Recovering

Recovering/Pilot Channel

No Recovery

No Recovery/Pilot Channel

Water



Stream Inventory Channelization (Round Lake Drain)

Figure No. 4-45

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

0 4000 Feet

N

Watershed Boundary

Major Roads

Baxter Stream Gages

Baxter Daily Stream Gage

Stream Channelization

N/A

None

None & Recovering

None & Recovering/Pilot Channel

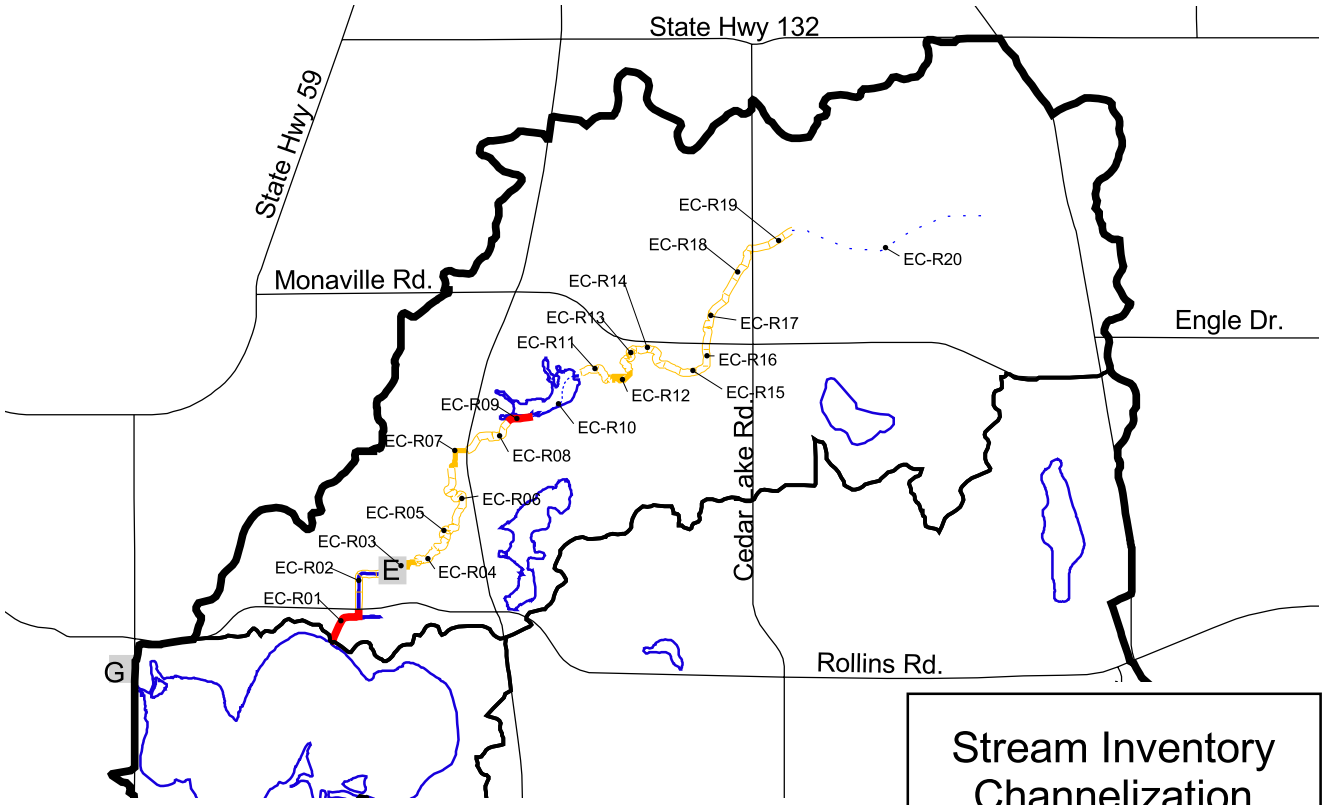
Recovering

Recovering/Pilot Channel

No Recovery

No Recovery/Pilot Channel

Water



Stream Inventory Channelization (Eagle Creek)

Figure No. 4-46

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Table 4-15b: Bank Erosion* (Length in approximate feet and Percent of Stream per Category)

Survey End Point	None	Low	Moderate	High
Squaw Creek at Nippersink Road	3200	22,400	16,000	3200
	7%	50%	36%	7%
Squaw Creek Tributary at Nippersink Road	0	6400	6400	0
	0%	50%	50%	0%
Squaw Creek at Route 134	0	12,800	0	0
	0%	100%	0%	0%
Squaw Creek at Route 60	3200	19,200	16,000	3200
	7%	46%	38.5%	7%
Squaw Creek (total)	6400	60,800	38,400	6400
	6%	54%	34%	6%
Round Lake Drain at Fairfield Village's Access Road	2400	3200	4800	2400
	18.75%	25%	37.5%	18.75%
Eagle Creek at Al's Place	4400	7700	6600	3300
	20%	35%	30%	15%

* None=0%; Low=1-33%; Moderate=34-66%; High=67-100% of the reach had eroded streambanks.

Figures 4-47, 4-48, and 4-49 present bank erosion results for the Mainstem, Round Lake Drain, and Eagle Creek, respectively.

Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

Baxter Stream Gages

X Baxter Daily Stream Gage

Stream Bank Erosion

N/A

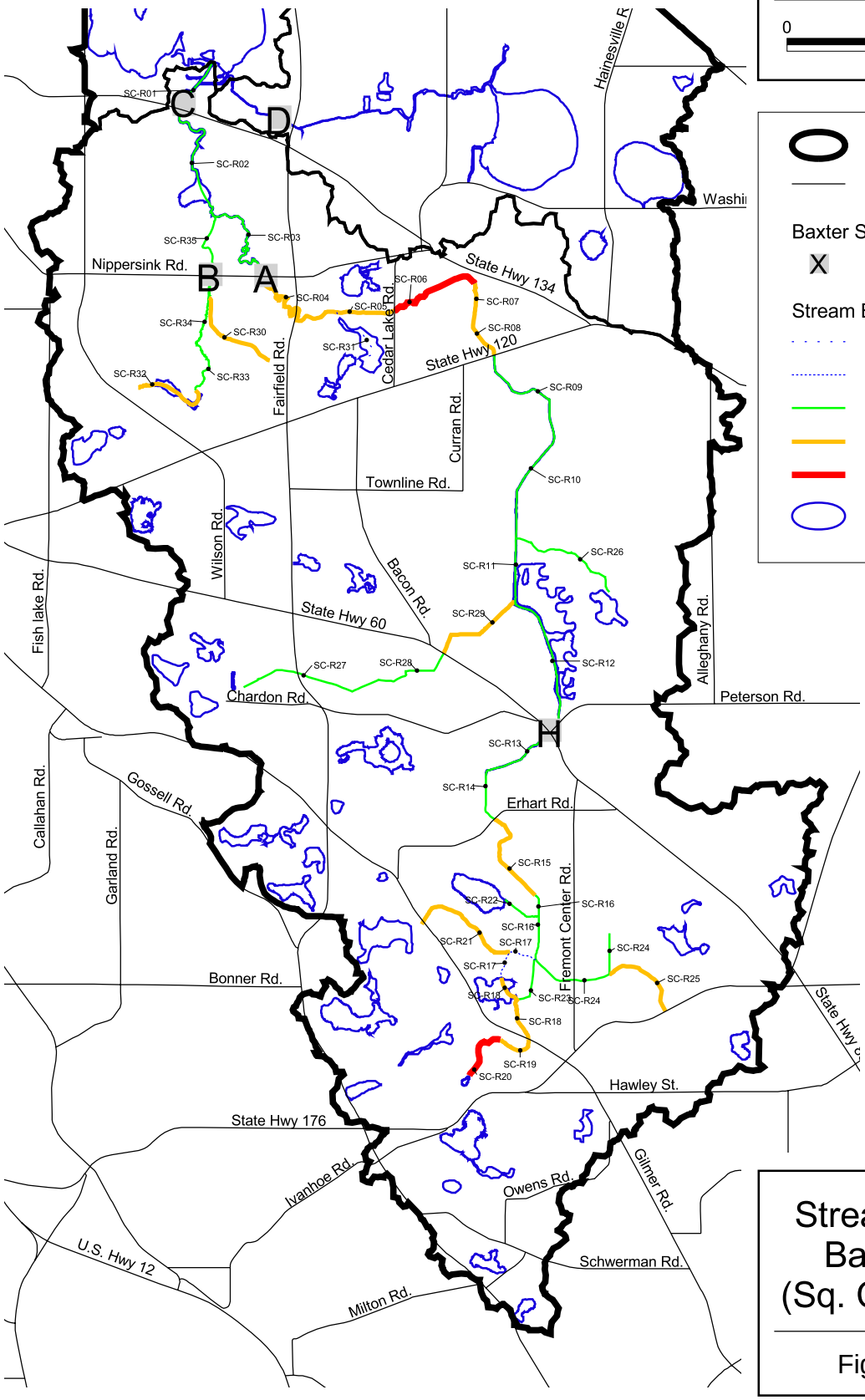
None

Low

Moderate

High

Water



Stream Inventory
Bank Erosion
(Sq. Cr. Mainstem)

Figure No. 4-47

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

0 4000 Feet

N

Watershed Boundary

Major Roads

Baxter Stream Gages

X Baxter Daily Stream Gage

Stream Bank Erosion

N/A

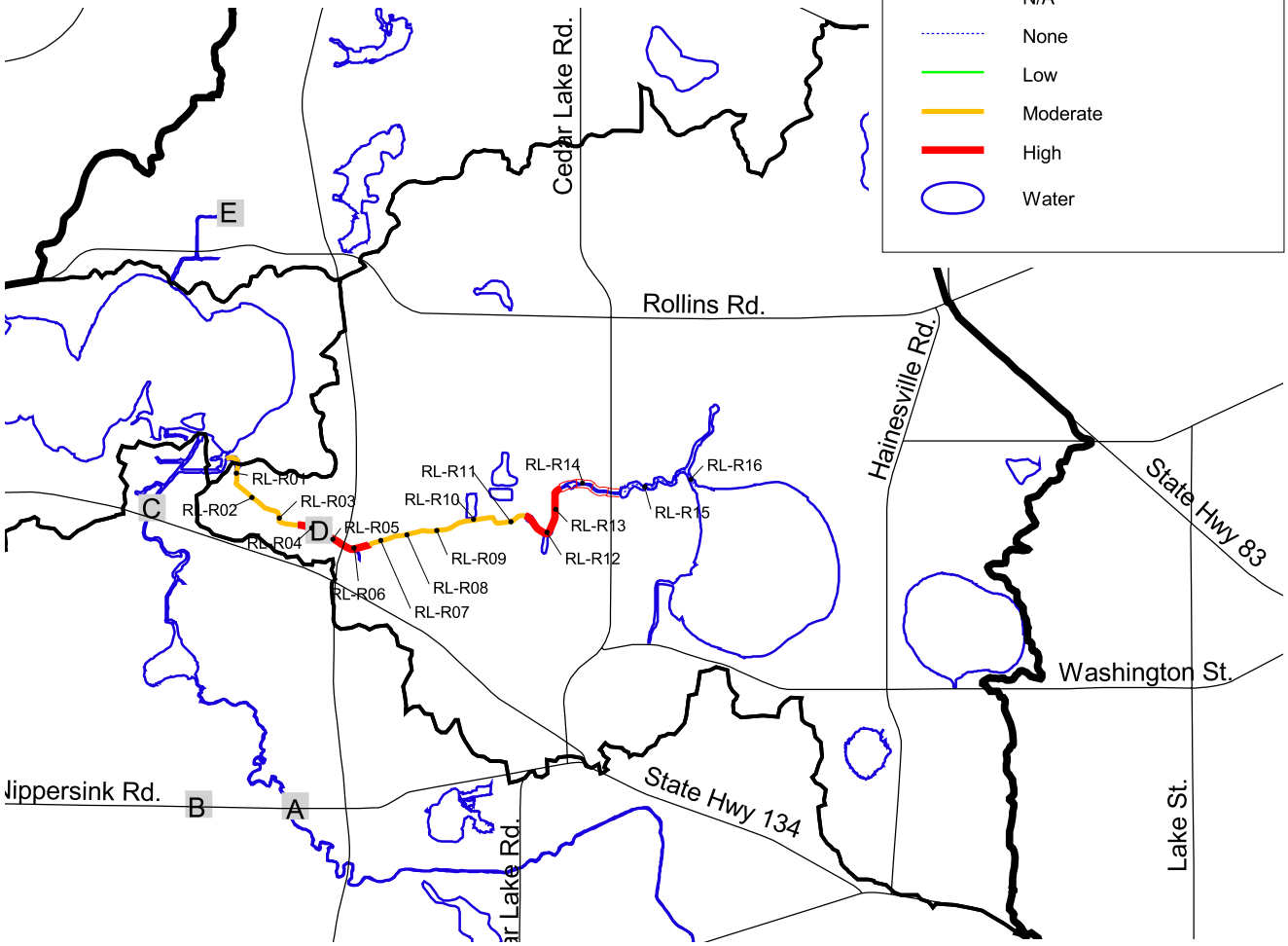
None

Low

Moderate

High

Water



Stream Inventory
Bank Erosion
(Round Lake Drain)

Figure No. 4-48

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

0 4000 Feet

N

Watershed Boundary

Major Roads

Baxter Stream Gages

X Baxter Daily Stream Gage

Stream Bank Erosion

N/A

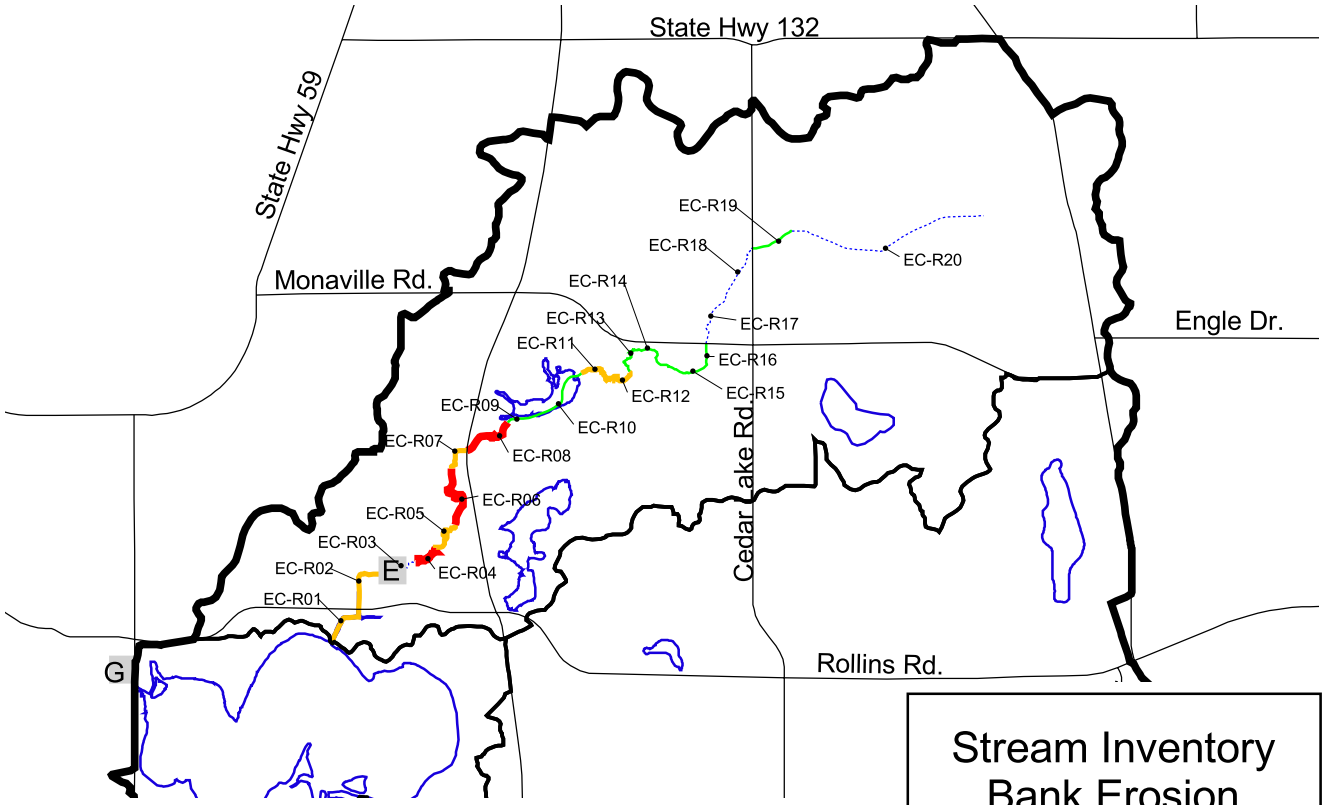
None

Low

Moderate

High

Water



Stream Inventory
Bank Erosion
(Eagle Creek)

Figure No. 4-49

Prepared by: Hey and Associates, Inc. 2003 (kgk)

4.16.3 Sedimentation

Sedimentation (Table 4-16) is the accumulation of silt in a stream that affects channel capacity and flow conveyance.

Table 4-16: Sedimentation (Length in approximate feet and Percent of Stream per Category)

Survey End Point	None	Low	Moderate	High
Squaw Creek at Nippersink Road	3200	28,800	12,800	0
	7.14%	64.3%	28.6%	0%
Squaw Creek Tributary at Nippersink Road	0	12,800	0	0
	0%	100%	0%	0%
Squaw Creek at Route 134	0	9600	3200	0
	0%	75%	25%	0%
Squaw Creek at Route 60	0	12,800	25,600	3200
	0%	30.8%	61.5%	7.7%
Squaw Creek (total)	3200	64,000	41,600	3200
	3%	57%	37%	3%
Round Lake Drain at Fairfield Village's Access Road	1600	4000	4800	2400
	12.5%	31.25%	37.5%	18.75%
Eagle Creek at Al's Place	2200	12,100	5500	2200
	10%	55%	25%	10%

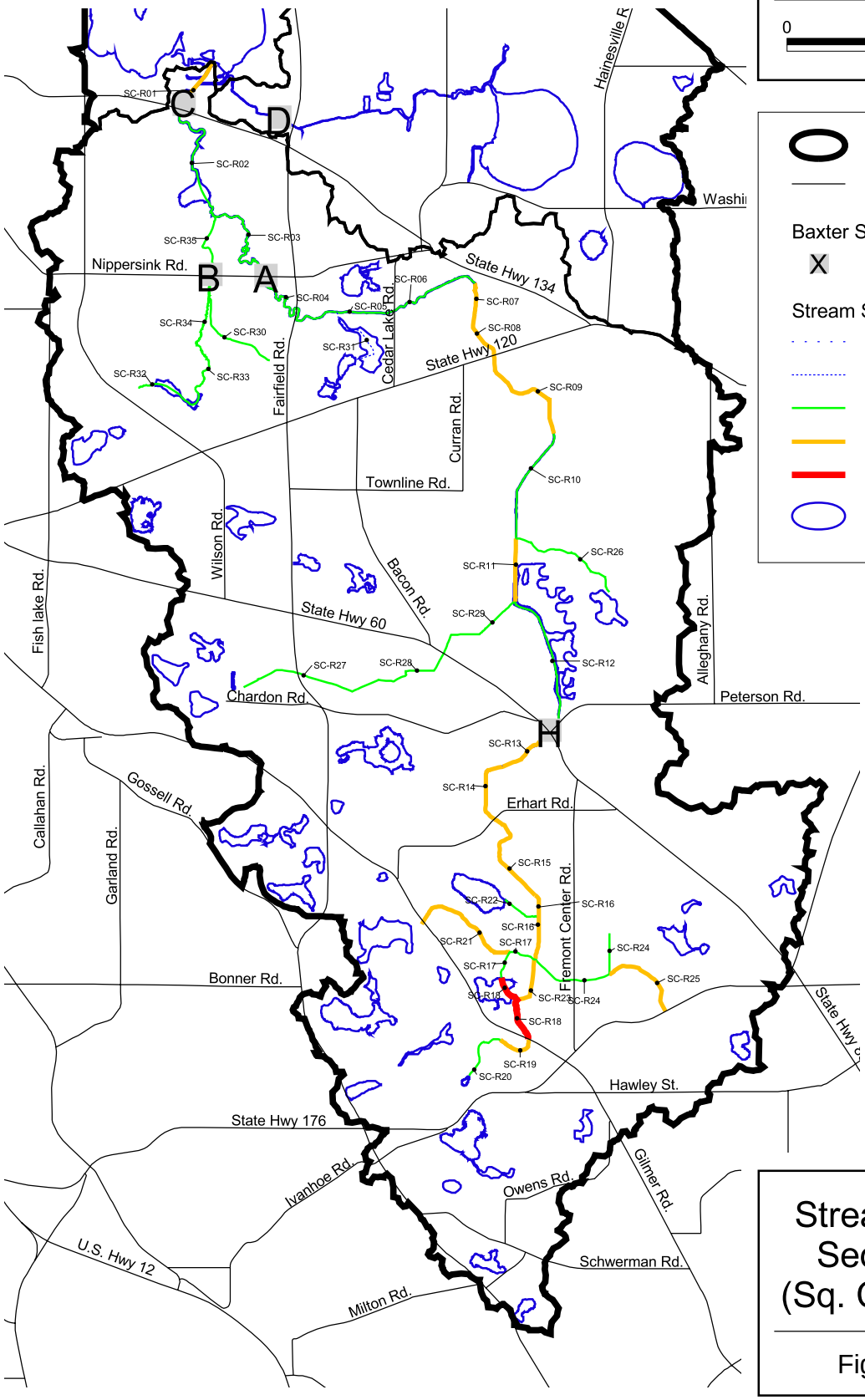
* None=0%; Low=1-33%; Moderate=34-66%; High=67-100% of the reach had sediment accumulations.

Figures 4-50, 4-51, and 4-52 present sedimentation results for the Mainstem, Round Lake Drain, and Eagle Creek, respectively.

Squaw Creek Watershed

0 1 Miles

N



Watershed Boundary

Major Roads

Baxter Stream Gages

X Baxter Daily Stream Gage

Stream Sedimentation

- N/A
- None
- Low
- Moderate
- High
- Water

Stream Inventory Sedimentation (Sq. Cr. Mainstem)

Figure No. 4-50

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

0 4000 Feet

N

Watershed Boundary

Major Roads

Baxter Stream Gages

X Baxter Daily Stream Gage

Stream Sedimentation

N/A

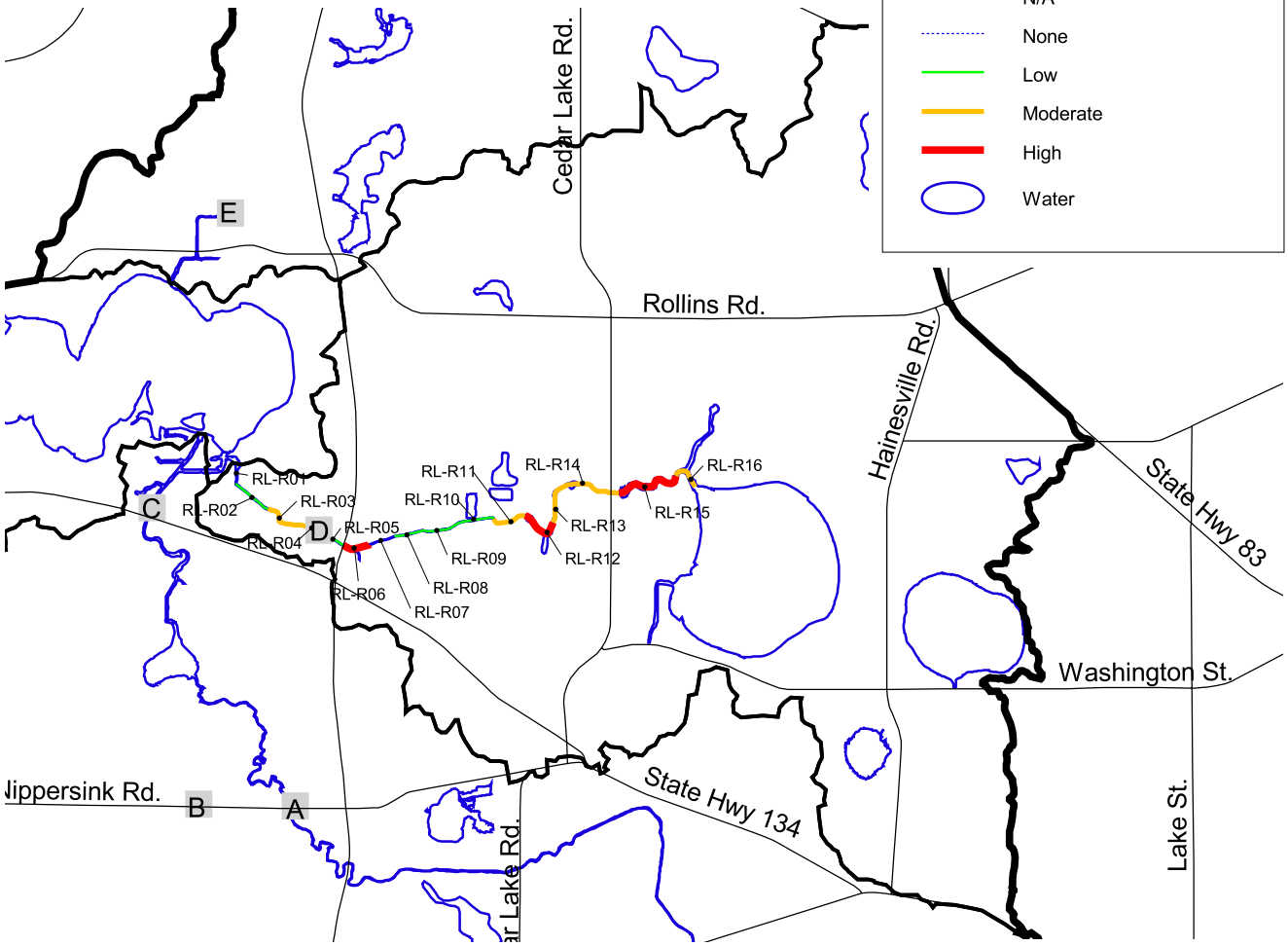
None

Low

Moderate

High

Water



Stream Inventory Sedimentation (Round Lake Drain)

Figure No. 5-51

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

0 4000 Feet

N

Watershed Boundary

Major Roads

Baxter Stream Gages

X Baxter Daily Stream Gage

Stream Sedimentation

N/A

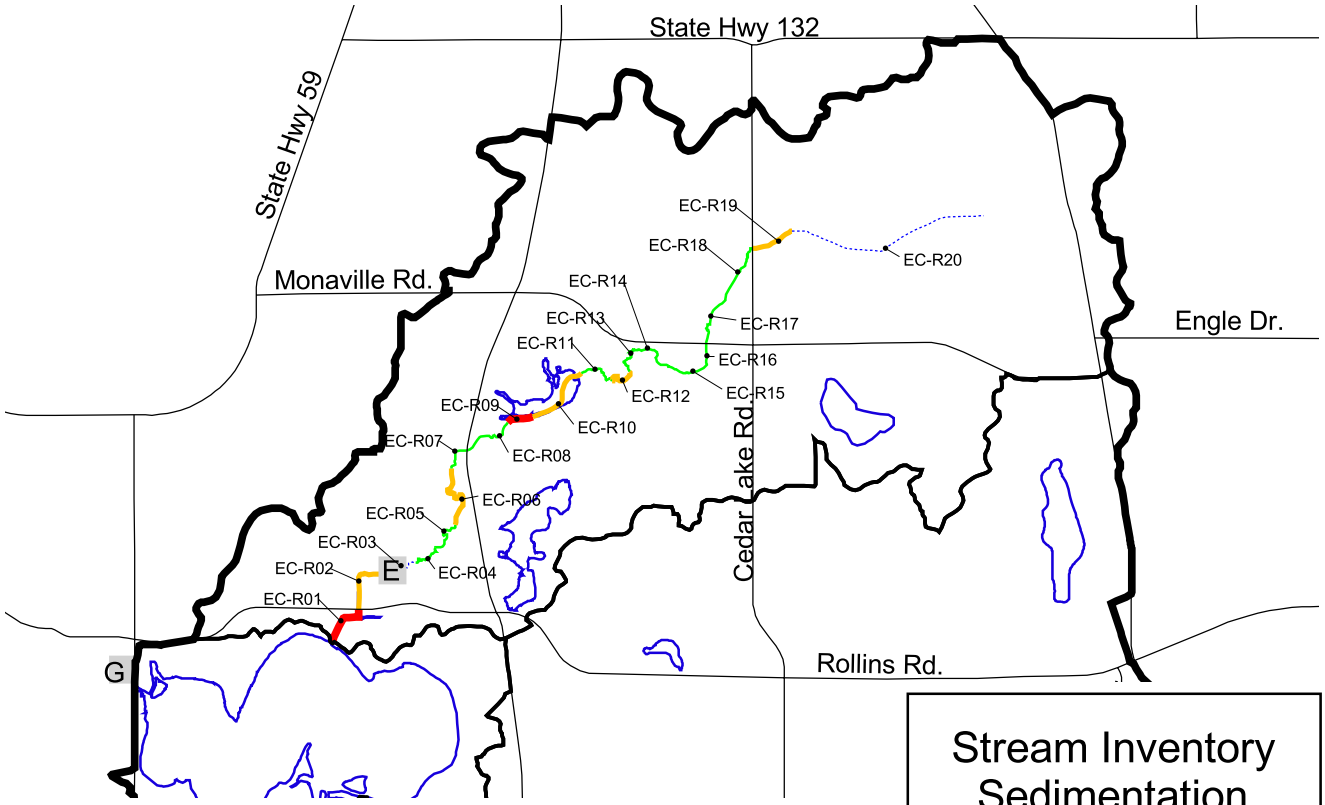
None

Low

Moderate

High

Water



Stream Inventory Sedimentation (Eagle Creek)

Figure No. 4-52

Prepared by: Hey and Associates, Inc. 2003 (kgk)

4.16.4 Pool/Riffle Development

Pool/Riffle Development (Table 4-17) refers to a characteristic occurring in naturalized streams. These areas create desirable habitat for macroinvertebrates. Pools are well-defined areas of deeper than average water and generally do not extend in length more than three or four times the stream width. Pools should almost immediately be followed by a riffle, which is characterized by shallower water than average and higher velocities with rippling or disturbances to the surface water tension that allow turbulence and mixing to occur.

Table 4-17: Pool-Riffle Development* (Length in approximate feet and Percent of Reaches per Category)

Survey End Point	None	Low	Moderate	High
Squaw Creek at Nippersink Road	32,000	12,800	0	0
	71%	29%	0%	0%
Squaw Creek Tributary at Nippersink Road	3200	3200	3200	3200
	25%	25%	25%	25%
Squaw Creek at Route 134	9600	3200	0	0
	75%	25%	0%	0%
Squaw Creek at Route 60	35,200	3200	3200	0
	84.6%	7.7%	7.7%	0%
Squaw Creek (total)	80,000	22,400	6400	3200
	71%	20%	6%	3%
Round Lake Drain at Fairfield Village's Access Road	11,200	1600	0	0
	87.5%	12.5%	0%	0%
Eagle Creek at Al's Place	9900	11,000	1100	0
	45%	50%	5%	0%

* None=0%; Low=1-33%; Moderate=34-66%; High=67-100% of the reach had pool/riffle development.

Figures 4-53, 4-54, and 4-55 present pool-riffle development assessments for the Mainstem, Round Lake Drain, and Eagle Creek, respectively.

Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

Baxter Stream Gages

X Baxter Daily Stream Gage

Pool Riffle Development

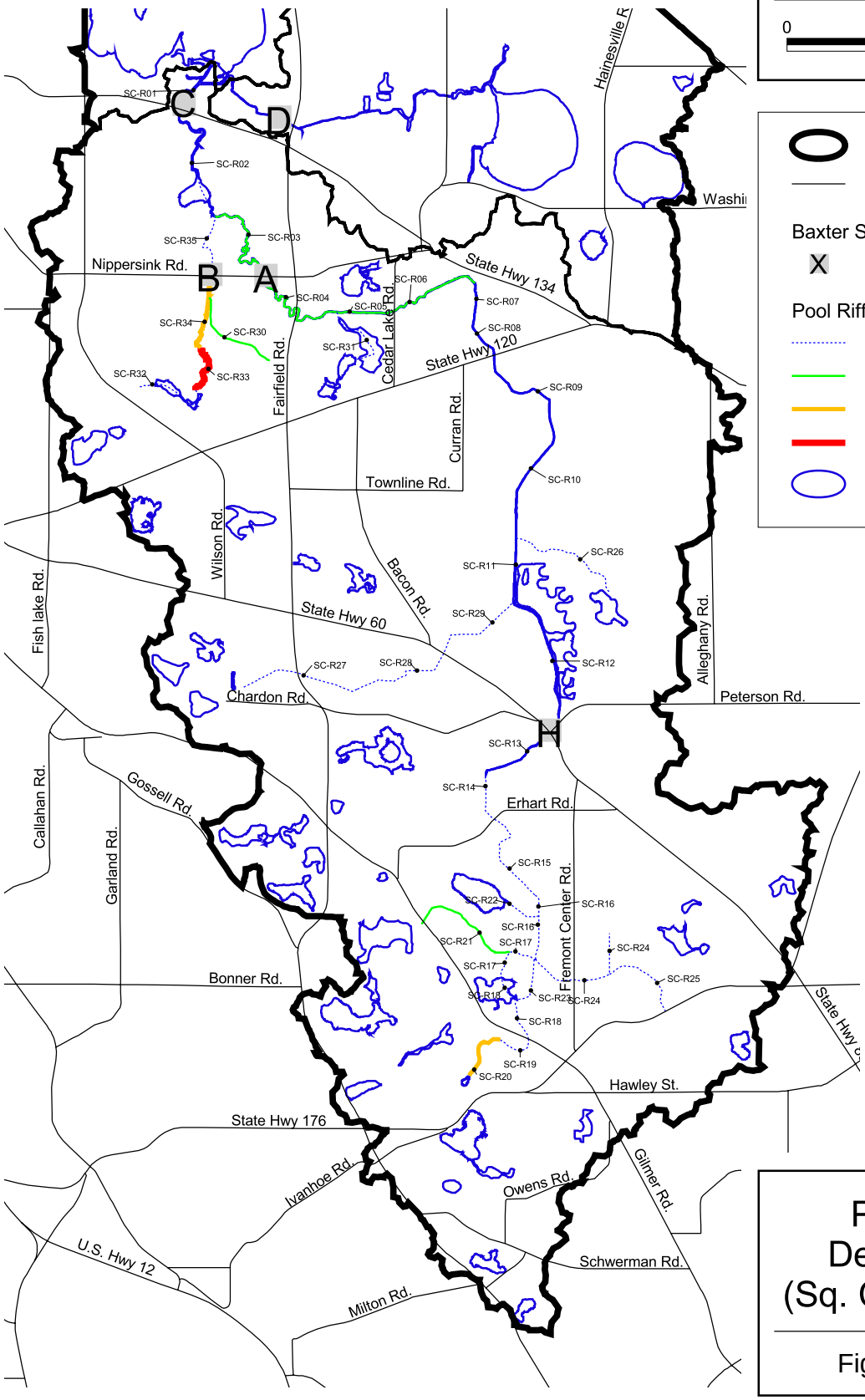
None

Low

Moderate

High

Water



Pool Riffle Development (Sq. Cr. Mainstem)

Figure No. 4-53

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

0 4000 Feet

N

Watershed Boundary

Major Roads

Baxter Stream Gages

X Baxter Daily Stream Gage

Pool Riffle Development

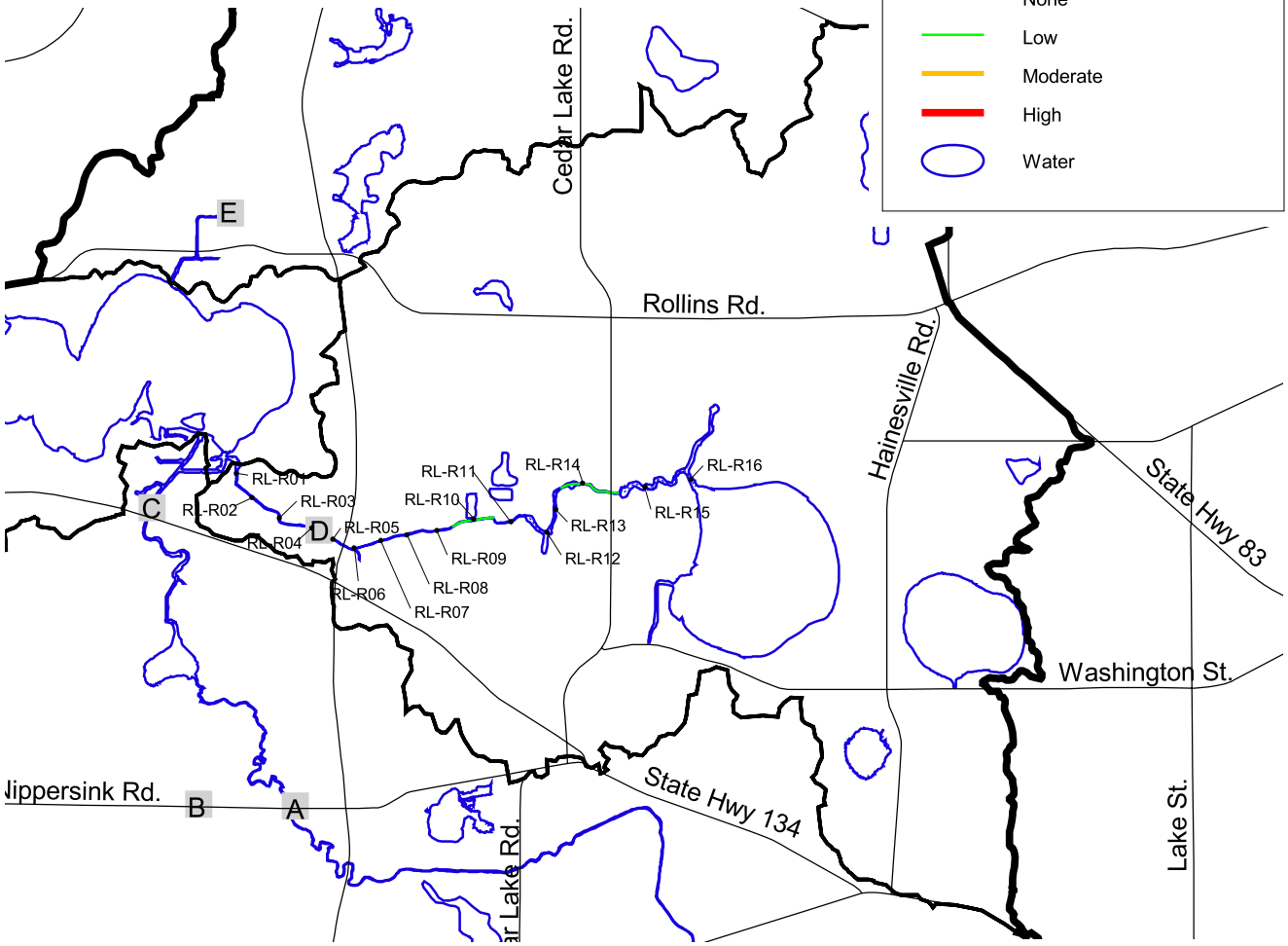
None

Low

Moderate

High

Water



Pool Riffle Development (Round Lake Drain)

Figure No. 4-54

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

0 4000 Feet

N

Watershed Boundary

Major Roads

Baxter Stream Gages

X Baxter Daily Stream Gage

Stream Bank Erosion

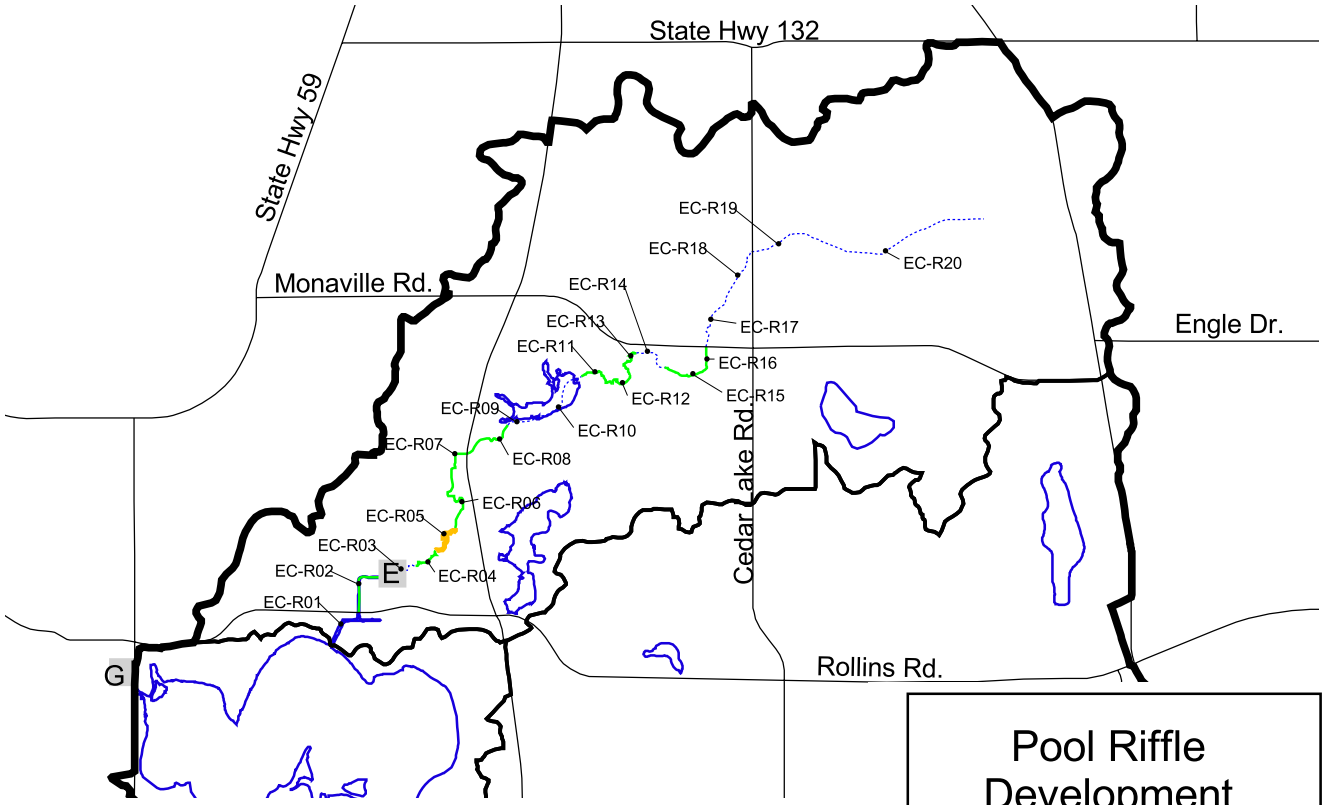
None

Low

Moderate

High

Water



Pool Riffle Development (Eagle Creek)

Figure No. 4-55

Prepared by: Hey and Associates, Inc. 2002 (kgk)

4.16.5 In-stream Cover for Fish

In-stream cover for fish (Table 4-18) refers to specific types of habitats that occur in portions of the stream that have sufficient water depth for fish.

Table 4-18: In-stream Cover for Fish (Percent Occurrence of Specific Habitat for Reaches)

Habitat	Squaw Creek at Nippersink Road	Squaw Creek Tributary at Nippersink Road	Squaw Creek at Route 134	Squaw Creek at Route 60	Round Lake Drain at Fairfield Village's Access Road	Eagle Creek at Al's Place
Undercut Banks	64%	50%	50%	15%	75%	80%
Pools over 28" Deep	57%	50%	75%	38%	6%	40%
Macrophytes	64%	100%	75%	92%	81%	55%
Logs	79%	75%	75%	92%	81%	80%
Overhanging Vegetation	93%	75%	100%	77%	81%	85%
Rootwads	43%	50%	100%	31%	50%	80%
Boulders	71%	0%	50%	15%	38%	65%
Backwaters	0%	50%	50%	77%	12.5%	25%

There are a number of locations in each watershed where significant debris accumulation was noted at the time of the assessment. Figures 4-56, 4-57, and 4-58 present these locations for the Mainstem, Round Lake Drain, and Eagle Creek, respectively. Debris accumulation is an ongoing serious problem in the watershed. Accumulated debris reduces the ability of channels to convey flow. This causes water to back up and potentially flood riparian properties.

Physical Data

The physical characteristics of the major streams in the watershed are summarized in Table 4-19.

Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

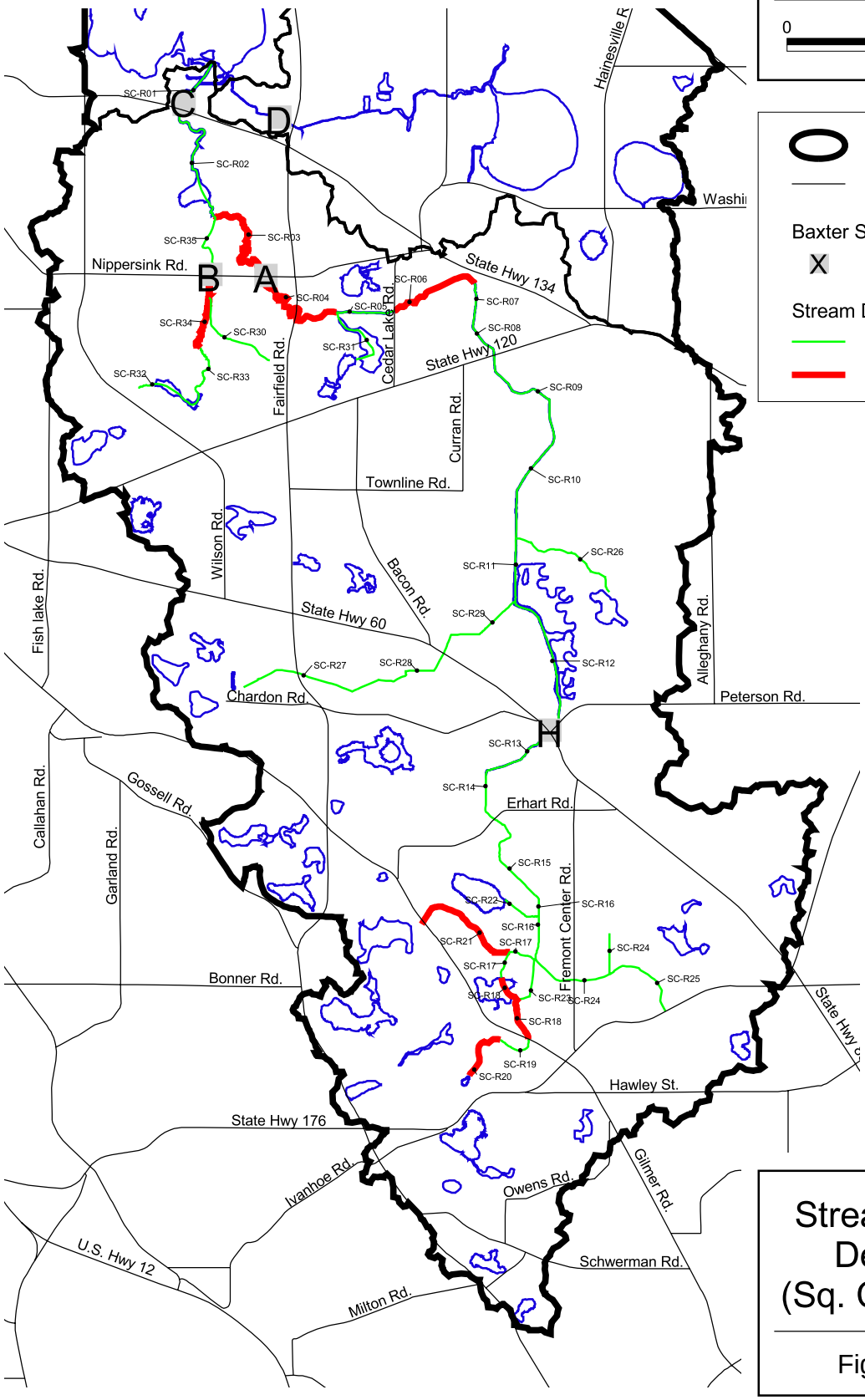
Baxter Stream Gages

X Baxter Daily Stream Gage

Stream Debris Load (In Stream)

Pass

Fail



Stream Inventory
Debris Load
(Sq. Cr. Mainstem)

Figure No. 4-56

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

0 4000 Feet

N

Watershed Boundary

Major Roads

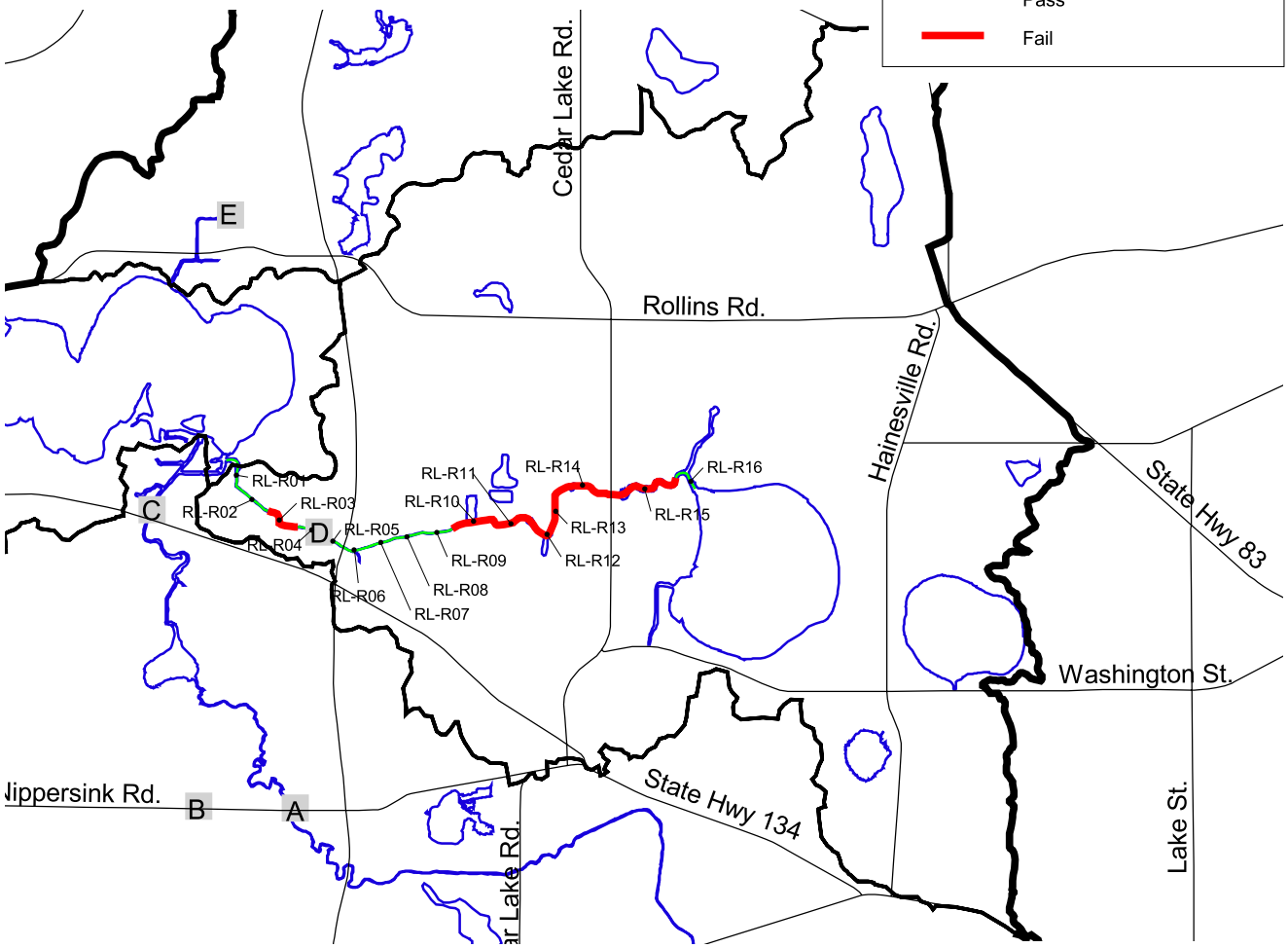
Baxter Stream Gages

X Baxter Daily Stream Gage

Stream Debris Load (In Stream)

Pass

Fail



Stream Inventory Debris Load (Round Lake Drain)

Figure No. 4-57

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

0 4000 Feet

N

Watershed Boundary

Major Roads

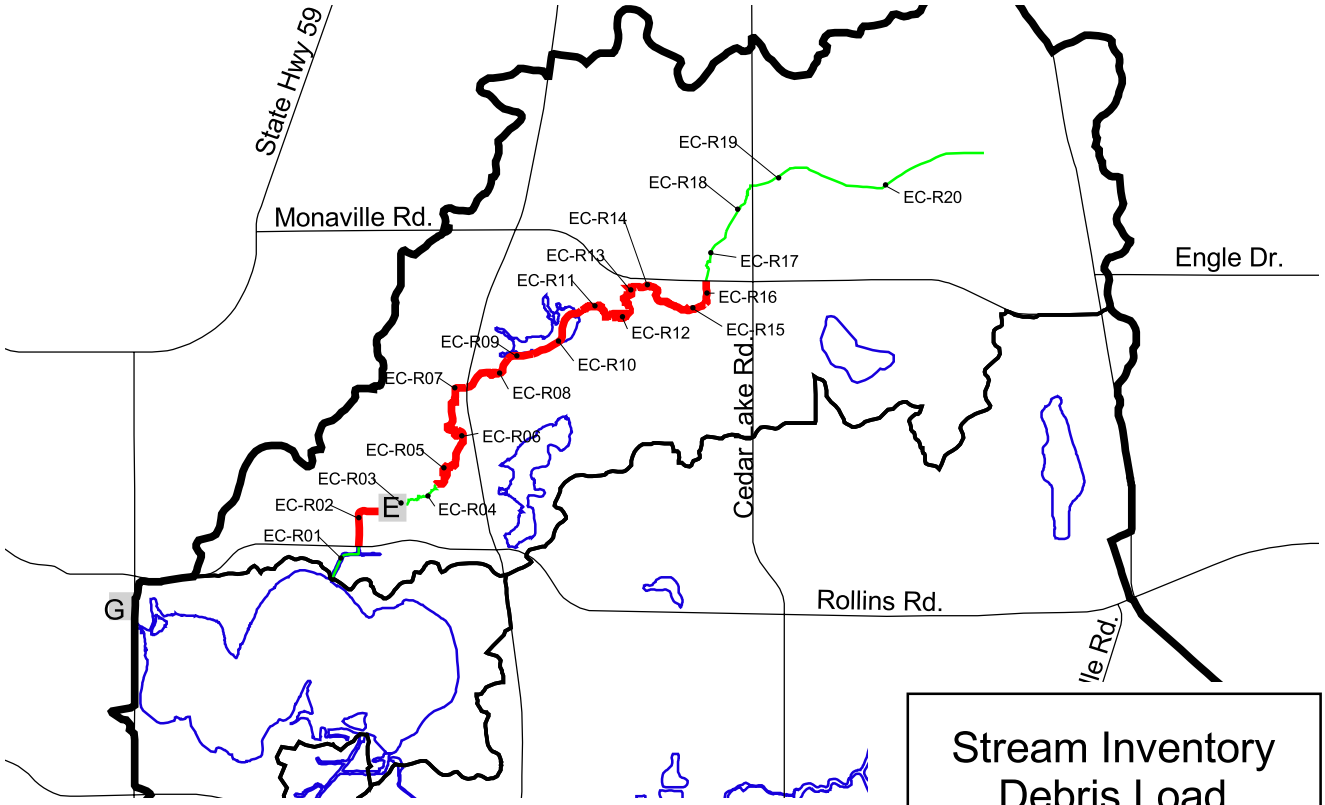
Baxter Stream Gages

X Baxter Daily Stream Gage

Stream Debris Load (In Stream)

Pass

Fail



Stream Inventory Debris Load (Eagle Creek)

Figure No. 4-58

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Table 4-19. Streams Physical Data

Watershed	Size (mi^2)	Stream Length (ft)	Slope (ft/mi)
Squaw Creek	27.63	63,000	6.1
Round Lake Drain	7.15	12,850	10.5
Eagle Creek	4.67	22,500	13.0

4.17 WILDLIFE HABITAT

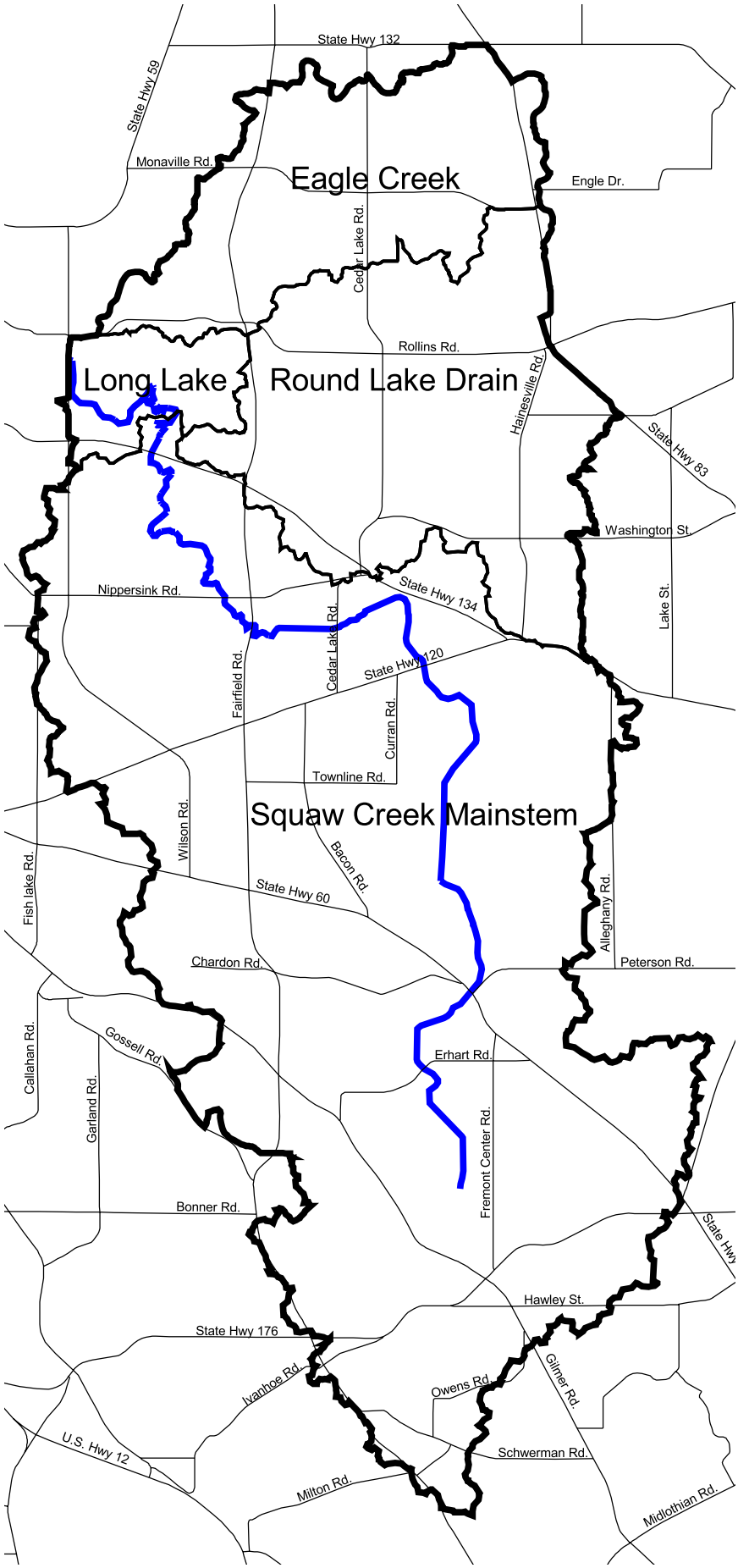
4.17.1 Upland

The effect of agricultural development has been to eliminate or fragment over 80 percent of the non-lake habitat present in the Squaw Creek watershed. The earlier comparison of Figure 4-4, "Pre-Settlement Vegetation" with Figure 4-6, "Effects of Agricultural Development" illustrates this point. The result of this habitat elimination and fragmentation was a dramatic reduction in the diversity of flora and fauna in the watershed to those species that could co-exist with agriculture.

4.17.2 Streams

The IDNR conducted biological surveys of Squaw Creek at Townline Road and Fairfield Road in September 1997. The IEPA 305b Report for 2002 contained no updated information on designated uses for the Squaw Creek Mainstem, and indicated that the designated uses for Eagle Creek include full overall use and full support of aquatic life.

The IDNR habitat assessment found that Squaw Creek had a Biological Stream Characterization (BSC) of D, indicating "Limited Aquatic Resource" (Figure 4-59). Key points of their conclusion were:



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

Class D Stream (Limited Aquatic Resource)

Biological Stream Characterization

Figure No. 4-59

Prepared by: Hey and Associates, Inc. 2003 (kgk)

- “Low BSC ratings for Squaw Creek reflect the poor habitat conditions found at both stations.”
- “Substrate at (Townline Road) was dominated by claypan, while (Fairfield Road) was dominated by silt and mud.”
- “Instream habitat (e.g. aquatic vegetation, woody debris, undercut banks, boulders, etc.) was scarce at both locations.”
- A Macrobiotic Index (MBI) of 5.2 to 6.2 (a Good to Fair rating) was calculated.
- The report stated, “The MBI, which uses aquatic insects, worms, and snails as indicators of water quality, was in the good to fair range for Squaw Creek, suggesting that water quality was not the primary limiting factor.”
- “Habitat was the primary limiting factor at the Squaw Creek stations.”
- “Squaw Creek appeared to have been recently … maintained and was very limited in habitat and instream cover.”
- “Streams will recover or ‘naturalize’ if left undisturbed…”
- “While removal of blockages is sometimes necessary, complete removal…is detrimental to stream communities.”

4.17.3 Lakes

There are four large lakes and numerous smaller lakes in the watershed. The four largest lakes are Long Lake, Round Lake, Highland Lake and Cranberry Lake. All but Long Lake are located in the Round Lake Drain watershed. Physical data for these lakes and the smaller Davis, Ray’s and Owens lakes are shown in Table 4-20.

These lakes are important wildlife and vegetation reservoirs. It is important that their water quality and native vegetation be preserved and improved. They provide important stop-over locations for migrating birds and habitat for fish and amphibians.

Table 4-20: Lakes Physical Data (IDOC, 1972, LCHD, 2004)

Lake	Area (acres)	Maximum Depth (ft)	Shoreline (miles)	Origin
Long	393	30	7.73	Glacial Dammed 1930
Round	239	32	4.51	Glacial Dammed 1950s
Highland	103	30	1.55	Glacial
Cranberry	16	20	0.76	Slough
Davis	36	18	1.69	Slough Dammed 1940
Ray's	15	8	0.9	Slough
Owens	5	9	0.4	Flooded Wetland

The 1972 *Lake County Surface Water Resources* report by the Illinois Department of Conservation evaluated Long, Round, Cranberry, Davis, Highland, and Ray's Lakes. The LCHD has resurveyed many of the lakes in the county over the last decade. They have prepared assessments of the management issues for each lake studied, and for this Plan the level of concern for each issue has been assigned based upon interpretation of these assessments (Table 4-21). Finally IEPA, in its 305b report has assessed the status of beneficial uses for Highland Lake, Round Lake and Long Lake. Table 4-22 presents the IEPA's assessment of the status of beneficial uses.

Table 4-21: Summary of Lake Management Issues (Based on LCHD Reports)

	Long Lake	Davis Lake	Owens Lake	Cranberry Lake	Highland Lake	Round Lake
Lack of bathymetric map	Medium	Medium		High		
Poor water clarity	Medium					
Elevated Phosphorus concentrations	Low					Low
Elevated Ammonia - Nitrogen concentrations						Low
Elevated heavy metal concentrations						Low
Shoreline erosion	High					Low
Shoreline condition					Medium	
Invasive species management	High			Medium	Low	High
Aquatic vegetation deficiency	Medium					
Aquatic plant diversity concerns					Low	
High conductivity and total dissolved solids	High				High	High
Low dissolved oxygen		Medium	Medium	Medium		Medium
Excessive aquatic vegetation		High	Low			
Potential impacts from development				High		
Wildlife habitat	Low				Medium	Medium
Fishery concerns						
Canada Geese / Seagulls	Medium				High	Medium
Lack of historical lake data					Medium	
Lack of wetland						Medium

Table 4-22: Status of Lake Beneficial Uses (IEPA)

		Highland Lake	Round Lake	Long Lake
Designated Uses	Overall	Full	Full	Partial Support
	Aquatic Life	Full	Full	Full
	Fish Consumption	Not Assessed	Not Assessed	Not Assessed
	Primary Contact (Swimming)	Full	Full	Partial Support
	Secondary Contact (Recreation)	Full	Partial Support	Partial Support
	Public Water Supply	Not Assessed	Not Assessed	Not Assessed
Potential Causes of Impairment	Nutrients		X	X
	Phosphorus			X
	Nitrogen (ammonia-N)		X	X
	Suspended Solids			X
	Excessive Aquatic Plants		X	
	Excessive Algal Growth / Chlorophyll			X
	Exotic Species		X	
Potential Sources of Impairment	Agriculture		X	X
	Crop Related Sources		X	X
	Non-irrigated Crop Production		X	X
	Urban Runoff / Storm Sewers		X	X
	Contaminated Sediments			X
	Forest / Grassland / Parkland		X	X

4.18 SURFACE WATER QUALITY

Water quality sampling has been undertaken in the watersheds by a number of parties over the last 25 years. A list of significant studies is presented in Table 4-23.

Table 4-23: Surface Water Quality Studies

Agency	Date	Type	Number Samples	Locations	Key Parameters
ISWS, ISGS	1977	Stream Flow	52	At Mouth	TSS, TP, DP, NH_3, DO
Baxter	2001	Stream Flow	52	7 Locations	TSS, TP, DP, NH_3, DO
IDOT	1996-1997	Stream Flow	18	10	TSS, TP, DO, NH3, Alk, TOC, Metals
LCHD	1989-2002	Lakes	Varies	6 Lakes	TSS, TP, DP, NH_3, DO, TDS
LCHD	1989	Surface	4-5	6 Locations	TSS, TP, DP

4.18.1 ISWS/ISGS Stream Data

The 1977 ISWS/ISGS study data are summarized in Table 4-24. The data are from a sampling point just above Fox Lake and include the Fish Lake Drain watershed flows. However, they are dominated by flows from the larger Squaw Creek watershed.

Table 4-24: 1977 Squaw Creek Water Quality Data (ISWS/ISGS)

Parameter	Mean (concentrations in mg/l)	Range
Temperature (ºC)	13.5	0.0 - 27.5
Dissolved Oxygen	10.1	3.0 - 16.0
Turbidity (FTU)	10.4	3.4 - 31.0
pH		7.98 - 8.75
Alkalinity	201	133 - 262
Hardness	289	102 - 413
Nitrate-N	0.92	0.04 - 2.37
Kjeldahl-N	2.49	0.5 - 9.89
Ammonia-N	1.11	0.03 - 3.65
Total silica	3.77	0.0 - 9.09
Total iron	0.66	0.09 - 4.28
Chloride	36	27 - 46
Sulfate	81	28 - 114
Total solids	449	392 - 510
Total dissolved solids	423	348 - 490
Suspended solids	27	0.0 - 72.0
Algal growth potential	78	10 - 170
Total phosphorus	0.83	0.21 - 1.94
Dissolved orthophosphorus	0.67	0.0 - 1.46

These data were collected while the Lake Villa and Round Lake Drain wastewater treatment plants were still in operation and the high nutrient concentrations reflect that fact. The measured concentrations are somewhat reflective of Long Lake surface water quality at that time, since all flow at the measuring station had left Long Lake just a short distance upstream.

The data show very high total and dissolved phosphorus. Of special concern was the very high dissolved phosphorus, at a mean of 0.67 ppm because of its stimulating effect on algae growth. This reflected the high sewage treatment plant inputs at that time. Data from 1974 and 1975 showed mean wastewater effluent concentrations of over 7 ppm Total Phosphorus and 4.38 ppm Dissolved Phosphorus from the Lake Villa plant, and 5.09 ppm Total Phosphorus and 4.18 ppm Dissolved Phosphorus for Round Lake. The Lake Villa plant had an average daily flow of 0.3 mgd (0.45 cfs) and the Round Lake plant had an average daily flow of 1.6 mgd (2.5 cfs).

4.18.2 Baxter Stream Data

The Baxter data show a marked improvement in surface water quality leaving the watershed. Table 4-25 presents the Baxter data and shows that Total Phosphorus on Eagle Creek has dropped to 0.097 ppm and Total Phosphorus on the Round Lake Drain has dropped to 0.063 ppm.

The Total Suspended Solids and Total Phosphorus concentrations are highest on the Mainstem monitoring stations. This suggests that agricultural and agricultural drainage are the principal sources of these constituents. It appears that TP concentrations increase in the spring and summer and are lowest in winter. There are similar trends for all of the Baxter monitoring stations. There also is a correlation of higher TP with higher flow rate. Charts of TP versus streamflow for all gages are presented in the Appendix.

Finally, the Baxter data shows very high Total Dissolved Solids (TDS) for the Squaw Creek tributary at Nippersink Road.

4.18.3 Other Sources

Table 4-26 contains water quality data from an IDOT study in 1996-97, for samples taken from Squaw Creek at Hwy 120. Also, the LCHD sampled surface runoff to Round Lake at six locations in 1989. The locations of these sampling and key results are shown in Table 4-27.

Table 4-25: Baxter Water Quality Data

		Station Label and Location						
		A	B	C	D	E	G	H
		Squaw Creek at Nippersink Road	**Squaw Creek Tributary at Nippersink Road**	**Squaw Creek at Route 134**	**Round Lake Drain at Fairfield Village's Access Road**	**Eagle Creek at Al's Place**	**Long Lake Spillway**	**Squaw Creek at Route 60**
Flow	Average	12.89	2.44	15.16	2.70	4.59	22.59	3.14
MGD	Max	134.9	16.2	112.2	42.9	96.1	221.3	20.9
	Min	0.21	0.41	0.40	0.01	-0.42	0.28	0.00
O&G	Average	5.02	5.02	5	5	5	5	5
(mg/L)	Max	6	6	5	5	5	5	5
	Min	5	5	5	5	5	5	5
TOTAL	Average	225.20	228.41	226.25	202.39	240.43	183.61	218.88
ALKALINITY	Max	290	308	305	281	356	210	284
(mg/L)	Min	79	131	117	98	108	141	118
BOD5	Average	2.65	2.35	2.73	2.49	2.33	3.27	2.57
(mg/L)	Max	12	5	6	5	4	25	5
	Min	2	2	2	2	2	2	2
NITRATE	Average	1.37	1.01	0.95	0.28	0.41	0.38	1.18
(mg/L)	Max	6.22	7.6	4.43	0.82	6.64	1.04	3.67
	Min	0.41	0.3	0.05	0.05	0.05	0.05	0.12
TOTAL	Average	623.5	1086.3	675.1	739.2	733.3	560.8	574.5
SOLIDS	Max	800	2100	1000	1300	1000	800	700
(mg/L)	Min	400	500	330	400	400	400	400
TDS	Average	516.7	969.9	590.3	653.8	634.7	493.1	480.6
(mg/L)	Max	697	1950	828	1280	902	622	655
	Min	162	409	283	301	257	322	315
TSS	Average	64.5	38.1	42.0	31.0	28.0	13.1	41.0
(mg/L)	Max	259	257	113	203	217	57	155
	Min	6	5	5	5	7	5	11
TVS	Average	183.9	199.9	183.4	176.6	198.4	166.2	177.9
(mg/L)	Max	248.4	319.2	285.3	376.2	304	262.4	236.6
	Min	104.5	120	96.69	107.5	98.4	86.8	123.6
COD	Average	40.3	30.8	36.5	22.6	28.9	31.3	34
(mg/L)	Max	65	52	57	51	59	55	64
	Min	17	10	10	10	10	10	10
NH3-N	Average	0.20	0.24	0.18	0.21	0.21	0.22	0.24
(mg/L)	Max	1	0.5	0.5	0.7	1.4	1.3	0.7
	Min	0.1	0.1	0.1	0.1	0.1	0.1	0.1
SRP	Average	0.041	0.039	0.040	0.023	0.038	0.021	0.064
(mg/L)	Max	0.134	0.211	0.153	0.095	0.146	0.058	0.332
	Min	0.01	0.01	0.01	0.01	0.01	0.01	0.01
T-P	Average	0.113	0.108	0.107	0.063	0.097	0.061	0.141
(mg/L)	Max	0.305	0.548	0.241	0.199	0.272	0.482	0.445
	Min	0.01	0.01	0.01	0.01	0.01	0.01	0.01
TKN	Average	1.59	1.52	1.60	1.32	1.37	1.61	1.75
(MG/l)	Max	2.59	2.38	2.8	5.65	4.85	7.09	5.37
	Min	0.37	0.49	0.91	0.56	0.5	0.47	0.73

* The average is the mean value of 51 samples taken over the course of a year.

Table 4-26: Water Quality Data at Hwy 120 from IDOT (May 1996 - October 1997)

Sample Date / Constituent	5/17/1996	5/20/1996	6/5/1996	6/17/1996	7/18/1996	8/6/1996	9/27/1996	12/3/1996	12/11/1996	1/4/1997	2/19/1997	2/21/1997	5/1/1997	5/25/1997	6/16/1997	8/17/1997	9/17/1997	10/27/1997	Average
Flow (cfs)	118	216	162	144	39	8	2	5	14	16	38	120	57	48	24	7	4		60.1
DO (mg/l)	-	5.5	4.8	5.5	5.6	-	6.8	13.1	-	-	11.5	11.5	-	7.2	5.7	5.6	-		7.5
Alk	310	86	168	146	196	192	272	242	198	192	127	82	159	144	188	189	179		180.6
TOC	66.0	61.1	71.1	80.3	90.0	90.1	26.9	38.4	39.4	26.9	23.2	17.1	29.7	40.7	36.4	11.9	24.5	27.9	44.6
Cl	34.7	20.0	30.8	27.5	42.5	32.2	51.1	85.8	69.1	69.8	70.9	28.7	74.3	55.9	62.2	84.4	63.8	73.9	54.3
SO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NH3-N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NO2-N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NO3-N	4.99	5.36	2.33	2.43	2.68	1.20	0.49	1.63	4.22	4.13	4.13	2.91	5.11	10.1	6.14	0.41	0.47	0.51	3.29
Tot.P	0.37	0.60	0.10	0.71	0.03	0.05	0.06	0.07	0.04	0.05	0.03	0.15	0.07	0.13	0.10	<DL	0.02	<DL	0.16
TSS	292	512	82	74	8	4	<DL	24	144	42	130	1308	124	286	160	194	264	32	216.5
Al	0.24	0.10	<.02	0.050	0.01	0.03	0.03	<.02	<.01	0.07	0.03	0.80	<.04	<.06	<.02	0.16	0.10		0.11
As	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.2	<.2	<.2	<.2	<.1	<.1	<.1		<0.1
B	0.06	0.06	0.09	0.070	<.01	0.08	0.07	0.05	<.02	0.04	0.04	<.02	<.02	0.04	<.02	0.07	0.17		0.06
Ba	0.29	0.35	0.03	0.020	0.04	0.06	0.04	0.04	0.04	0.05	0.03	0.02	0.04	0.03	0.04	0.04	0.05		0.07
Ca	49.2	36.0	54.9	49.200	71.8	78.3	78.4	113	103	136	67.6	25.2	59.1	70.9	65.6	61.9	70.8		70.1
Cu	0.01	<.01	0.02	0.220	0.07	0.04	0.03	0.08	<.01	0.01	0.14	0.05	0.05	0.02	<.02	<.01	0.01		0.05
Fe	0.12	0.01	0.10	0.120	0.18	0.15	<.01	<.01	<.03	<.1	<.03	<.03	<.01	0.08	0.02	0.22	0.14		0.08
K	<1	4	<1	4	5	3	6	3	4	3	3	4	3	<2.5	<1	5	5		3.38
Mg	20.6	14.6	22.8	20.000	30.1	32.0	38.0	50.4	45.2	46.1	30.2	10.3	34.0	31.0	29.9	32.4	39.0		31.0
Mn	0.01	<.01	0.03	0.010	0.05	0.01	0.21	0.12	0.05	0.04	0.01	<.01	0.01	0.02	0.01	0.01	0.07		0.04
Na	21.7	14.0	16.6	17.300	27.3	22.4	31.9	53.5	37.9	38.2	41.4	17.3	39.6	34.1	29.9	48.7	53.0		32.04
Pb	<.05	<.05	<.05	<.05	<.04	<.05	<.05	<.04	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05		<0.05
Si	3.30	3.64	3.45	2.930	3.79	2.77	2.40	3.58	3.09	3.39	2.92	3.61	2.90	2.94	2.22	2.87	1.99		3.0
Sr	0.11	0.08	0.10	0.100	0.15	0.17	0.19	0.25	0.22	0.24	0.13	0.05	0.16	0.15	0.16	0.19	0.27		0.2
Zn	0.07	0.07	0.02	0.160	0.04	0.05	0.05	0.05	<.01	<.01	0.08	0.04	0.07	0.03	<.01	<.01	0.01		0.1

Table 4-27: LCHD Lakes Water Quality Data

		Cranberry		Davis		Highland		Long		Owens		Round		Schreiber	
		E	H	E	H	E	H	E	H	E	H	E	H	E	H
Alkalinity	Average	111	172	153.4	230	139.2	179.2	196.2	254.2	160.6	178.8	112.86	193.6	123	147
mg/l CaCO3	Max	120	193	175	254	153	211	214	316	177	189	140	261	131	177
	Min	97.9	130	131	209	130	149	181	225	137	167	97.3	148	115	136
Total Kjeldahl nitrogen	Average	1.18	4.62	1.078	4.352	0.9704	3.06	1.3838	3.834	1.196	2.338	0.782	3.482	1.134	3.426
mg/l	Max	1.39	6.37	1.26	5.9	1.08	5.01	1.72	7.1	1.49	3.29	1.12	7.4	1.42	6.65
	Min	0.8	1.49	0.92	2.22	0.914	1.12	0.779	1.85	0.87	1.64	0.52	0.775	0.93	2.14
Ammonia nitrogen	Average	0.14[k]	3.40	<0.1k	3.186	<0.1k	2.0202	<0.1	2.723	<0.1	0.585k	<0.1	2.517	<0.1	2.15
mg/l	Max	0.139	5.17	<0.1	5.45	<0.1	4.08	<0.1	6	<0.1	1.35	<0.1	6.53	<0.1	5.27
	Min	<0.1	0.221	<0.1	1.04	<0.1	0.291	<0.1	0.725	<0.1	<0.1	<0.1	0.417	<0.1	1.1
Nitrate nitrogen	Average	0.060[k]	0.094[k]	0.051k	0.081k	0.1k	<0.05k	0.363k	0.117k	1.1k	0.411k	<0.05	0.05k	0.066	0.112
mg/l	Max	0.063	0.129	0.057	0.095	0.102	<0.05	0.38	0.121	2.96	1.04	<0.05	0.06	0.076	0.168
	Min	<0.05	<0.05	0.039	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.052	0.082
Total phosphorus	Average	0.02	0.35	0.0476	0.5704	0.0302	0.0792	0.0918	0.6612	0.124	0.2996	0.019	0.2494	0.0346	0.423
mg/l	Max	0.037	0.511	0.066	0.837	0.04	0.123	0.146	1.23	0.229	0.533	0.024	0.608	0.066	1.44
	Min	0.013	0.037	0.03	0.303	0.015	0.034	0.049	0.209	0.051	0.124	<0.01	0.034	0.02	0.101
Soluble reactive phosphorus	Average	<0.005[k]	0.360[k]	0.011k	0.4872	0.006k	0.008k	0.012k	0.592	0.0246	0.1032	<0.005	0.22975	0.007k	0.201
mg/l	Max	<0.005[k]	0.449	0.011	0.756	0.006	0.01	0.022	1.23	0.054	0.349	<0.005	0.489	0.007	0.715
	Min	<0.005[k]	<0.005	<0.005	0.222	<0.005	0	<0.005	0.152	0.008	0.011	<0.005	<0.005	<0.005	0.034
TDS	Average	247.80	299.60	313.2	390.4	333.8	351.6	586.4	612	323.6	356	479	521.6	156	174
mg/l	Max	265	316	376	405	362	364	619	640	400	442	534	538	170	190
	Min	220	268	264	380	288	336	550	570	264	296	450	488	140	170
TSS	Average	1.18	7.98	2.08	7.74	3.3	6.28	9.7	13.22	10.98	23.24	2.66	7.92	3.38	12.86
mg/l	Max	2	11	3.2	13	4.9	11	11.9	35	31	55	4.4	10	8.4	37
	Min	0.6	2.3	1	5.6	2.4	2.9	6.3	4.7	2	7.2	1	4.2	1	4
TS	Average	264.80	317.60	327.2	423.2	354	366.4	635.6	644.4	366	391.4	495.2	545.6	167.4	192.8
mg/l	Max	283	334	387	447	370	374	677	681	460	485	528	570	176	234
	Min	251	284	265	403	321	358	573	576	276	308	473	529	156	178
TVS	Average	107.40	115.40	109.8	137.6	112	117.4	185.4	181.4	129.2	124.6	102.2	110.6	63.8	63
mg/l	Max	122	140	142	148	131	140	205	219	183	164	119	137	84	73
	Min	93	96	79	115	81	78	153	167	93	95	86	86	50	50
Secchi Disk Depth	Average	10.96	NA	8.138	NA	6.576	NA	4.114	NA	4.382	NA	10.28	NA	9.7	NA
ft	Max	13.55	NA	12.37	NA	8.24	NA	5.61	NA	6	NA	18.7	NA	12.1	NA
	Min	7.71	NA	4.76	NA	4.33	NA	3.61	NA	3.15	NA	5.6	NA	6.4	NA
Conductivity	Average	0.38	0.50	0.51432	0.69534	0.55562	0.60956	0.94304	1.03478	0.53952	0.60598	0.8366	0.9296	0.2746	0.3462
milliSiemens/cm	Max	0.414	0.551	0.6367	0.7329	0.5706	0.6618	0.9992	1.092	0.6451	0.6945	0.875	1.02	0.285	0.406
	Min	0.3449	0.4156	0.415	0.6701	0.5404	0.5597	0.9083	0.9914	0.4113	0.5151	0.839	0.871	0.269	0.296
pH	Average	7.79	6.66	7.802	6.796	8.232	6.856	8.108	6.842	7.77	7.242	8.7	7.29	7.57	6.79
	Max	8.37	7.27	8.36	7.21	8.44	7.39	8.19	7.28	8.64	8.33	8.82	7.62	8.43	7.03
	Min	7.31	6.33	7.56	6.5	8.05	6.49	8.02	6.35	7.35	6.72	8.5	6.89	7.17	6.53
DO	Average	7.38	0.16	4.892	0.046	8.118	0.47	7.216	0.048	6.164	2.428	8.85	1.728	7.048	0.088
	Max	10.4	0.6	8.45	0.1	9.52	1.95	8.93	0.15	11.33	10.63	10.63	6.97	10.02	0.1
	Min	2.8	0.01	1.44	0	6.81	0.01	5.64	0.01	1.36	0.03	7.88	0.08	4.8	0.08

Table 4-28: LCHD Round Lake Watershed Runoff Water Quality

	Water Temp. (degrees F)	DO (mg/L)	BOD (mg/L)	pH	NH_3-N (mg/L)	NO_3-N (mg/L)	P (mg/L)	PO_4 (mg/L)	Chl a (mg/m)	TS (mg/L)	TSS (mg/L)	VS (mg/L)	Fecal Coliform (# colonies per 100 ml)
Gateway Pond	16.47	7.7	na	7.95	0.18	2.27	0.22	0.05	9.27	653.3	39.4	421.5	na
Drainage Channel - Shorewood and Leslie	17.43	6.88	na	7.55	0.22	1.67	0.11	0.04	4.25	789.66	31.33	211.33	na
Drainage Channel - East End	15.35	9.15	na	7.7	0.17	1.4	0.13	0.05	2.16	644.66	25.37	205	na
Drainage Channel - East Branch / Hainesville Road	15.66	8.2	na	7.9	0.14	1.77	0.12	0.04	5.08	759.6	46.22	254.8	na
Dave's Channel	13.46	7.98	na	2.5	0.16	1.33	0.16	0.04	7.72	835.5	59.54	362	na
Mallard Creek Shopping Center / Discharge to Gateway Pond	15	na	4	7.7	0.14	0.19	0.2	0.08	na	200	15	100	>7800

4.18.4 LCHD Lakes Data

Data for the lakes in the watershed was provided by the LCHD. Table 4-28 presents a summary of these data.

Long Lake and Round Lake also were sampled by the IEPA as part of their Summer 1979 study "Chemical Analysis of Surficial Sediment from 63 Illinois Lakes." This study found that Long Lake had elevated Volatile Suspended Solids (VSS) relative to the other lakes sampled. Long Lake also had highly elevated TP concentrations in its sediment. Round Lake also had elevated VSS and lead (Pb) concentrations but was normal for TP. The LCHD found elevated levels of Cadmium and Mercury in Round Lake sediment, but these metals were not being transmitted into fish (LCHD, 1989).

Both lakes had normal concentrations of chromium and zinc. Sediment can be a key indicator of pollutant sources since they tend to settle in lakes and higher concentrations indicate potential sources of the constituent in question. The highly elevated TP concentrations in Long Lake reflect the sewage treatment plant discharges upstream. The normal (but on the high side of normal) metal concentrations reflect the relatively low degree of urbanization in the watershed. Table 4-29 presents a comparison of mean Long Lake and Round Lake sediment concentrations versus similar results for Lake Ellyn, which receives exclusively urban runoff from downtown Glen Ellyn, Illinois and IEPA data.

Table 4-29: Sediment Constituent Comparison

Constituent	Long Lake	Round Lake	Lake Ellyn	IEPA Ranges	
				Normal	Elevated
VSS (mg/kg)	1.7-14.6	10.2-18.7	--	5-13	13-17
TP (mg/kg)	390-1530	240-570	2200	225-1175	1175-1650
Cr (mg/kg)	6-29	11-16	--	14-30	30-38
Pb (mg/kg)	30-80	80-130	1130	15-100	100-150
Zn (mg/kg)	63-150	99-150	580	50-175	175-250

4.19 THREATENED AND ENDANGERED SPECIES

There are twenty refuges in the Squaw Creek Watershed that contain threatened and endangered species. Another six sites are just outside the watershed. The general location of these refuges is presented later in the Greenway Plan. Table 4-30 presents a list of the threatened and endangered species in the watershed.

Table 4-30: Squaw Creek Watershed Rare Species

Rare Plants

Genus and Species	Common Name	Endangered or Threatened
Agropyron Trachycaulum	Bearded Wheat Grass	E
Betula Alleghaniensis	Yellow Birch	E
Carex Brunnescens	Brownish Sedge	E
Carex Chordorrhiza	Cordroot Sedge	E
Carex Crawfordii	Crawford Sedge	E
Carex Cryptolepis	Small Yellow Sedge	E
Carex Disperma	Short-leaf Sedge	E
Carex Echinata	Sedge	E
Carex Trisperma	Three-seeded Sedge	E
Chamaedaphne Calyculata	Leatherleaf	T
Cornus Canadensis	Bunchberry	E
Drosera Rotundifolia	Round-leaved Sundew	E
Epilobium Strictum	Downy Willow Herb	T
Eriophorum Virginicum	Rusty Cottongrass	E
Galium Labradoricum	Northern Bedstraw	T
Larix Laricina	Tamarack	T
Oenothera Perennis	Slender Sundrop	T
Potamogeton Gramineus	Grass-leaved Pondweed	E
Potamogeton Praelongus	White-stemmed Pondweed	E
Potamogeton Robbinsii	Fern-leaf Pondweed	E
Rhynchospora Alba	Beaked Rush	T
Ribes Hirtellum	Northern Gooseberry	E
Rubus Pubescens	Dwarf Raspberry	T
Salix Serissima	Autumn Willow	E
Utricularia Minor	Small Bladderwort	E
Vaccinium Corymbosum	Highbush Cranberry	E
Vaccinium Macrocarpon	Large Cranberry	E
Vaccinium Oxyoccos	Small Cranberry	E
Veronica Scutellata	Marsh Speedwell	T

Table 4-30 (continued): Squaw Creek Watershed Rare Species

Rare Birds and Animals

Buteo Lineatus	Red-shouldered Hawk	T
Childonias Niger	Black Tern	E
Emydoidea Blandingii	Blanding's Turtle	T
Etheostoma Exile	Iowa Darter	E
Fundulus Diaphanus	Banded Killifish	T
Gallinula Chloropus	Common Moorhen	T
Grus Canadensis	Sandhill Crane	E
Ixobrychus Exilis	Least Bittern	T
Notropis Heterodon	Blackchin Shiner	T
Notropis Heterolepis	Blacknose Shiner	E
Nycticorax Nycticorax	Black-crowned Night Heron	E
Podilymbus Podiceps	Pied-billed Grebe	T
Rallus Limicola	Virginia Rail	W
Sterna Forsteri	Foster’s Tern	E
Xanthocephalus Xanthocephalus	Yellow-headed Blackbird	E

4.20 DEMOGRAPHICS

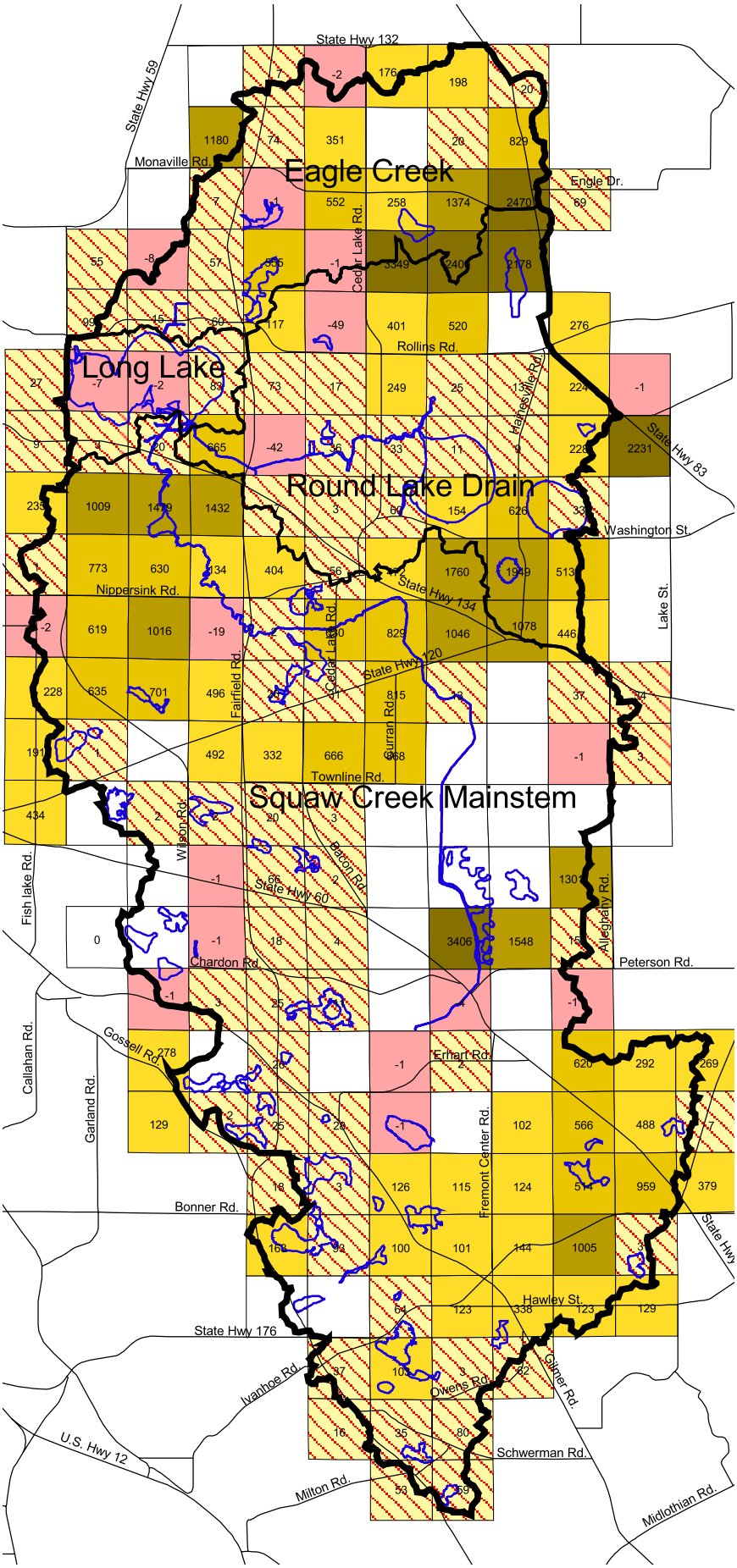
Population, households, and employment data for the Squaw Creek watershed were all developed from NIPC interpreted census data for 1990 for existing conditions. Future 2020 conditions were based on NIPC population, households and employment forecasts. These forecasts were coordinated by NIPC with the municipalities in the watershed and with Lake County Planning and Development staff. Table 4-31 presents the 1990 population, households and employment statistics for the three watersheds. Table 4-31 also presents forecasted growth in these categories for the three watersheds.

Table 4-31: Population, Households, and Employment

		Mainstem	Round Lake Drain	Eagle Creek
Population	1990	8895	23144	4913
	2020	41720	41124	13325
Percent Increase		369%	77%	171%
Households	1990	3138	7223	1557
	2020	15772	14207	4531
Percent Increase		403%	97%	191%
Employment	1990	2856	3870	697
	2020	9123	8480	1176
Percent Increase		219%	119%	69%

Figure 4-60 shows the change in population from 1990 to 2020 by section in the watersheds and Figure 4-61 shows change in households. Figure 4-62 presents employment change by section. Figure 4-63 presents population density for 1990 by section, and Figure 4-64 presents forecasted 2020 population density by section.

The above NIPC forecasts assume the construction of Route 53 and the availability of sewer and water service in the affected sections where growth is forecast.



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

Water

Population Change

-5 Population loss

No change

50 0 to 100 gain

300 100 to 500 gain

750 500 to 1000 gain

1500 1000 to 2000 gain

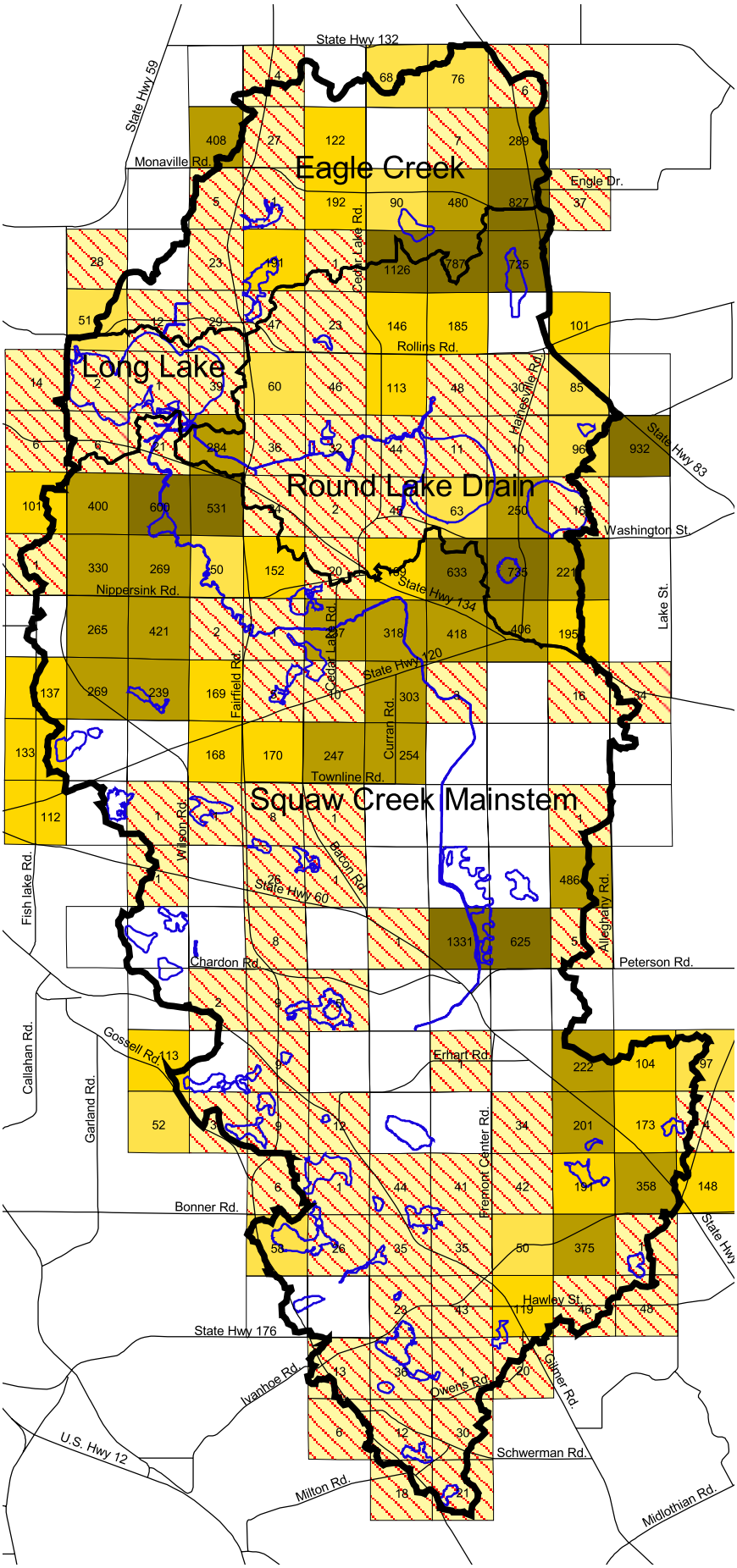
2500 Greater than 2000 gain

SOURCE: Northeastern Illinois Planning Commission

Population Change 1990 - 2020

Figure No. 4-60

Prepared by: Hey and Associates, Inc. 2003 (kgk)



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

Water

Household Change

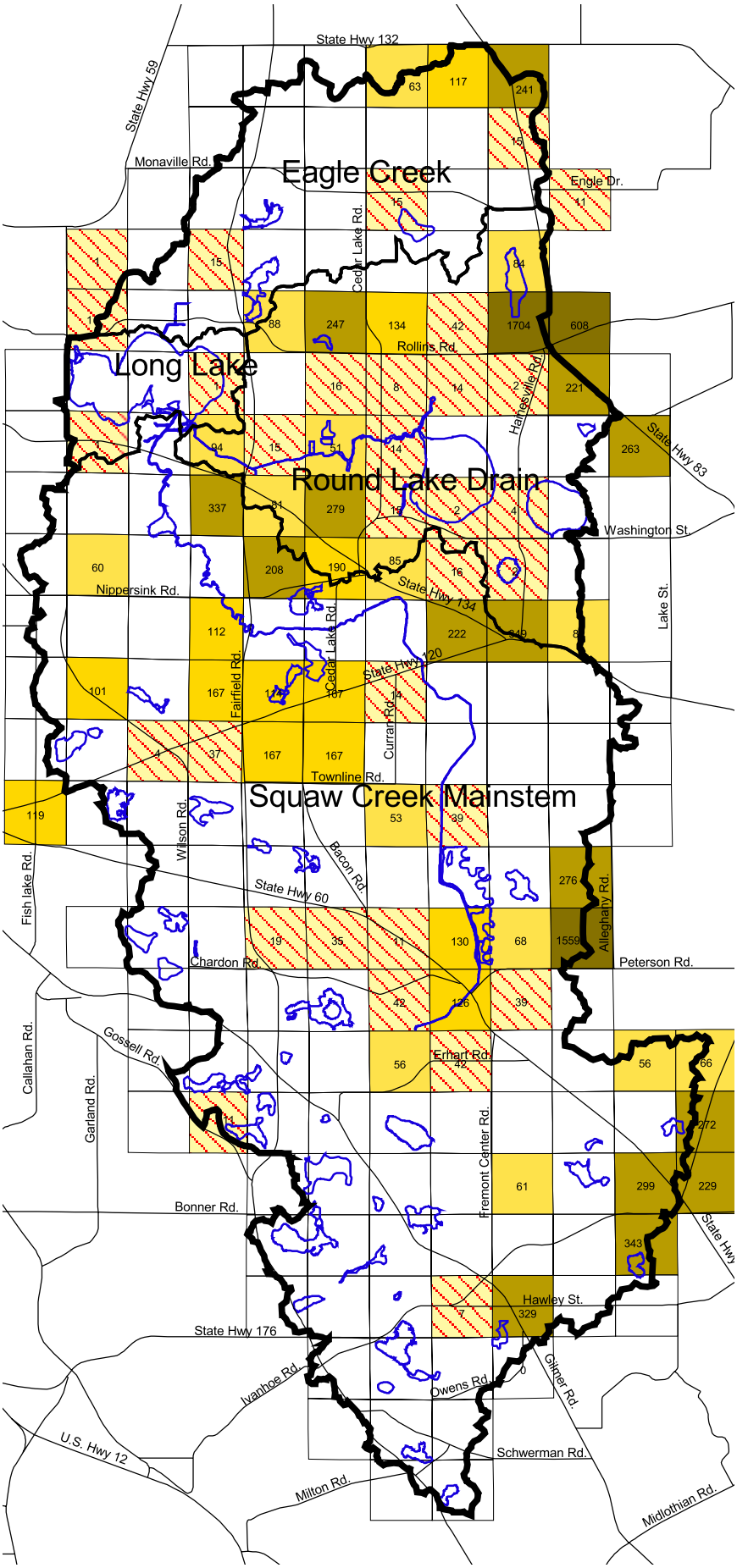
- No change
- 25 — 0 to 50 gain
- 75 — 50 to 100 gain
- 150 — 100 to 200 gain
- 350 — 200 to 500 gain
- 750 — Greater than 500 gain

SOURCE: Northeastern Illinois Planning Commission

Household Change 1990 - 2020

Figure No. 4-61

Prepared by: Hey and Associates, Inc. 2003 (kgk)



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

Water

Employment Change

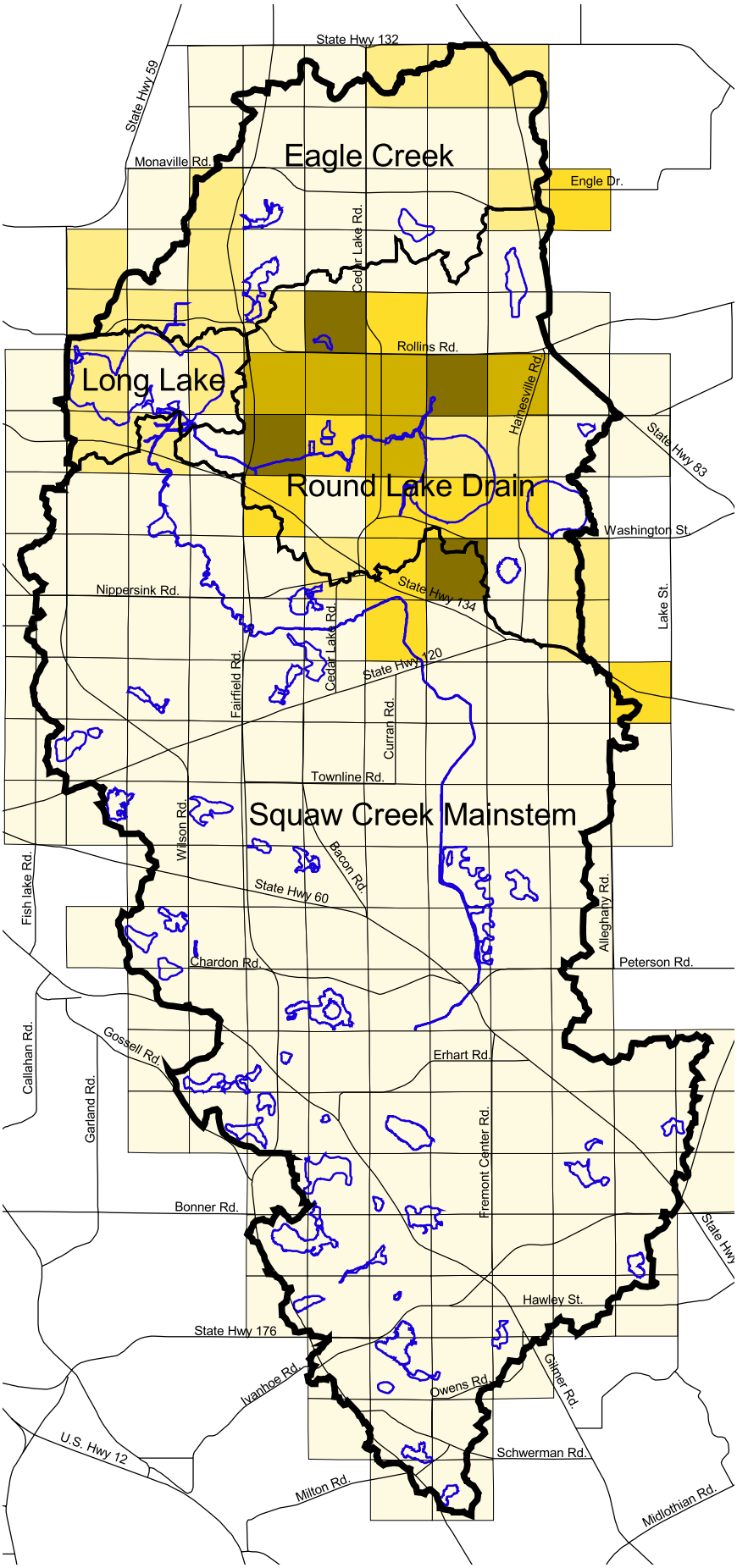
- No change
- 25 — 0 to 50 gain
- 75 — 50 to 100 gain
- 150 — 100 to 200 gain
- 350 — 200 to 500 gain
- 750 — Greater than 500 gain

SOURCE: Northeastern Illinois Planning Commission

Employment Change 1990 - 2020

Figure No. 4-62

Prepared by: Hey and Associates, Inc. 2003 (kgk)



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

Water

People per Acre

Less than 1

1 - 4

4 - 8

8 - 12

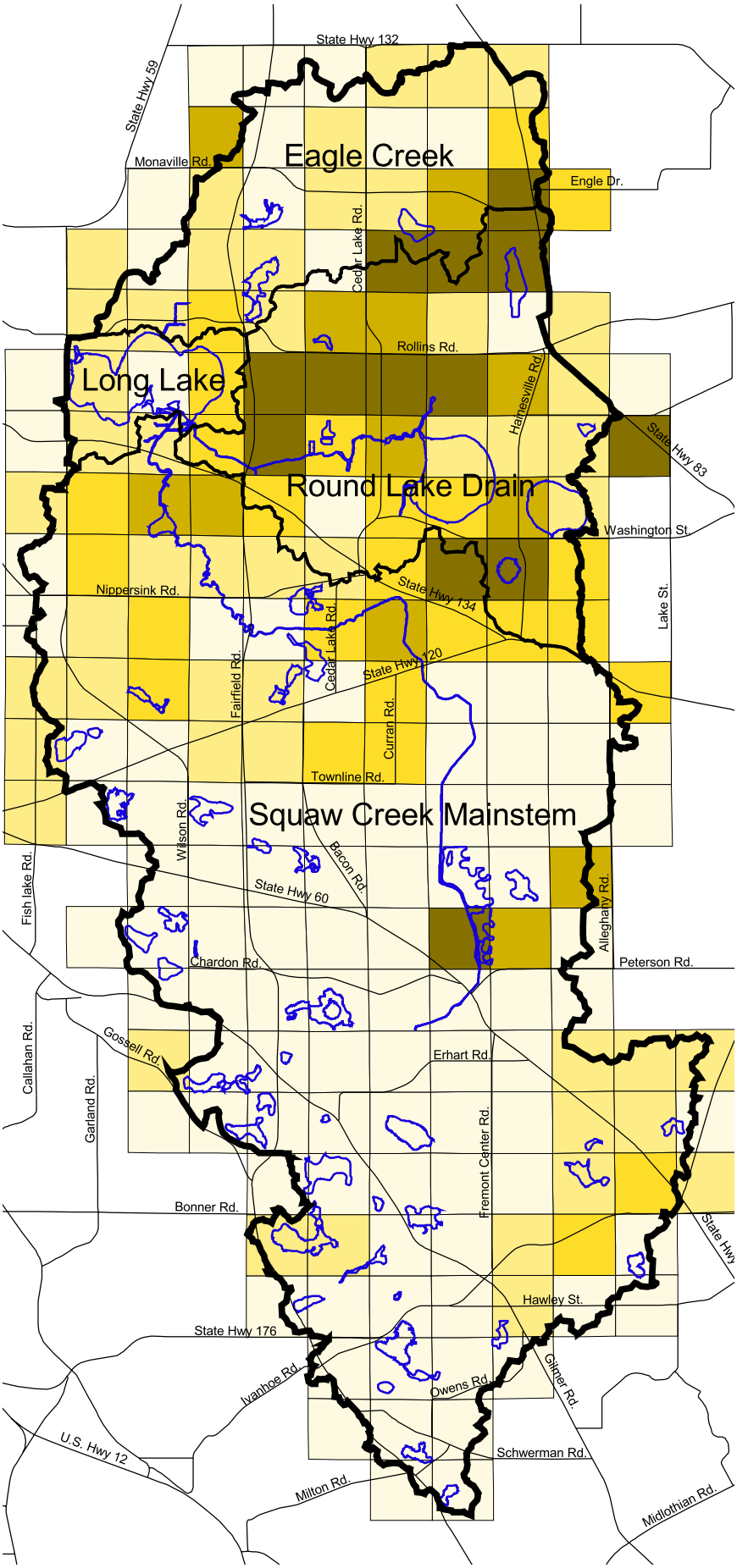
Greater than 12

SOURCE: Northeastern Illinois Planning Commission

Population Density 1990

Figure No. 4-63

Prepared by: Hey and Associates, Inc. 2003 (kgk)



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

Water

People per Acre

Less than 1

1 - 4

4 - 8

8 - 12

Greater than 12

SOURCE: Northeastern Illinois Planning Commission

Population Density 2020

Figure No. 4-64

Prepared by: Hey and Associates, Inc. 2003 (kgk)

4.21 GOVERNMENTAL JURISDICTIONS

Figure 4-1 displayed the different governmental jurisdictions and their boundaries in the Squaw Creek Watershed. Table 4-32 describes the various authorities of these jurisdictions relative to Plan implementation.

Table 4-32: Local Government Authorities

Entity	Zoning	Sewer	Water	Landscape Maintenance	De-icing	Certified WDO Community	Enforce Code
Townships							
Grant				X	X		
Lake Villa				X	X		
Avon				X	X		
Wauconda				X	X		
Fremont				X	X		
Villages							
Grayslake	X	X	X	X	X	X	X
Hainesville	X	X	X	X	X	X	X
Hawthorn Woods	X			X	X	X	X
Lake Villa	X	X	X	X	X	X	X
Mundelein	X	X	X	X	X	X	X
Round Lake	X	X	X	X	X	X	X
Round Lake Beach	X	X	X	X	X	X	X
Round Lake Heights	X	X	X	X	X	X	X
Round Lake Park	X	X	X	X	X	X	X
Wauconda	X	X	X	X	X	X	X

4.22 TRANSPORTATION SYSTEM

Figure 4-65 presents the major transportation features of the watershed. Several highways and two major rail lines, the Wisconsin Central and the Soo Line, serve the

watershed. The Wisconsin Central line is also used by METRA for commuter rail service at Round Lake.

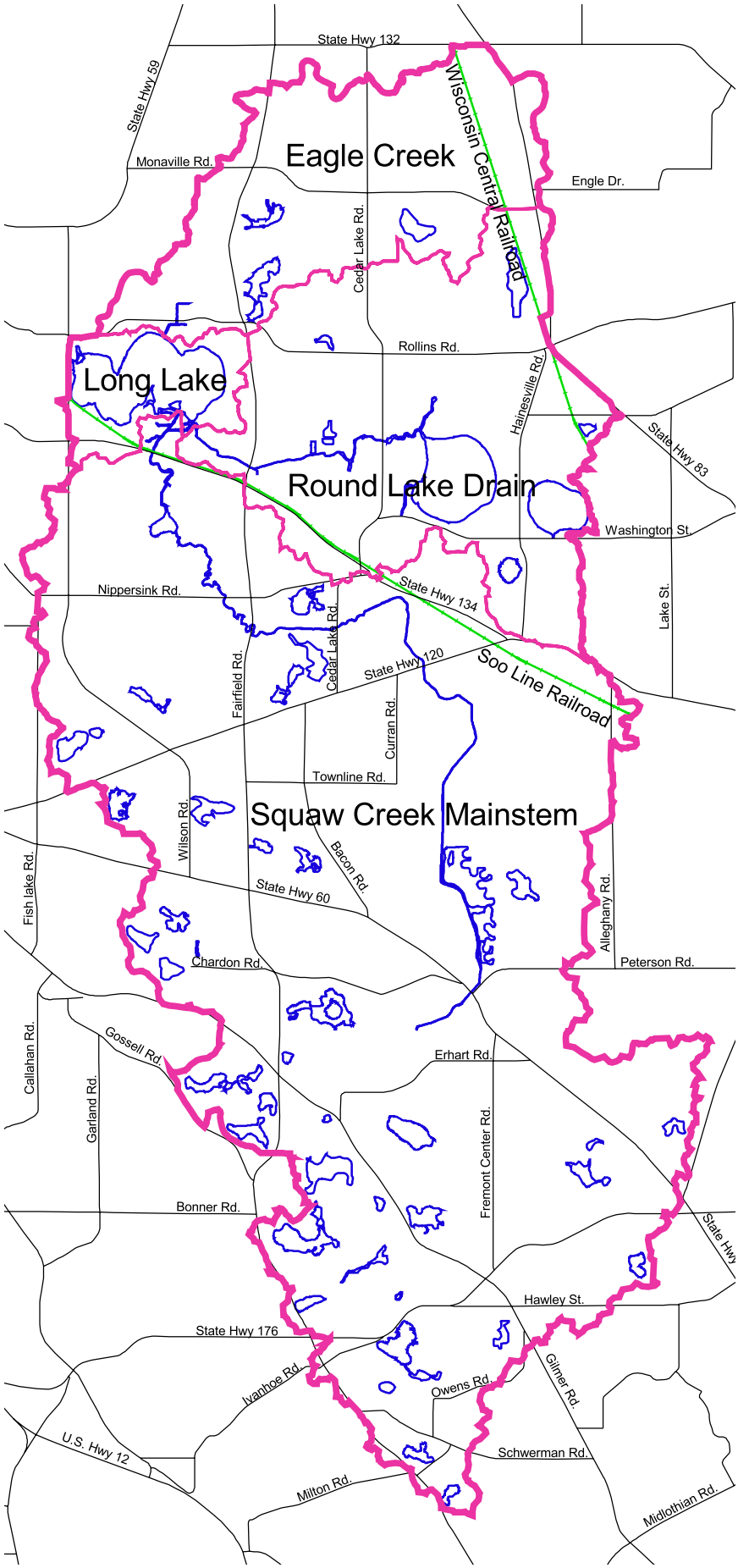
A review of the 5-year Transportation Improvement Plan from the Chicago Area Transportation Study (CATS) indicated 21 projects scheduled in the watershed. Virtually all of these projects are re-surfacing or widening and do not represent new highways. The one exception is right of way acquisition for IL 53.

IL 53 North-South Tollway From IL 120 Belvidere Rd (Lake/Gurnee) To Lake Cook Rd (Lake/Long Grove) H-AL I-NEW H-AL:IL 22: QNTN to IL 83; IL: LK-CK to IL 60; H-New (Freeway) Wilson to 53 10-94-0047 ILL Row Acquisition 02 Total Cost: $6,000,000 Federal

The EIS summary for the Route 53 project is included with other projects in the Appendix.

4.23 WETLAND BANKING

There are two federally-approved wetland banks in the watershed. Their locations are shown on Figure 4-66. The Squaw Creek Wetland Bank will provide a total of 200 acres of wetland credits. The Big Sag Wetland Conservancy will restore 78 acres of wetlands and 38 acres of uplands at its location. Taken together, these two banks represent significant natural resources restoration of almost 300 acres in what was formally the Big Sag Wetland.



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Major Roads

Railroads

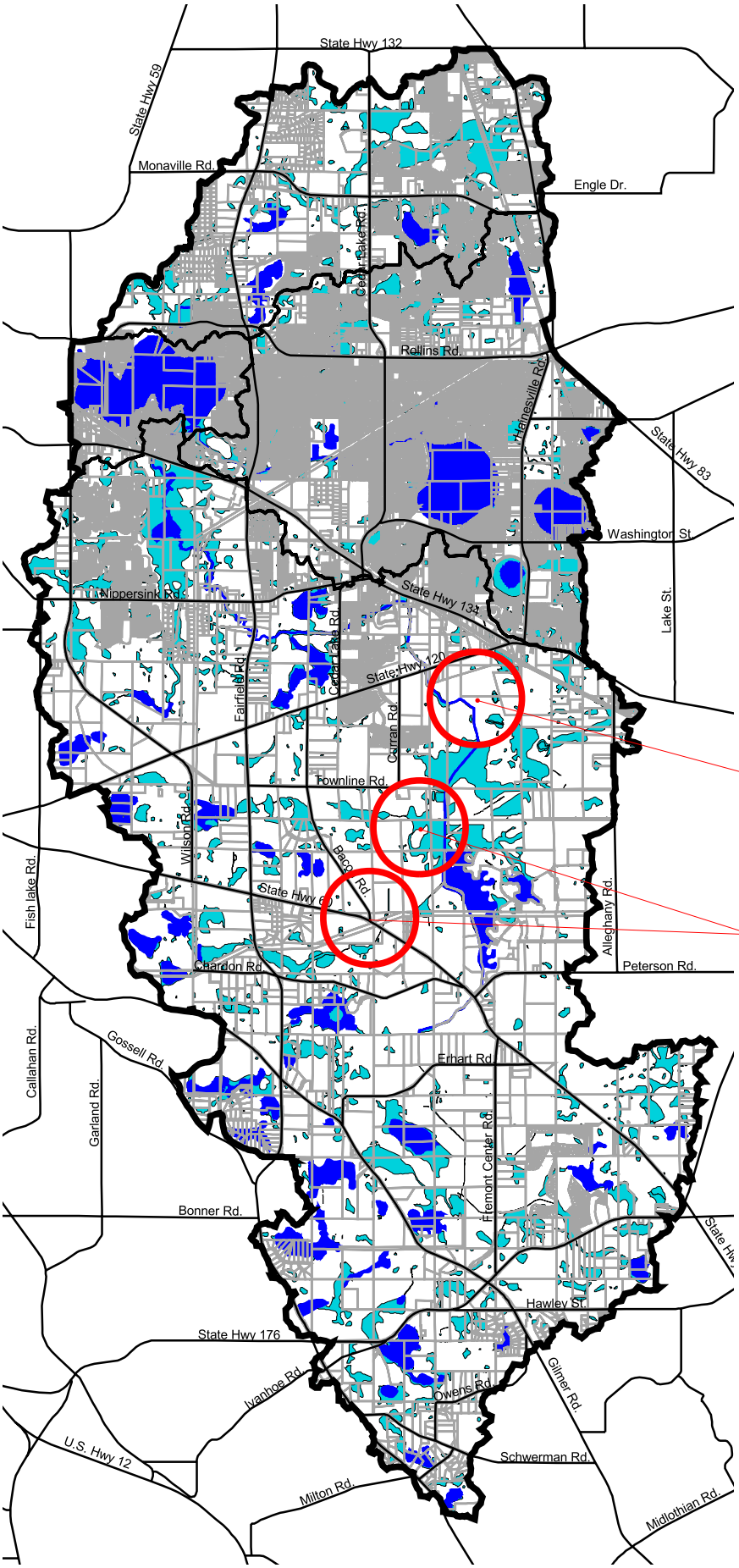
Water

SOURCE: Lake County Dept. of Information and Technology

Major Transportation Features

Figure No. 4-65

Prepared by: Hey and Associates, Inc. 2003 (kgk)



Squaw Creek Watershed

0 1 Miles

N

- Watershed Boundary
- Major Roads
- Wetland Banks
- Parcels
- Open Water
- Wetlands

Wetland Banks

Figure No. 4-66

Prepared by: Hey and Associates, Inc. 2003 (kgk)

CHAPTER 5
PROBLEM ASSESSMENT

5.1 BENEFICIAL USE IMPAIRMENT

The health of aquatic resources is usually best expressed in terms of the beneficial uses that they support. For example, a lake that supports swimming is typically considered valuable and in good health. A stream that supports a warm water fishery is considered healthy, whereas one that supports only pollution-tolerant organisms is considered unhealthy.

Beneficial uses can conflict. This may seem contradictory unless the entire universe of beneficial uses is considered. Streams can serve many functions including water supply, drainage, and wastewater disposal. Sometimes these uses can conflict with other beneficial uses such as aquatic life, canoeing, or swimming. Figure 5-1 is a matrix of beneficial uses prepared by NIPC that shows different beneficial water resources uses and which uses may be in conflict.

The attainment of a balance of these desired beneficial uses is the purpose of this Plan. The attainment of these uses requires that the management agencies described earlier take specific actions to address the reasons these uses are not being attained. Win-win results can be attained in use conflict situations, such as stream cleaning and habitat conservation.

5.2 FLOOD DAMAGE REDUCTION

5.2.1 Current Conditions

Flooding of structures occurs from a number of sources within the Squaw Creek Watershed. LCSMC prepared a Flood Damage Inventory in 1999 primarily based on interviews with local officials conducted in 1995. There were a total of 44 flood problem sites identified by LCSMC in its inventory (LCSMC, 1999). Figure 3-31 presented the results of that inventory. Table 5-1 documents the number of flood damage areas by classification from the LCSMC inventory.

Squaw Creek Watershed

POTENTIAL STREAM USE CONFLICTS

		Natural Resource Preservation	Game Fishing	Non-Game Fishing	Body Contact	Non-Power Boating	Power Boating	Streamside Activities	Potable	Agricultural	Industrial	Floodwater Control	Agricultural	Urban	Commercial Navigation	Wastewater Disposal
	Natural Resource Preservation	X														
RECREATION	Game Fishing		X													
	Non-Game Fishing			X												
	Body Contact				X											
	Non-Power Boating					X										
	Power Boating						X									
	Streamside Activities							X								
WATER SUPPLY	Potable								X							
	Agricultural									X						
	Industrial										X					
	Floodwater Control											X				
DRAINAGE	Agricultural												X			
	Urban													X		
	Commercial Navigation														X	
	Wastewater Disposal															X

Source: Northeastern Illinois Planning Commission

LEGEND

- Little or No Probable Conflict Between Uses
- Uses May Moderately Conflict
- Uses May Severely Conflict

Potential Beneficial Use Conflicts

Figure No. 5-1

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Table 5-1: LCSMC Flood Damage Inventory -- Flood Damage Acreage by Class

	Overbank Flooding	Depressional Storage Flooding	Drainage Problems
Mainstem	23 acres	53 acres	77 acres
Round Lake Drain	296 acres	251 acres	110 acres
Eagle Creek	none	none	22 acres

Few of the over 500 properties that flooded in 1993 seemed to be present on the FEMA floodplain mapping. To further study this problem, a more detailed mapping of the affected area (Round Lake Drain and Long Lake) was prepared. This more detailed mapping utilized the 1979 FIS 100-year flood profile and LCSMC's 2-foot topographic mapping. Figure 4-22 presented the LCSMC mapping for Squaw Creek, Figure 4-23 presented the remapping of the FIS flood profile for the Round Lake Drain and Figure 4-24 presented the remapping for Long Lake.

Table 5-2 summarizes the number of structures in the floodplain based on the revised mapping for Round Lake Drain and Long Lake, the LCSMC floodplain study results for the mainstem of Squaw Creek, and the available FEMA mapping for Eagle Creek

Table 5-2: Structures in Squaw Creek Watershed Floodplains

Water Body	Number of Structures in 100-year Floodplain	Number of Structures in 10-year Floodplain
Round Lake Drain	366	226
Long Lake	104	22
Squaw Creek Mainstem	18	0
Eagle Creek	0	0

This information correlates better with 1993 reported flooding. Based on these results, most of the flooding in the Squaw Creek Watershed occurs in the Round Lake Drain and around the south shore of Long Lake. The principal cause of flood damage in these areas is overbank flooding, although drainage problems and depressional flooding are significant. The number of structures in the 10-year floodplain are significantly less than

in the 100-year floodplain based on the FIS 10-year profile and LCSMC's 2-foot topography. However, upstream of Sunset Drive the difference in the Round Lake Drain 10-year and 100-year profiles is less than 0.5 feet and many structures appear to be in the 10-year floodplain.

The mitigation of overland flooding on the Round Lake Drain will require a combination of the following actions: reduce flood discharges through additional storage; increase the conveyance of the Round Lake Drain at key locations; construct levees to protect property from flooding, floodproofing, or buyouts.

Reduction of flood discharges would require significant additional storage. It also could involve using more of the storage available in Round and Highland Lakes. Discharges must be reduced significantly, if no channel modifications are made, to shrink the floodplain.

Improving the capacity of road culverts at Fairfield, Brentwood, Beachview, South Channel and Clarendon coupled with improvements to instream conveyance also may reduce flood profiles on the Round Lake Drain. Increasing culvert capacity at Meadowbrook, Oakwood, Orchard, Highland, Morningside and especially Golfview may help to reduce overbank flooding on the Round Lake Drain.

Finally, levees may be an option for some reaches with significant damages. However, the cost of this solution, its space requirements, potential ecological impacts and the need for pumping routine drainage will make its application less attractive than increased storage or conveyance options.

All of the above potential solutions require significant additional study. It is imperative that a floodplain restudy and mapping be completed. Flood audits also need to be conducted to define structures likely to be damaged under different flood reduction alternatives. The Flood Insurance Study is old and doesn't consider current larger rainfall amounts. Both the Round Lake Drain and Eagle Creek models are much less detailed than LCSMC's Mainstem model and did not have the advantage of LCSMC's 2-foot topographic data. No reliable conclusions regarding the best solution to flooding problems can be made without these re-studies.

Based on the LCSMC inventory and information provided by the municipalities there are numerous drainage and depressional area flooding problems in the Round Lake Drain. These problems should be studied in a comprehensive manner to develop the most cost-effective solutions.

5.2.2 Future Concerns

A major concern of the Watershed Stakeholders was whether flood damages were likely to increase in the future as the result of new development increasing the peak flow rates. Another concern raised during stakeholder meetings was that new development would increase the volume of runoff leading to increased flooding downstream even with the restrictive WDO release rates.

Most of the United States requires new development to only maintain post-development discharges at pre-development rates (Dreher, et al, 1989). Frequently, the design event is not the 100-year event but some lesser event such as the 10-year event. This is the approach in the Wisconsin State detention ordinance. The 100-year discharge from a detention basin designed under these criteria will be about 1.5 to 2.0 cfs per acre, or 10 times what is allowed under the WDO. Discharges from basins designed with these less restrictive criteria can join together to actually make flooding worse than before development. This type of problem is generally not possible with the very restrictive release rates of the WDO (Dreher, et al, 1989). The existing WDO requires most new development to provide stormwater detention sufficient to limit the 100-year event discharge to 0.09 cfs per acre of disturbed area. This is a more restrictive release rate than applies to most of Lake County, which must meet a 100-year release of 0.15 cfs per acre of disturbed area.

The subject of stormwater detention was studied in detail in 1989 by NIPC in its report "Evaluation of Stormwater Detention Effectiveness in Northeastern Illinois". That report found that a release rate of 0.04 cfs per acre for the 2-year event and a release rate of 0.15 cfs per acre for the 100-year event should be adequate to prevent any increase in flooding due to new development, including volume effects, for at least a 30 square mile watershed. This report formed the technical basis for the use of 0.04 and 0.15 release

rates in the WDO and for similar release rates in the DuPage and Kane County ordinances. (Dreher, et. al, 1989).

Although the NIPC/OWR study conclusions are valid, generally the specific characteristics of any particular watershed need to be considered. For the Squaw Creek watershed, SMC utilized the 1979 FEMA Floodplain Study as a basis for considering specific release rate needs for the Squaw Creek watershed. Based on the FEMA Floodplain Study, the existing, "per acre" 100-year flood peak discharges in Squaw Creek were ***lower*** than NIPC's recommended release rate of 0.15 cfs per acre. As a result, SMC established a watershed-specific release rate of 0.09 cfs per acre for the Squaw Creek watershed, matching the existing condition "per acre" peak flowrates in Squaw Creek.

5.2.3 Volume Effects Study for Long Lake

To further examine the effect that increased runoff volume from new development in the Squaw Creek Watershed might have on flooding conditions in a collection area, such as Long Lake, a separate model study was performed specifically for Long Lake.

This study used the existing LCSMC model for the Mainstem completed in 2000 and combined it with the FIS models completed for FEMA in 1979 for Eagle Creek and the Round Lake Drain including Long Lake. The 1979 FIS models were first rerun to verify their results. Once this was completed, the 1979 FIS models were enhanced by a more detailed simulation of watershed hydrology. This was accomplished by increasing the number of subwatersheds in the Eagle Creek model from 5 to 20 (the original model covered only a portion of the watershed) and from 8 to 16 for the Round Lake Drain model. The three models were then combined to form a "complete" computer model for the entire Squaw Creek Watershed above Long Lake. The area draining directly to Long Lake also was added to the models.

Flood discharges and flood depths in Long Lake were then computed for different recurrence events including the 100-year event. The results showed an elevation of 743.5 for the 100-year critical duration storm event on Long Lake versus a 100-year flood elevation of 743.0 shown on the current FEMA flood profiles. The 0.5-foot difference was considered acceptable for the purposes of making relative comparisons of potential volume effects, and the "complete" computer model was used to represent the existing condition for the volume effects analyses.

Next, NIPC-projected new development for 2020 was assigned to subwatersheds in the enhanced combined model. This was done based on NIPC quarter-section household forecasts. It was assumed that each new household contributed 16,500 square feet of developed area to account for roads and non-residential development. It was assumed that 38 percent (6,270 square feet) of this area was impervious. A total of about 2.24 square miles (about 6 percent) of new impervious area was added to the watershed by this approach.

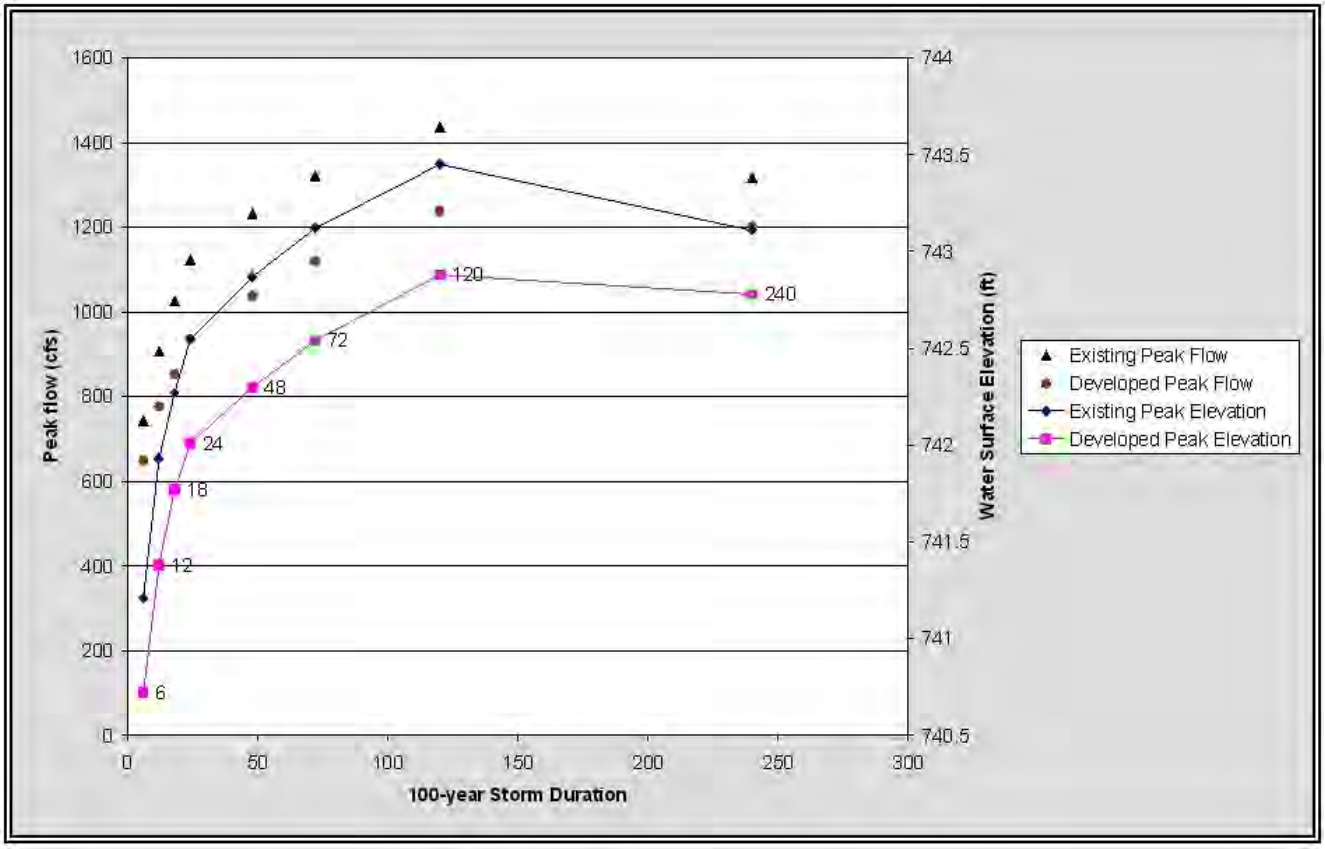
Each watershed that had growth assigned to it was split into two parts. The first part retained the original curve numbers and times of concentration and any regional storage that had been previously simulated. The second part had a new curve number and time of concentration calculated to reflect the new development. A detention basin meeting WDO design requirements (100-year release of 0.09 cfs/acre, 2-year release of 0.02 cfs/acre and storage for the 100-year, 24-hour event) was added to capture runoff from the "new development" watershed. This "future conditions" model was then run to determine how effective WDO detention was on mitigating increased flood discharges and rates. Table 5-3 documents the results of this analysis. Figure 5-2 presents the effect of new development on Long Lake flood discharges and elevations.

Table 5-3: Flood Effect of Increased Development on Long Lake

	Peak elevation (ft)		**Peak flow (cfs)**	
Storm Duration (hr)	Existing Conditions	With Development Corresponding to NIPC Population Forecast	Existing Conditions	With Development Corresponding to NIPC Population Forecast
6	741.21	740.72	743	649
12	741.93	741.38	908	777
18	742.27	741.77	1026	854
24	742.55	742.01	1123	936
48	742.87	742.3	1233	1038
72	743.12	742.54	1322	1120
120	743.45	742.88	1437	1238
240	743.11	742.78	1318	1202

The results show that for the 100-year event, continued implementation of the current WDO detention requirements should prevent increases to the peak discharges and peak flood elevations at Long Lake.

Squaw Creek Watershed



Long Lake Flooding Effects from New Development

Figure No. 5-2

Prepared by: Hey and Associates, Inc. 2003 (kgk)

5.3 WATER QUALITY

5.3.1 Background

Prior to development, the only significant transport of solids in the watershed occurred during large runoff events. This is because there were few channels to rapidly convey flow and little exposed soil. These events had sufficient energy to dislodge vegetation and transport soils. Even these large events, however, were mitigated by the lack of a defined drainage channel or stream in the watershed. The relatively slow and stable delivery of water to the receiving lakes and wetlands in the watershed ensured a supply of clean water.

Agricultural development altered this arrangement by first increasing runoff volume by removing prairie and forest vegetation. The exposure of farm fields to erosion increased sediment loads in runoff as well. The drainage of thousands of acres of wetlands by the construction of tile systems and drainage channels completed the alteration and increased the rate and volume of runoff reaching streams and lakes. Streambank erosion also increased, leading to increased sediment delivery through the channel system. These same actions also isolated wetlands and ponds from the historic flow paths such as Ray's Lake and the large wetland at the mouth of Eagle Creek.

Urban development prior to 1990 also increased pollutant loads to Long and Round Lakes. Urban pollutants from fertilizer and pesticide usage were transported from developed areas via storm sewers and drainage channels. Without detention, these pollutants rapidly reached lakes. Without detention, rainfall events that would not have produced runoff now produced significant rates of discharge that further eroded receiving channels, increasing sediment delivery to lakes. Erosion during construction also contributed new sediment to the channels and lakes. New septic systems built in unsuitable soils or undersized and not maintained contributed a constant stream of pollutants. Finally, the development of the Lake Villa and Round Lake Sanitary District sewage treatment facilities introduced a constant direct source of pollutants to the channels and lakes.

Long Lake was transformed from a clear, highly desirable recreational water body prior to 1950 to a green, algae choked system in less than 30 years (IDOC, 1972). Most of this change occurred within ten years of the introduction of sewage effluent in the 1940s. The Lake County Health Department noted that "It has been reported that this (Long Lake) was a very clear and weedy lake prior to 1950."(LCHD, 2002)

5.3.2 Constituent Concentrations

The Baxter data and the observations of the IDNR during its assessment of the Mainstem of Squaw Creek suggest that water quality is not limiting the attainment of any instream beneficial use for the Squaw Creek Mainstem, Eagle Creek, or the Round Lake Drain. Instream constituent concentrations for key parameters such as dissolved oxygen (DO), ammonia (NH3), total suspended solids (TSS) and total phosphorus (TP) are all similar or better than concentrations on stream segments in northeastern Illinois that support diverse warm water fisheries (USEPA, 1986).

A comparison of the seven Baxter and one IDOT monitoring station constituent ranges versus the Illinois General Use Standards is presented in Table 5-4.

Table 5-4: Water Quality Versus General Use Standards (mean/maximum mg/l)

Constituent	General Use Standard	Squaw Creek at Route 134	Squaw Creek at Nippersink	Squaw Creek at Route 60	Squaw Creek Tributary at Nippersink	Eagle Creek	Round Lake Drain	IDOT Route 120
TP	0.05	0.11 / 0.24	0.11 / 0.31	0.14 / 0.45	0.11 / 0.55	0.10 / 0.27	0.06 / 0.20	0.16/ 0.70
TDS	1000.0	590 / 828	517 / 697	481 / 655	970 / 1950	635 / 902	653 / 1280	No Data
NH_3	1.5 - 3.1	0.18 / 0.50	0.20 / 1.0	0.24 / 0.70	0.24 / 0.5	0.21 / 1.40	0.21 / 0.70	No Data

The total phosphorus standard is for lakes of 20 acres or larger and is not met in virtually every stream in Illinois. Total phosphorus in flowing streams in Illinois that do not have a point source discharge typically are in the ranges sampled (USGS, 2002). The total dissolved solids number usually reflects road salting for deicing. The most urbanized monitoring stations have the highest average and maximum Total Dissolved Solids (TDS) value. This reflects the sodium component showing up as a dissolved solid.

Seasonal violations of the TDS standard are common throughout Illinois as a result of deicing activity. However, the high TDS values on the Squaw Creek Tributary are a concern that warrants further investigation since this is not an urbanized stream. The NH3 standard is dependent on water temperature and pH because these factors determine how much un-ionized ammonia may be present instream. Un-ionized ammonia is toxic to aquatic life. The 1.5 mg/l standard was not exceeded for any of the monitoring locations for the dates sampled.

Water quality data from the Baxter, IDOT, and LCHD were compared in an effort to detect significant trends regarding pollutant sources and the effect of flow rate on water quality. The data were arranged in order of degree of urbanization for the contributing watershed at the point of sampling in Table 5-5 below for NH3, nitrate (NO3), TP, soluble reactive phosphorus (SRP), TSS, TDS, and alkalinity.

Table 5-5 Comparison of Water Quality Data (mg/l)

Sampling Point (Most to Least Urban)	Urbanization (Percent)	Data Source	NH3	NO3	TP	SRP	TSS	TDS	Alkalinity
Round Lake Watershed	80	LCHD	0.18	1.8	0.16	N.D.	40	700	N.D.
Round Lake Drain At Fairfield Road	80	Baxter D	0.21	0.28	0.06	0.02	31	654	202
Eagle Creek at Al's	50	Baxter E	0.21	0.41	0.10	0.04	28	635	240
Squaw Creek at 134	30	Baxter C	0.18	0.95	0.11	0.04	42	590	226
Squaw Tributary At Nippersink Road	20	Baxter B	0.24	1.01	0.11	0.04	38	970	228
Squaw Creek at Nippersink	20	Baxter A	0.20	1.37	0.11	0.04	65	517	225
Squaw Creek at 60	10	Baxter H	0.24	1.18	0.14	0.06	41	480	219
Squaw Creek at 120	10	IDOT	N.D.	3.29	0.16	N.D.	217	N.D.	188

These data indicate that as urbanization decreases TDS decreases. This is likely because of less road salt usage in the more rural and agricultural watersheds. As urbanization decreases, NO3 increases. This suggests that sources such as fertilizer applications to crops are the most significant contributor of these constituents. The two highest values for NO3 were measured are at Route 60 and Route 120 on Squaw Creek. The watersheds above these areas are almost entirely rural and agricultural land use. There does not seem to be any trend for NH3 with all average values in a small range between 0.18 and 0.24 ppm. This may be because of the rapid transformation of NH3 to NO3 in the aquatic environment.

TP and SRP also are highest for the most agricultural watersheds. The Baxter data at Route 60 and the IDOT data at Route 120 contain the two highest average TP values. The Baxter data for the Round Lake Drain, the most urban watershed, show the lowest average TP and SRP values. The high TP values from the agricultural watersheds most likely are the result of fertilizer applications and streambank erosion. The channel below Route 60, between Route 60 and Route 120, was dug through hydric soil to drain

wetlands. Hydric soil is highly mobile and easily eroded. This could account for high TP values during runoff events. However, analysis of TP concentrations versus flow for the Route 60 (Appendix) and Route 120 (Appendix) data do not completely support this hypothesis. At Route 60 the plot shows that TP often is high when flow is low. This suggests that streambank erosion is not the major source of TP. At Route 120 the trend is stronger with higher TP values more closely associated with high flows. This suggests that in the "Big Sag" wetland streambank erosion in the agricultural channel is a bigger problem.

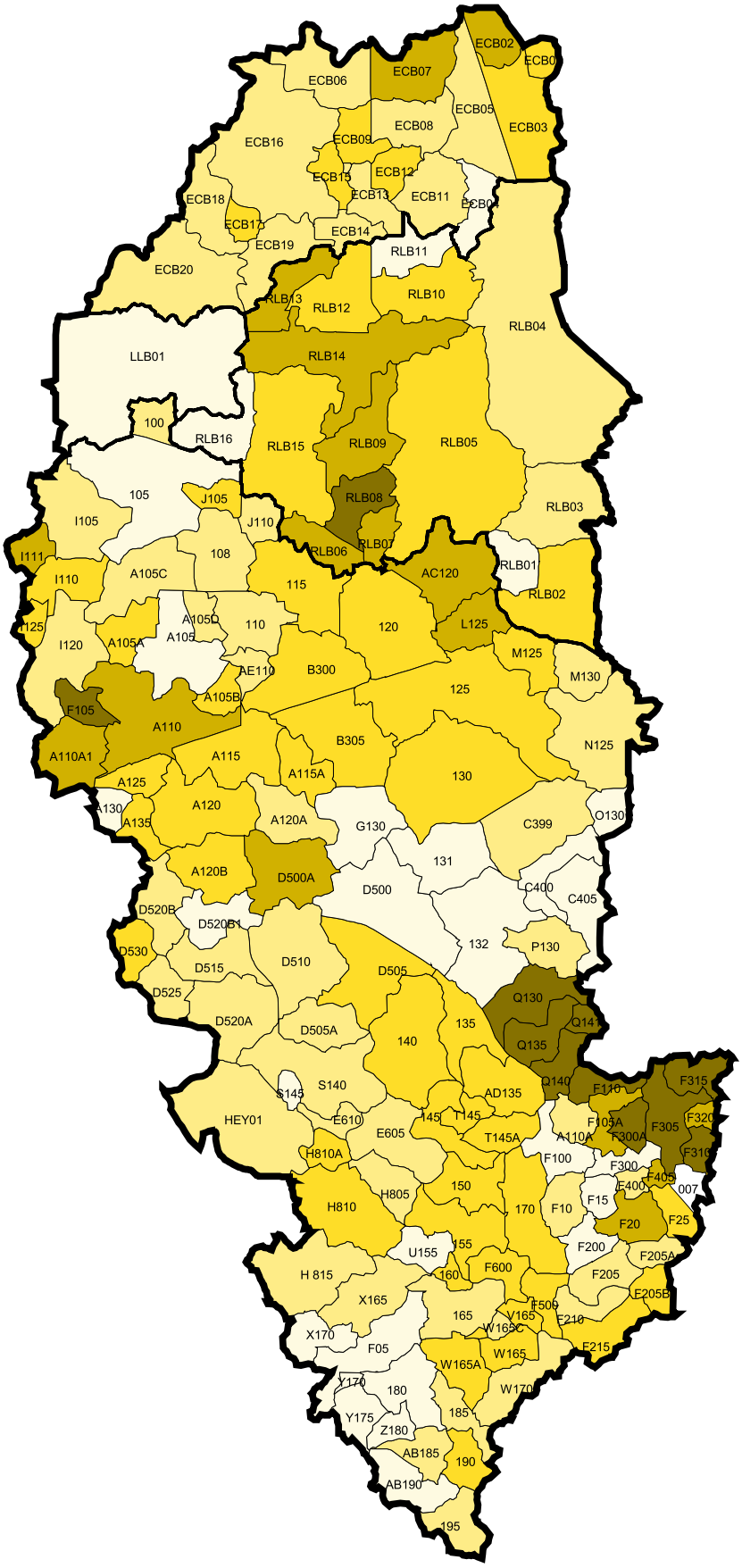
The LCHD data suggest that TP from urban runoff in the Round Lake Drain above Round Lake should be more in the range of 0.11 to 0.22 ppm. This is consistent with the results of the Nationwide Urban Runoff Project National (TP = 0.42 ppm) and NIPC NURP Lake Ellyn results (TP = 0.48 ppm) (USEPA, 1983; Hey and Schaefer, 1983). The LCHD data also indicate much higher NO3 values than observed by Baxter at Fairfield Road on the Round Lake Drain. This is mostly due to the effect that Round Lake has to remove pollutants from the 60 percent of the watershed above it. For example the TP from Round Lake is typically about 0.02 ppm and NO3 is less than 0.05 ppm (LCHD, 2002). These concentrations when weighted by watershed area are enough to explain the Baxter data. The low values also may be due to a small extent to the interception and storage of runoff below Round Lake by ditches, swales, depressions and wetlands.

The above data reflect a dramatic change from samples collected by the ISWS and ISGS in 1977. Average total phosphorus has been reduced by almost an order of magnitude from 0.83 to 0.06 mg/l leaving Long Lake. This is a direct result of the removal of the two wastewater discharges. The pending reduction in discharge from the Baxter plant should reduce the Squaw Creek values to less than 0.10 mg/l as well. Round Lake continues to act as a pollutant sink for TSS, TP and N03 in stormwater based on LCHD and Baxter data.

Constituent Loads

Constituent loads in the watershed are delivered to receiving waters by either point source or nonpoint sources. Point sources include urban storm sewers and wastewater treatment plant discharges. Nonpoint sources include agricultural runoff (including tiles) streambank erosion, atmospheric deposition, regeneration of pollutants from settled sediment and wildlife (especially geese). NIPC has developed typical unit loads of pollutants for different land uses (NIPC, 1992). To screen for parts of the watershed that may be the major pollutant sources, these unit loads were combined with the 1995 land use data to generate annual loads by subwatershed. Loads were developed based on whether a subwatershed was sewered or unsewered and by the land use in the subwatershed.

Figure 5-3 presents the results of these computations by subwatershed for TSS. Figures 5-4 and 5-5 present results for TP, and Zinc. Table 5-6 compares the pollutant loads from the Baxter study versus these loads.



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Total Suspended Solids (lbs/acre)

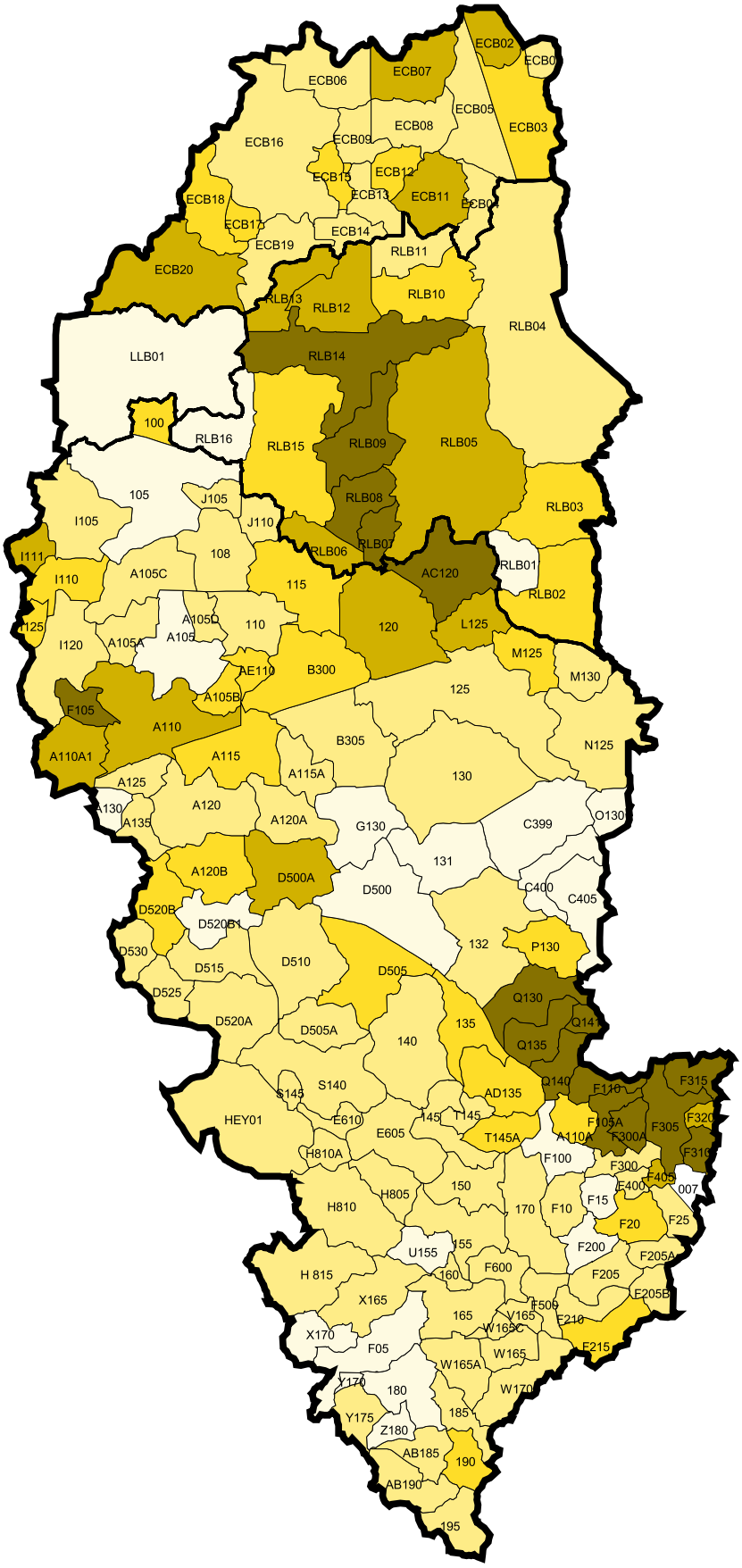
- 16.199 - 130.834
- 130.834 - 230.542
- 230.542 - 377.339
- 377.339 - 685.111
- 685.111 - 1049.68

Note: Loading estimates based on typical unit loads of pollutant for various land uses (published by NIPC in 1992) multiplied by the land use areas included in the NIPC 1995 land use data.

Total Suspended Solids Loading

Figure No. 5-3

Prepared by: Hey and Associates, Inc. 2003 (kgk)



Squaw Creek Watershed

0 1 Miles

N

Watershed Boundary

Total Phosphorous (lbs/acre)

- 0.073 - 0.204
- 0.204 - 0.351
- 0.351 - 0.511
- 0.511 - 0.77
- 0.77 - 1.27

Note: Loading estimates based on typical unit loads of pollutant for various land uses (published by NIPC in 1992) multiplied by the land use areas included in the NIPC 1995 land use data.

Total Phosphorous Loading

Figure No. 5-4

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Squaw Creek Watershed

0 1 Miles

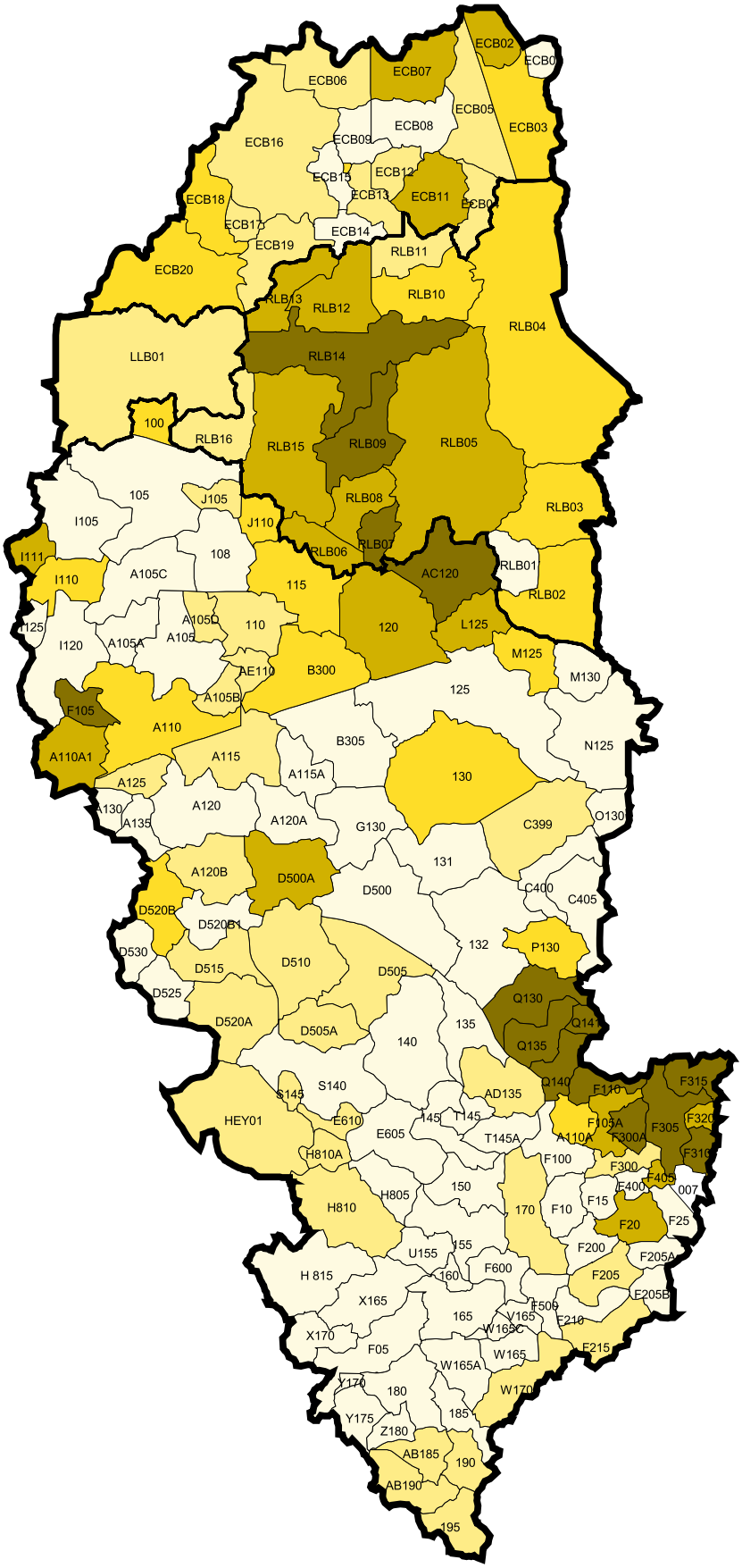
N

Watershed Boundary

Zinc (lbs/acre)

- 0.024 - 0.175
- 0.175 - 0.304
- 0.304 - 0.471
- 0.471 - 0.757
- 0.757 - 1.397

Note: Loading estimates based on typical unit loads of pollutant for various land uses (published by NIPC in 1992) multiplied by the land use areas included in the NIPC 1995 land use data.



Zinc Loading

Figure No. 5-5

Prepared by: Hey and Associates, Inc. 2003 (kgk)

Table 5-6: Baxter and NIPC Pollutant Load Estimates (1000 lbs/year)

Location	TP		TSS		TDS	
	NIPC	Baxter	NIPC	Baxter	NIPC	Baxter
Squaw @ Rte 60	2.41	1.34	1798	391	2520	4584
Squaw @ Rte 134	6.29	4.92	4577	1938	7834	27187
Squaw @ Nippersink	4.93	4.42	3519	2527	6237	20233
Eagle Creek	1.2	1.36	671	390	1745	8844
Nippersink Ditch	0.92	0.80	726	282	935	7196
Round Lake Drain	2.45	0.52	1407	254	3140	5356

The Baxter data suggest that the NIPC-derived pollutant loading estimates may be too high for TP and TSS and too low for TDS. However, it is important to distinguish that the NIPC loadings are for load leaving a land use and are not the same as the Baxter numbers. The Baxter numbers reflect instream loads and include sources such as streambank and bed erosion and also the deposition and removal of pollutants by wetlands or ponds along the flow route. Neither estimate indicates that water quality is a limiting factor for beneficial uses.

5.4 HABITAT

As discussed in Chapter 2, the water resources of Squaw Creek Watershed have been impacted by human activities, particularly, large amount of agricultural development over the last century. More specific discussions based on the stream inventory results of Chapter 4 follow.

5.4.1 Squaw Creek Mainstem

The mainstem has limited value for aquatic habitat. According to the Illinois Department of Natural Resources (IDNR) study in 1997, the Biological Stream Characterization (BSC) was determined to be a D, Limited Aquatic Resource. The IDNR summary stated that “Habitat was the primary limited factor at the Squaw Creek stations” and that “Squaw Creek appeared to have been recently…maintained and was very limited in habitat and instream cover.” The IDNR also stated that “Steams will recover or

‘naturalize’ if left undisturbed…” and “While removal of blockages is sometimes necessary, complete removal…is detrimental to stream communities.”

Based on the stream inventory conducted as part of this study, other limiting factors for aquatic habitat are:

1. Forty percent of stream has moderate to high erosion (Table 4-15). This contributes to 40 percent of the stream having moderate to high sedimentation levels (Table 4-16), which in turn decreases the amount of benthic invertebrates,
2. The mainstem has unstable and ‘flashy’ hydrology throughout the year,
3. The creek is maintained as channelized and free of debris blockages,
4. There is a low percentage of pool/riffle development (Table 4-17), and
5. Much of the Mainstem is an artificial channel cut through highly unstable soils.

On a positive note, based on the stream inventory, the creek did have a high percentage of in-stream cover for fish (Table 4-18) at the time of the inventory in 1999.

5.4.2 Round Lake Drain

The Round Lake Drain is severely limited as aquatic habitat for the following reasons based on the stream inventory

1. There are moderate to high levels of bank erosion (Table 4-15) that contribute to the majority of the stream length. This erosion contributes to moderate to high sedimentation levels (Table 4-16), which decreases the habitat for and the amount of benthic invertebrates;
2. The stream experiences unstable hydrology throughout the year, and
3. There is a lack of pool/riffle development (Table 4-17).

However, based on the stream inventory, the creek did have a high percentage of in-stream cover for fish (Table 4-18).

5.4.3 Eagle Creek

Eagle Creek offers moderate aquatic habitat because significant portions of it have not been severely channelized and there are large on-channel wetland areas within its corridor. Based on the stream inventory, the following are reasons for the limited aquatic habitat:

1. Forty-five percent of the stream has moderate to high levels of bank erosion (Table 4-15) that contributes to 35 percent of the stream having moderate to high sedimentation levels (Table 4-16), which decreases the amount of habitat for and number of benthic invertebrates,
2. An unstable and 'flashy' hydrology throughout the year, and
3. A low percentage of pool/riffle development (Table 4-17).

However, based on the stream inventory, the creek did have a high percentage of in-stream cover for fish (Table 4-18).

5.4.4 Long Lake

The lake has several problems affecting its aquatic habitat quality. Based on the Lake County Health Department 2002 report, the following problems are limiting aquatic habitat (LCHD, 2002):

1. Poor water clarity and elevated phosphorous concentrations,
2. Shoreline erosion,
3. Invasive shoreline plant species,
4. Minimal aquatic vegetation and presence of Eurasian water milfoil, and
5. High conductivity and total dissolved solids.

5.4.5 Round Lake

The lake has several problems affecting its aquatic habitat quality. Based on the Lake County Health Department 1989 report, the following problems are limiting aquatic habitat (LCHD, 1989):

1. A dense stand of Eurasian milfoil encircling the lake,
2. Elevated phosphorous concentrations in hypolimnion,
3. Less than 3 percent of the watershed area is wetlands and none adjacent to the lake, and
4. Above normal levels of the heavy metals, cadmium and mercury,
5. Shoreline erosion particularly in channels,
6. High conductivity readings.

5.4.6 Highland Lake

Although Highland Lake has high attainment of beneficial uses, it does have a few problems affecting its aquatic habitat. Based on the Lake County Health Department 2002 report, the following aquatic habitat problems were stated (LCHD, 2002):

1. Shoreline erosion,
2. Lack of aquatic plant diversity, and
3. Resident geese and gulls.

5.4.7 Other Lakes

Both Cranberry and Schreiber Lakes are ecologically diverse and harbor rare species. Threats to their water budget and water density from agriculture and urban development should be addressed.

5.5 STATUS OF BENEFICIAL USES

The status of beneficial stream and lake uses has been assessed for Squaw Creek, Long Lake and Round Lake by the IEPA and the LCHD, respectively. Table 5-7 shows their assessments.

Table 5-7: IEPA Status of Beneficial Uses

Beneficial Use	Squaw Creek	Long Lake	Round Lake
Overall	Partial/Minor	Partial/Minor	Partial/Minor
Fishing	Not Assessed	Not Assessed	Not Assessed
Aquatic Life	Partial/Minor	Full	Full
Swimming	Not Assessed	Partial/Minor	Partial/Minor
Water Supply	Not Identified	Not Identified	Not Identified
Recreation	Not Identified	Partial/Minor	Partial/Minor
Trend	Not Identified	Improving	Fluctuating

The IDOC first discussed the status of lake beneficial uses for the watershed in its 1972 report, "Lake County Surface Water Resources". Table 5-8 presents the results of that report for the lakes in the watershed as updated by the IDNR in 2004 to reflect current conditions.

Table 5-8: IDNR Lakes' Beneficial Use Assessment

Lake	Game Fish	Rough Fish	Fish Kill	Habitat	Access	Comments
Cranberry	Bass Bluegill	Yes	1945	Shallow	Private	None
Davis	Bass	No	1958	Shallow	Public	Severe Water Fluctuation
Highland	Bass Bluegill	Yes	No	Fair	Private	Aggressive Vegetation Management Recommended
Long	Bass Walleye	Yes	1998	Moderate	Public	Bass/Bluegill reported dead in Spring 1998
Rays	Bass	Yes	Yes	Moderate	Public	Small Shallow Lake Subject to Winterkill
Round	Bass Bluegill	Yes	No	Good	Public	Once a Commercial Carp Fishery, Urban Development Destroyed Critical Adjacent Wetlands

These results suggest that the water resources in the watershed are generally in good condition and are supporting the identified beneficial uses with only minor impairments.

However, consideration of a broader list of beneficial uses as identified in stakeholder meetings suggests a different picture. Table 5-9 presents a revised list of beneficial uses that includes stakeholder input.

Table 5-9: Status of Beneficial Uses Perceived by Stakeholders

Beneficial Use	Squaw Creek	Eagle Creek	Round Lake Drain	Long Lake	Round Lake
Drainage (No Flooding)	Threatened	Threatened	Not Attained	Moderate	Threatened
Drainage (Agricultural)	Attained	Attained	Attained	Attained	Attained
Game Fishing	Not Attained	Not Attained	Not Attained	Threatened	Threatened
Aquatic Life	Not Attained	Threatened	Not Attained	Attained	Attained
Swimming	Not Applicable	Not Applicable	Not Applicable	Threatened	Threatened
Wildlife Habitat	Not Attained	Threatened	Not Attained	Threatened	Threatened
Boating	Not Applicable	Not Applicable	Not Applicable	Attained	Attained
Canoeing	Not Attained	Not Attained	Not Attained	Attained	Attained
Riparian Activity	Not Attained	Not Attained	Not Attained	Threatened	Threatened
Pollutant Management	Not Attained	Threatened	Not Attained	Attained	Attained

This assessment shows a different picture than the IEPA approach. It is clear that a number of desired uses such as game fishing, wildlife habitat, canoeing, and riparian activities (picnicking and hiking) are not being attained. Adequate urban drainage also is not being attained because the existing resource in the Round Lake Drain and around portions of Long Lake has flooding problems.

5.6 CAUSES AND SOURCES OF USE IMPAIRMENTS

The causes and sources according to the IEPA are presented in Table 5-10.

Table 5-10: Causes and Sources of Squaw Creek Use Impairments (IEPA, 2002)

	IEPA		Long Lake	Round Lake
Causes		**Causes**		
Nutrients	Moderate	Nutrients	Moderate	Moderate
Siltation		Siltation	Slight	Slight
Organic Enrichment / Low DO		Organic Enrichment / Low DO	Slight	Slight
Suspended Solids		Suspended Solids	Slight	Slight
Noxious Aquatic Plants		Noxious Aquatic Plants	Slight	Moderate
Habitat Modification				
Sources		**Sources**		
Agriculture		Agriculture	Slight	Slight
Land Development		Land Development	Slight	Moderate
Urban Runoff / Storm Sewers	High	Urban Runoff / Storm Sewers	High	High
Septic Systems		Septic Systems	Slight	
Streambank / Shoreline Erosion		Streambank / Shoreline Erosion	Slight	
Contaminated Sediment		Contaminated Sediment	High	
Recreational Activities		Recreational Activities	High	Slight
Upstream Impoundment	Moderate	Upstream Impoundment	Slight	Slight

The above assessment notes that the major source of problems for the two lakes is urban stormwater runoff. The past effects of wastewater discharges to Long Lake are apparent in the contributions from contaminated sediment and recreational (boating) activities that would disturb these sediments. It is important to note that the above assessment does not consider habitat effects. The loss of critical wetland habitat was mentioned in Table 4-8 for Round Lake. The filling of these wetlands would never be allowed under current regulations but it is apparent that their loss has had an adverse affect on the Round Lake fishery. The normal water elevations of Long Lake, Round Lake and Highland Lake have remained similar for over 80 years. Long Lake's normal water elevation of 739.0 NGVD is the same as it was in 1920. Round Lake's current water elevation of 759.0 is two feet lower than in 1920. Highland Lake today is one foot higher at 739.0 than in

1920. This is true even though Long Lake installed a dam in 1930 and Round Lake installed a dam in the early 1950s.

Further analysis of the causes and sources of use impairment based on the data available in Chapter 4 and the assessment in this Chapter suggested several modifications to the above assessment. The IEPA did not have the Baxter data nor did they have the stream inventory work performed for this project among other data sources.

The wealth of data from the Baxter water quality sampling and previous efforts by the LCHD for runoff to Round Lake makes this task easier. Table 5-11 presents the annual loads from various sources at different locations in the watershed for TSS and TP. Current lake water column quality is presented for comparison as well.

Table 5-11: Pollutant Source Loads to Long and Round Lakes

Source	Concentration (mg/L)		Long Lake Load (lbs)		Round Lake Load (lbs)	
	TSS	TP	TSS	TP	TSS	TP
Agriculture/Stream Related						
Squaw Creek at Rte 134 (1)	42.0	0.107	1857000	4700		
Urban						
Round Lake Drain (1)	31.0	0.063	386000	780		
Drainage Channel (1.1 mi^2) (Shorewood & Leslie) (2)	31.3	0.11			60000	200
Renwood Tributary (1 mi^2) (Hainesville Road) (2)	46.2	0.12			80000	200
Dave's Channel (0.6 mi^2) (2)	59.5	0.16			62000	150
Rural						
Eagle Creek (1)	28.0	0.10	227000	770		
Geese (lbs/bird/year) (3)	100	0.3	50000	150	50000	150
Atmospheric Deposition						
Wetfall (lbs/acre/year) (4)	21.4	0.21	8000	80	5000	50
Dryfall (lbs/acre/year) (4)	90.3	0.60	34000	200	21000	150

(1) Baxter Study
(2) LCHD, 1989
(3) DuPage Environmental Commission, 1998
(4) Hey and Schaefer, 1983

The above results help to indicate the principal pollutant sources to the two major lakes in the watershed that have water quality problems. It does not take into account internal regeneration of TP. This is an important source in Long Lake as noted by LCHD (LCHD, 2002) Highland Lake is fortunate to not have serious water quality problems at this time (LCHD, 2002). The above analysis assumed an annual yield of 12 inches for each watershed and a resident goose population of 500. A discussion for Long and Round Lakes follows.

Use impairments due to milfoil also are an important issue for lakes in the watershed. More stringent management efforts to control zebra mussels also are needed. A more detailed discussion for Long and Round Lakes follows.

5.6.1 Long Lake

The analysis of pollutant loads by source for Long Lake indicates that the Mainstem and its predominantly agricultural inputs are the major source of TSS and TP to the lake at this time based on the Baxter data. Currently, Long Lake's epilimnion (the upper portions of lake water) TP is about 0.06 to 0.09 mg/l. Both the Mainstem and Eagle Creek mean concentrations are above this level, meaning that their inputs are worsening Long Lake TP levels. Interestingly, the Round Lake Drain TP level is 0.06 mg/l which means that the urban portion of the watershed, even without BMPs in place, is actually not worsening Long Lake TP levels.

This analysis suggests that the major effort to control TSS and TP for Long Lake should focus on the Mainstem and its agricultural activities. This is especially true since no farms are currently participating in available soil erosion control programs (LCSWCD, 2002). Eagle Creek should be the next priority. The effect of new development also needs to be considered since both the Mainstem and Eagle Creek will experience extensive development over the next twenty years. If TP levels in Long Lake are to meet a standard of 0.05 mg/l then discharges from agriculture and development should be near this number. Wetland detention basins designed to meet the WDO can produce an effluent in this range and would mimic the pre-development watershed hydrology. The benefits of partial retention basins should be investigated similar to Kane County's WDO requirements (KCSWC, 2000). Low impact development techniques also could prove

beneficial but the low infiltration capacity of the soils and geology of the watershed need to be considered (Prince George's County, 1999).

5.6.2 Round Lake

The pollutant loading source budget for Round Lake points to the need to retrofit BMPs in the watershed. All of the major subwatersheds to Round Lake contribute stormwater runoff that is significantly higher in TSS and TP than the epiliminion of Round Lake. The area currently in wetland or detention basins is less than one percent of the contributing watershed (LCHD, 1989).

Significant opportunities for retrofit may be available at the following locations.

- Gateway Pond,
- A series of ponds and detention basins to the northwest and including the Mallard Creek Shopping Center,
- The drainage channels tributary to the lake,
- Renwood Golf Course, and
- Bengson Park

Source control of phosphorus in this watershed also would benefit the lake. A more detailed audit of TP inputs to the lake and potential retrofit projects would be very beneficial to Round Lake in the long term.

5.6.3 Streams

Although water quality apparently is not limiting the beneficial uses of any of the creeks, the above analysis suggests where remedial actions should be prioritized (IDNR, 1997). Clearly, measures should be immediately taken to control agricultural pollutant loads. This includes 100 percent participation in soil erosion control programs and remedial actions such as reconnecting the streams to wetlands, streambank stabilization, on-line sediment basins, and riparian buffers.

The LCHD and Baxter water quality data also note that Long Lake and Round Lake have elevated TDS concentrations when compared to other lakes in the watershed (Tables 4-25

and 4-28). Long Lake, in particular, is at nearly 600 ppm TDS which is twice the level of other lakes in the watershed. Round Lake is at nearly 500 ppm TDS.

The Round Lake levels might be explained by road salting activity. The Baxter data for the Round Lake Drain show TDS levels of about 650 ppm.

The Long Lake levels are not as easily explained. The Squaw Creek water quality data are all below Long Lake levels with one exception, the Squaw Creek tributary at Nippersink Road. Although the Round Lake Drain mean TDS is 10 percent higher than Long Lake it is only about 12 percent of the watershed. The Squaw Creek tributary is at nearly 1000 ppm TDS. This suggests a very significant source. This source should be identified and corrected, if possible.

Based on the above assessment, the principal sources of various constituents to key resources in the watershed are summarized in Table 5-12.

Table 5-12: Principal Constituent Sources

Location	TSS	TDS	TP	NO_3	Metals
Long Lake	• Agriculture • Streambank Erosion	• Unknown Source on Nippersink Trib • Road Salt	• Agriculture • Streambank Erosion	• Agriculture	Urban Runoff
Round Lake	• Urban Runoff • Streambank Erosion	Road Salt	• Urban Runoff • Streambank Erosion	• Urban Runoff • Agriculture	Urban Runoff
Highland Lake	• Urban Runoff	Road Salt	Urban Runoff	Urban Runoff	Urban Runoff
Squaw Creek					
Route 60	Agriculture	Road Salt	Agriculture	Agriculture	Urban Runoff
Route 120	• Agriculture • Streambank Erosion	Road Salt	• Agriculture • Streambank Erosion	Agriculture	Urban Runoff
Route 134	• Agriculture • Streambank Erosion	Road Salt	• Agriculture • Streambank Erosion	Agriculture	Urban Runoff
Nippersink	Agriculture	• Unknown • Road Salt	Agriculture	Agriculture	Urban Runoff
Round Lake Drain below Round Lake	• Urban Runoff • Streambank Erosion	Road Salt	• Urban Runoff • Streambank Erosion	Urban Runoff	Urban Runoff
Eagle Creek	• Streambank Erosion • Agriculture	Road Salt	• Streambank Erosion • Agriculture	• Urban Runoff • Agriculture	Urban Runoff

Less emphasis should be placed on the findings for the stream segments. This is because the beneficial uses of these streams are not limited by water quality at the levels found by Baxter, IDOT and LCHD. The results are more critical for the lakes, especially Long and Round. The results indicate that both of these lakes continue to act as sinks for TSS, TP and nitrogen. Constituent concentrations and loads are above background concentrations in both of these lakes. This indicates a long-term trend toward worsening in-lake water quality and a deterioration in beneficial uses. Each of these lakes also has specific in-lake problems that appear to be of higher priority than influent water quality but it is an issue nonetheless.

5.7 PROBLEM ASSESSMENT CONCLUSIONS

A discussion of the conclusions of the problem assessment for the beneficial uses of the Squaw Creek Watershed stream segments and lakes is presented in Table 5-13 for the Mainstem, in Table 5-14 for Eagle Creek, in Table 5-15 for the Round Lake Drain in Table 5-16 for Long Lake and Table 5-17 for Round Lake.

Table 5-13: Status of Mainstem Beneficial Uses

Use	Status
Flooding	Flood damages are not a significant issue on the mainstem. The floodplain definition is current and was performed using current technology. A floodway has been defined. The WDO restricts development in the floodplain. The current WDO detention requirement is adequate to prevent any increase in flooding due to new development including volume effects.
Drainage	Past agricultural development has provided adequate drainage for agriculture through farm tiles, ditches and channelization. With regular maintenance the system provides adequate capacity to allow productive farming.
Aquatic Habitat	Aquatic habitat is largely non-existent in the Mainstem. The stream is largely a trapezoidal channel cut through wetlands and uplands to provide agricultural drainage. It is regularly maintained by removal of any woody debris to ensure that farm tiles can drain freely. This use is currently legally and practically servient to the agricultural drainage use. Significant isolated areas of wetland and pond habitat exist in the mainstem but they have been fragmented by the creation of the agricultural drainage system.
Riparian Habitat	Most of the Mainstem riparian zones are in agriculture. A narrow band of woody vegetation exists along either side of most of the channel with farm fields immediately adjacent. In short, Riparian habitat is poor or missing for most of the Mainstem.
Game Fishing	The lack of instream aquatic habitat and the fragmentation of the pre-settlement wetlands and riparian zones has resulted in a degraded fishery. The lack of habitat and the volatile flow conditions were all cited by the IDNR as the reasons for lack of either a diverse macroinvertebrate community or a game fishery.
Swimming	This use is not a historic nor feasible use for the Mainstem.
Boating	This use is not feasible for the Mainstem due to channel size and flow conditions.
Canoeing	This use is limited by lack of access and volatile instream hydrology. There is inadequate baseflow in the system to allow canoeing due to the modifications made to promote agricultural drainage.
Pollutant Management	The fragmentation and channelization of the Mainstem to improve drainage severely limits its capacity to settle and hold sediment and associated pollutants. About 30 percent of the watershed enters the Mainstem without contacting wetlands or depressional storage areas where runoff is detained and pollutants can settle. This is very different than the pre-settlement watershed where runoff from most events moved slowly through a series of wetlands and ponds rather than an incised channel. Opportunities exist to reconnect the channel to wetlands.
Open Space and Greenway	There is still an opportunity to link LCFPD holdings with floodplains, wetlands and other public open space to create a continuous greenway. This greenway could be used to protect threatened and endangered species and habitat.

Table 5-14: Status of Eagle Creek Beneficial Uses

Use	Status
Flooding	Flood damages are not a significant issue on Eagle Creek. However, the floodplain definition is old (1979) and was performed using unacceptable technology by WDO standards. A floodway has been defined. The WDO restricts development in the floodplain. The current WDO detention requirement is adequate to prevent any increase in flooding due to new development, including volume effects. Most development in this watershed occurred after WDO implementation and after Corps of Engineers protection of wetlands.
Drainage	Past agricultural drainage development through farm tiles, ditches, and channelization has degraded significantly in this watershed. The system no longer provides adequate capacity to allow productive farming in many drained wetland areas along Eagle Creek. The extent of agricultural drainage modifications is less than the Mainstem watershed because Eagle Creek provided a natural drainage conduit.
Aquatic Habitat	Significant aquatic habitat is present in Eagle Creek. The stream is relatively natural with only about 10 percent channelized. About 50 percent of the channel contains pools and riffles and other significant habitat features. About 25 percent of the stream bottom is cobble and gravel. The stream inventory work suggests that it probably would be rated a C if not a B stream in selected segments. Significant isolated areas of wetland and pond habitat exist in the Eagle Creek watershed and many remain connected as part of riparian zones.
Riparian Habitat	Only 20 percent of the Eagle Creek riparian zones are in agriculture. Significant wetlands that are part of regional storage locations exist along either side of the channel. Riparian habitat has been preserved from the effects of residential development by the WDO buffer requirements.
Game Fishing	With the phase-out of the Lake Villa wastewater treatment plant discharge, Eagle Creek appears to have the habitat structure and water quality to support a warm water fishery consistent with a stream of this size. Game fishing is not likely because of the size of the stream and lack of access, but the creek can provide a nursery for fry and baitfish.
Swimming	This use is neither a historic nor a feasible use for Eagle Creek.
Boating	This use is not feasible for Eagle Creek due to channel size and flow conditions.
Canoeing	This use is limited by lack of access and lack of adequate instream hydrology. There is inadequate baseflow in the system to allow canoeing due to the size of the stream.
Riparian Activity	Most of the length of Eagle Creek is in private ownership. Although the LCFPD has significant holdings in the watershed they include only 20 percent of the length of Eagle Creek. Lack of access, outside the LCFPD, limits this use. If access could be improved there are significant areas that could support this use.
Pollutant Management	Eagle Creek has excellent capacity to settle and hold sediment and associated pollutants. About 75 percent of the watershed flows directly into wetlands or depressional storage areas where runoff is detained and pollutants can settle. Slight instream modification could assure that runoff from most events will move slowly through a series of wetlands and ponds rather than the channel of Eagle Creek. This must be done without increasing flooding. Most of the development in the Eagle Creek watershed flows into wet or wetland detention basins built to meet WDO requirements. These basins also provide water quality treatment of urban runoff.

Table 5-15: Status of Round Lake Drain Beneficial Uses

Use	Status
Flooding	Flood damages are a significant issue on the Round Lake Drain with approximately 366 structures in the floodplain. The floodplain definition is old (1979) and was performed using techniques that would not be acceptable under the current WDO. A floodway has been defined. Most of the flooding in the watershed is the result of structures being built in the floodplain prior to the definition of flood zones. The WDO restricts current development in the floodplain but most of the watershed was developed prior to its adoption. The current WDO detention requirement is adequate to prevent any increase in flooding due to new development including volume effects. A flood audit is needed after a new floodplain is defined to assess flooding solutions including buyouts.
Drainage	Past agricultural development created drainage for agriculture through farm tiles, ditches and channelization. This system now supports an urban watershed that has replaced the farm fields of the late 1800s and early 1900s. This new demand has resulted in significant drainage and flood conveyance problems. There is a general lack of data on the existing drainage system and more detailed study is needed.
Aquatic Habitat	Aquatic habitat is largely non-existent in the Round Lake Drain. The stream is largely a trapezoidal channel cut from the historic outfall connection between Round Lake and Long Lake to provide first agricultural and now urban drainage. Some isolated areas of wetland and pond habitat exist off the main channel but they have been isolated by the creation of the drainage system.
Riparian Habitat	Most of the Round Lake Drain riparian zones are urban. A narrow band of woody vegetation exists along either side of the channel downstream of Round Lake with houses and other urban land use immediately adjacent. In short, riparian habitat is poor or missing for most of the Round Lake Drain.
Game Fishing	The lack of instream aquatic habitat and the fragmentation of the pre-settlement wetlands and riparian zones has resulted in a degraded fishery. The lack of habitat and the volatile flow conditions are all reasons for lack of either a diverse macroinvertebrate community or a game fishery.
Boating	This use is not feasible for the Round Lake Drain due to channel size and flow conditions
Riparian Activity	Virtually all of the length of the Round Lake Drain is in private ownership. The LCFPD and local open space agencies have almost no holdings in the watershed except for Renwood golf course. Lack of access and the unaesthetic state of the Round Lake Drain limit this use. Most of the Round Lake Drain remains a ditch with little or no riparian vegetation on its sideslopes and little habitat value.
Pollutant Management	The fragmentation and channelization of the Round Lake Drain to improve drainage severely limits its capacity to settle and hold sediment and associated pollutants. About 45 percent of the watershed enters the Round Lake Drain without contacting wetlands or depressional storage areas where runoff is detained and pollutants can settle. This is very different than the pre-settlement watershed where runoff from most events moved slowly through a series of wetlands and ponds rather than an incised channel. Development in the watershed also occurred without adequate detention to mitigate urban runoff pollutants. For most of the watershed pollutants enter the stream directly from storm sewers, tiles and ditches.

Table 5-16: Status of Long Lake Beneficial Uses

Use	Status
Flooding	Flooding is a significant issue on Long Lake with approximately 100 structures in the floodplain. The floodplain definition is old (1979) and was performed using techniques that would not be acceptable under the current WDO. A floodway has been defined. Most flooding on Long Lake results from structures being built in the floodplain prior to the definition of flood zones. The WDO restricts current development in the floodplain but most of the watershed was developed prior to its adoption. The current WDO detention requirement is adequate to prevent any increase in flooding due to new development including volume effects.
Drainage	Long Lake receives all agricultural drainage in the watershed. Its normal water elevation and conveyance is the same now as when a dam was installed in 1930.
Aquatic Habitat	Aquatic habitat was severely stressed in Long Lake by the discharge of nutrient-rich wastewater from Lake Villa and the Round Lake S.D. IDOC suggested that complete rehabilitation of the entire lake was needed in 1972. Algae blooms were a severe problem in terms of light penetration and consumption of dissolved oxygen. With the removal of these wastewater discharges, Long Lake has largely recovered and aquatic habitat has improved dramatically. Improvements to this use are dependent on control of nutrient rich sediment in the lake and weeds.
Riparian Habitat	Most of the Long Lake riparian zones are urban. A narrow band of woody vegetation exists along either side of about 40 percent of the shoreline, with houses and other urban land use immediately adjacent. Riparian habitat is poor or missing for most of the Long Lake shoreline.
Game Fishing	The improvement in aquatic habitat has improved the fishery of Long Lake. The LCHD reports that the current fishery is populated by 15 species, and the DNR recommended that aquatic vegetation monitoring and control programs, as well as fish length and catch limits, be instituted at Long Lake.
Swimming	Swimming is currently a fully attained use on Long Lake with no recently reported beach closings. Control of urban runoff and septic system discharges is needed to improve the ability to swim in Long Lake.
Boating	Power boating is fully attained on Long Lake, although it conflicts at times with weed control by props cutting and spreading milfoil. Boating also may resuspend nutrient laden sediment. All Long Lake access points are privately owned.
Canoeing	This use is fully attained on Long Lake except to the extent it conflicts with boating.
Riparian Activity	Most of the Long Lake shoreline is privately owned. Local open space agencies have no holdings around the lake. Lack of access and suitable sites limits this use.
Pollutant Management	Long Lake acts as a sink to capture and retain most of the sediment and adsorbed pollutants that enter it from the three watersheds. The relative abilities of these three watersheds to trap pollutants before they reach Long Lake was discussed earlier. In summary, the improvement of drainage in the Mainstem for agriculture and the Round Lake Drain for agriculture and then urban development has added pollutant loads from runoff to the lake. Much of the watershed enters Long Lake without contacting wetlands or depressional storage areas where runoff could be detained and pollutants could settle. This is very different than the pre-settlement watershed where runoff from most events moved slowly through a series of wetlands and ponds rather than an incised channel. Development in the watershed also occurred without adequate detention to mitigate urban runoff pollutants. The full attainment of beneficial uses on the lake requires that sustainable solutions be implemented to control these runoff pollutants. In particular the Baxter water quality data indicates that the mainstem is the major source of phosphorus to Long Lake. The Baxter data also show that agriculture is the major source of TP to Long Lake. High TDS inputs from the Squaw Creek Tributary require further investigation.

Table 5-17: Status of Round Lake Beneficial Uses

Use	Status
Flooding	Flood damages are not a significant issue on Round Lake with no structures in the floodplain. The floodplain definition is old (1979) and was performed using techniques that would not be acceptable under the current WDO. The WDO restricts current development in the floodplain but most of the watershed was developed prior to its adoption. The current WDO detention requirement is adequate to prevent any increase in flooding due to new development including volume effects.
Drainage	Round Lake receives little agricultural runoff since most of its watershed urbanized between 1950 and 1980. Its normal water elevation is about two feet lower but its conveyance is the same now as when a dam was installed in the early 1950s.
Aquatic Habitat	Aquatic habitat was severely stressed in Round Lake by the urbanization of the watershed and in particular the loss of wetlands that were connected to the lake (IDOC, 1972). IDOC in 1972 suggested that these wetlands provided a spawning area for pike and other gamefish and refuge for baitfish. The lake currently supports a modest fishery.
Riparian Habitat	Most of the Round Lake riparian zones are urban. Riparian habitat is poor or missing for most of the Round Lake shoreline.
Game Fishing	The LCHD is scheduled to reassess Round Lake in 2003. Current known impairments are related to lack of habitat and heavy fishing pressure.
Swimming	Swimming is currently a fully attained use on Round Lake with only 1 beach closing reported in the past year due to high bacteria counts. Control of urban runoff and septic system discharges is needed to improve the ability to swim in Round Lake.
Boating	Power boating is a fully attained use on Round Lake. However, this use conflicts at times with weed control by props cutting and spreading milfoil. Boating also may contribute to turbidity as a result of prop action in shallow areas. Public boat docks are located at several locations.
Canoeing	This use is fully attained on Round Lake except to the extent it conflicts with boating.
Riparian Activity	Most of the length of the Round Lake shoreline is in private ownership. The LCFPD and local open space agencies have no holdings around the lake. Lack of access and suitable sites limits this use.
Pollutant Management	Round Lake acts as a sink to capture and retain most of the sediment and adsorbed pollutants that enter it from its 2000 acre watersheds. Round Lake has the advantage that Highland Lake and Cranberry Lake and since 1995, Hook's Lake are upstream and act to capture runoff from a large part of the watershed before it reaches the lake. The urban development of the Round Lake watershed has added pollutant loads from runoff to the lake. About 70 percent of the watershed enters Round Lake without contacting wetlands or depressional storage areas where runoff is detained and pollutants can settle. This is very different than the pre-settlement watershed where runoff from most events moved slowly through a series of wetlands and ponds rather than storm sewers. Development in the watershed also occurred without adequate detention to mitigate urban runoff pollutants. For about 50 percent of the watershed pollutants enter the lake directly from storm sewers, tiles and ditches. The full attainment of beneficial uses on the lake requires that sustainable solutions be implemented to control these runoff pollutants. In particular, 1989 water quality monitoring by the LCHD indicate the surrounding watershed is the largest source of TP to the Lake. High TDS from road salting also needs to be addressed.

CHAPTER 6
GOALS AND OBJECTIVES

6.1 DEVELOPMENT OF GOALS AND OBJECTIVES

The Lake County Stormwater Management Commission (SMC) organized a committee of watershed stakeholders in December 2001 for the purpose of soliciting input throughout the development of the Squaw Creek Watershed Management Plan. The committee of stakeholders was developed with the intention of including representation from the broad spectrum of groups affected by watershed-related decisions, including:

- Residents,
- Municipal and township governments,
- Regulatory agencies,
- Developers,
- County, state, and federal elected officials,
- The business community,
- Environmental interest groups, and
- Regional planning agencies.

6.2 PLAN GOALS

At the first stakeholder meeting, the group was given the opportunity to provide input on all of their watershed-related concerns. Each attendee was given the opportunity to prioritize the list of concerns by assigning points to their highest priority concerns. The individual points were combined to create an overall list of concerns prioritized by their cumulative point totals. A summary of the outcome is provided in Appendix M.

Based on the concerns raised at the first meeting, goals for the Plan were developed. These goals provide a "first glance" vision of the Plan's purpose. The five goals for the Plan are provided below. Each goal is followed by a brief explanation of the goal's intent.

Goal Number 1: Reduce existing flood damage potential and prevent the creation of increased flood damage potential.

The Plan should identify existing flood damage locations within the watershed based on historic data, including reported flood damages, and identify ways to reduce the flood damages at these locations in the future. The Plan should also identify ways to prevent the creation of new flood damage problems in the watershed.

Goal Number 2: Improve water quality in the watershed's streams and lakes.

The Plan should identify the existing level of water quality in the watershed's streams and lakes based on available data. It should also list existing water quality data needs. Based on the available data, the Plan should identify sources of water quality degradation, ways to reduce additional degradation, and opportunities to improve the water quality.

Goal Number 3: Preserve, protect, and enhance existing natural areas; and restore or create new, sustainable natural areas

The Plan should identify existing natural areas in the watershed. A methodology should be developed to prioritize the natural areas that should be preserved, and this methodology should be applied to the natural areas identified within the watershed.

Natural areas should be preserved in a sustainable and beneficial manner. "A sustainable and beneficial manner" is meant to imply that the natural area preservation and protection strategy will have long-term effects, and the natural areas will not degrade.

Natural areas should be preserved and protected in ways that will allow them to function as they do in healthy watersheds. The United States Environmental Protection Agency (USEPA) describes watershed health as "the relative ability of the watershed to perform its natural and historic functions such as: supply clean water, provide habitat, support biodiversity, and control erosion and flooding; as well as provide useful functions such as recreational and agricultural activities."

The Plan should also identify open space areas that are exist within the watershed and identify opportunities to restore or create new, sustainable natural areas.

Goal Number 4: Develop and utilize tools for Plan implementation.

The Plan should identify existing funding mechanisms that can be pursued for implementation of the Plan. It should also provide suggestions for funding mechanisms that could be developed to promote Plan implementation. Example: a municipality may dedicate an annual budget to Plan implementation or organize fundraising efforts for specific watershed projects.

The Plan should also identify additional tools that can be developed to increase Plan implementation. These tools might include supplemental documents, improved communication and coordination within the watershed, data collection, or simply updating the Plan as necessary.

Goal Number 5: Involve the public in the use and stewardship of the Squaw Creek watershed

The Plan should identify ways to involve the public with the water resources and natural areas in the watershed (e.g. trails, volunteer opportunities, hands-on educational opportunities, etc.). Stakeholders will be more likely to become stewards if they develop a relationship with the watershed. The Plan should identify ways to educate the public about watershed issues and how they can be involved. Public information topics and strategies for distributing public information should be compiled.

6.3 PLAN OBJECTIVES

Based on the goals defined by the stakeholder group and the concerns from the first meeting, objectives were developed for each goal. The objectives were discussed at numerous meetings. As more data became available, the goals and objectives were modified to address specific problems and opportunities in the Squaw Creek watershed. The objectives add definition to the goal statements and provide specific, identifiable components of achieving the goals.

The final version of the objectives developed by the stakeholder committee is provided below. The Action Plan chapter of this plan provides specific actions that can be undertaken to achieve the objectives.

OBJECTIVES

(Note: Objectives are not listed in priority order)

Goal Number 1: Reduce Existing Flood Damage Potential and Prevent the Creation of Increased Flood Damage Potential

Objective 1A: Identify existing sources of flooding, historic damages associated with flooding, and properties with flood damage potential.

Objective 1B: Prevent the creation of new flood damage problems through the implementation of regulatory provisions.

Objective 1C: Reduce existing flood damage potential through the implementation of flood damage reduction projects.

Objective 1D: Utilize the "Green Infrastructure" concept to protect and enhance the natural components of the drainage system.

Objective 1E: Investigate the management of lake levels to reduce flooding.

Goal Number 2: Improve Water Quality in the Watershed's Streams and Lakes

Objective 2A: Assess the water quality in the watershed's streams and lakes.

Objective 2B: Protect water resources from sedimentation due to soil erosion.

Objective 2C: Maintain or improve the water quality of stream reaches and lakes whose beneficial uses are not currently water quality impaired.

Objective 2D: Improve the water quality of lakes and stream whose beneficial uses are water quality impaired.

Goal Number 3: Preserve, protect, and enhance existing natural areas; and restore or create new, sustainable natural areas

Objective 3A: Inventory and evaluate open space and natural areas in the watershed, and prioritize protection, preservation, and enhancement efforts.

Objective 3B: Maintain the functional values of existing natural resources.

Objective 3C: Enhance all streams in the watershed to a Biological Stream Characterization rating of "C" (Moderate Aquatic Resource) or better.

Objective 3D: Develop and implement strategies for balancing the uses and demands on the watershed's resources

Objective 3E: Attain full, unimpaired use of the lakes in the watershed.

Goal Number 4: Develop and Utilize Tools for Plan Implementation

Objective 4A: Develop and pursue funding mechanisms for implementation of the Plan.

Objective 4B: Develop cross-coordination between agencies, units of government, and the public.

Objective 4C: Pursue adoption of the plan at the local level.

Objective 4D: Develop documents that can supplement the Plan and be used as tools to facilitate plan implementation.

Objective 4E: Develop a list of potential roadblocks to Plan implementation and a management strategy for dealing with those roadblocks.

Objective 4F: Develop a long-term data collection program for the watershed.

Objective 4G: Assess Plan implementation and update Plan on a defined schedule.

Objective 4H: Organize the plan in a usable format to facilitate implementation.

Goal Number 5: Involve the public in the use and stewardship of the Squaw Creek Watershed

Objective 5A: Provide schools with a resource information sheet for developing watershed-related curriculum.

Objective 5B: Publicize watershed-related activities and make watershed-related educational materials available to the public.

Objective 5C: Provide information on what residents can do individually to improve the watershed in a simple format that could be distributed to all residents.

Objective 5D: Attempt to directly involve the public in watershed improvement activities.

Objective 5E: Increase the stakeholders' awareness of the watershed's natural areas and water resources.

Objective 5F: Increase the stakeholders' experiential use of the watershed's natural areas and water resources.

CHAPTER 7
ACTION PLAN

7.1 INTRODUCTION

This chapter presents the recommended action plan for the Squaw Creek watershed. The Action Plan is organized by subject area with a tabulation of action items, priority, conceptual cost, and responsible parties. The Action Plan is designed to address the causes and sources of beneficial impairments identified in Chapter 5. It also presents a program to assist with Plan implementation. The recommended actions are provided in an outline format at the end of this chapter.

7.2 FLOODING

The Action Plan for Flooding presents recommendations in a logical sequence to eliminate flooding for the 100-year event for the watershed. This section starts with recommendations to better define the flooding problem in the watershed followed by recommended solutions that need to be evaluated once better data is available. It concludes with recommendations for actions that will be beneficial regardless of the solution chosen to reduce flood risk. Many of the recommendations cut across other important plan goals such as water quality and natural resources. Where this is true it is noted. The highest priority tasks, recommended project lead and conceptual cost estimates are presented in Table 7-1.

7.2.1 Floodplain Studies

Basic data defining flood risk and damage have not been updated since 1979 for the Round Lake Drain and Eagle Creek. Updates using current rainfall recurrence data and better definition of the watershed are needed. Current rainfall estimates for flood risk are 10 to 20 percent higher than the same estimates in 1979. LCSMC now has better topographic information available to define the watersheds. Efforts similar to LCSMC's study of the Mainstem are needed all the way through Long Lake.

7.2.2 Flood Audits

Once better data on flood risk elevations has been developed it needs to be compared to the elevation of buildings and roads in the watersheds to define which structures and properties will flood. This will be done in new flood audits for the two watersheds. This also will help to define the amount of damage likely to be suffered during different recurrence flood events.

7.2.3 Flood Damage Reduction Analysis

Once the above studies are completed, structural and non-structural flood damage mitigation measures will need to be evaluated. The Plan recommends a number of regional detention sites that would need further technical and administrative study prior to implementation. These sites could store water to reduce the rate of flood flow and thereby reduce flood elevations. The Plan also recommends measures be evaluated to increase the capacity of the Round Lake Drain or to route high flows out of the drain into temporary storage to reduce flooding on Long Lake. Finally, the Plan also recommends evaluation of levees or walls that could prevent flood water from reaching residences.

Evaluation of the flood damage reduction potential of the conceptual sites shown on the next several pages is recommended. The evaluation of the recommended sites was beyond the scope of this Plan but as many candidate sites as seemed feasible were identified for future evaluation. The feasibility of using any site includes positive landowner interest, and the Plan recommends that landowners be contacted prior to further consideration as a potential project site.

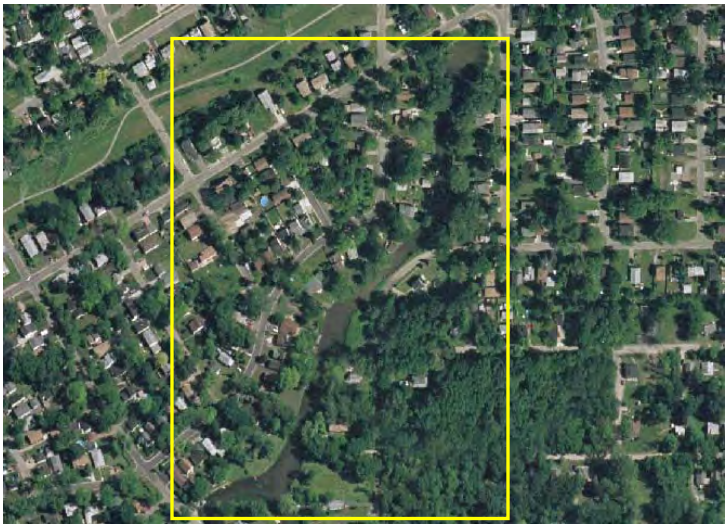
The Village of Round Lake Beach public works director has indicated that frequent flooding north of Round Lake has been reduced by the construction of Hook's Lake in 1994. This detention area provides about 200 acre-feet of storage for the 100-year event and controls discharges from the 500-acre watershed north of Rollins Road.

Potential locations for storage or mitigation wetlands in the Round Lake Drain watershed include:

1. Evaluate increased detention capacity in the area north of Highland Lake and east of Round Lake. This could be accomplished either in the Renwood Country Club golf course area or in the forested open space west of Hainesville Road and north of Lake Avenue.

Conceptual Location Only

2. Evaluate levees around the inlet area west of West End Drive.



Conceptual Location Only

3. Evaluate a large storage area between Sunset Drive and Lotus Drive.

Conceptual Location Only

4. Evaluate increased conveyance in the tributary to Round Lake Drain through dredging or channelization. This would alleviate the significant local flooding that takes place in the neighborhoods in the northern part of the Round Lake Drain watershed. If this were done in combination with the storage area between Sunset Drive and Lotus Drive (item #3), the new detention area would receive the additional flow from the tributary.

Conceptual Location Only

1. Evaluate increased conveyance in the Round Lake Drain main channel between Lotus Drive and Fairfield Road.

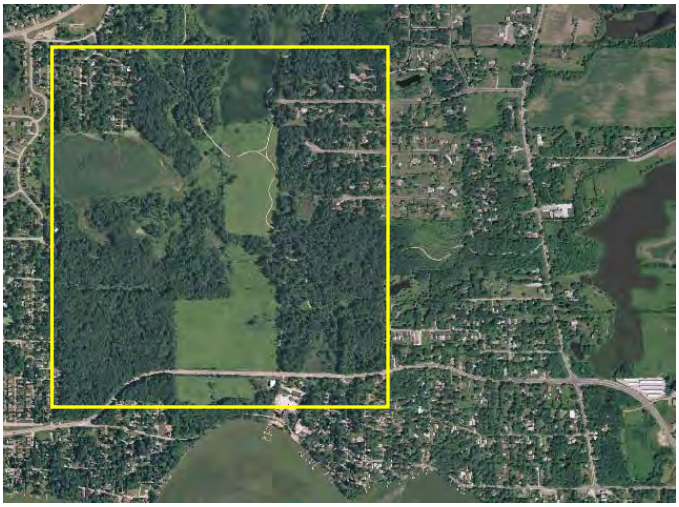
Conceptual Location Only

2. Evaluate a channel to direct major flood flows from the Round Lake Drain into the wetland complex south of Long Lake, along the Squaw Creek mainstem. A control structure could be placed to maintain current typical flows in the Round Lake Drain and only redirect high flows to the Squaw Creek complex. This would accommodate increased upstream conveyance.

Conceptual Location Only

Potential locations for storage or mitigation wetlands in the Eagle Creek watershed include:

1. Grant Woods Forest Preserve, just north of Long Lake.



Conceptual Location Only

2. The wetland / lake area along the mainstem, just east of Fairfield Road.

Conceptual Location Only

3. The area along the mainstem just north of Monaville Road.

Conceptual Location Only

Potential locations for stormwater storage or mitigation wetlands in the Squaw Creek mainstem watershed include:

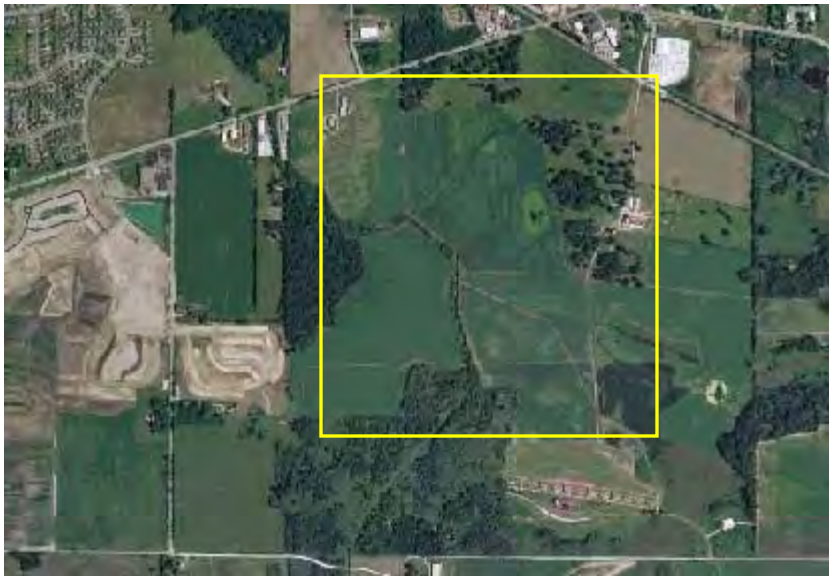
1. The wetland/lake area directly south of Long Lake

Conceptual Location Only

2. South of Nippersink and just west of Cedar Lake Road

Conceptual Location Only

3. South of Belvidere Road (Hwy 120) and north of the Northbrook Sports Club



Conceptual Location Only

4. Directly southwest of Campbell Airport

Conceptual Location Only

7.2.4 Lake Management to Reduce Flooding

The role that Round Lake, Highland Lake and Long Lake water level management can play in mitigating flood damage is recommended for evaluation. In particular, round Lake has a very large amount of flood storage available with only a one-foot drop in

normal water level. Similarly, a one-foot, or less, drop in the normal water elevation of Long Lake may have a very big effect on the number of structures in the floodplain since the floodplain also would drop one foot. This needs to be carefully evaluated for potential impacts to lake usage and property owners.

7.2.4 Drainage Improvements

Comprehensive drainage studies in concert with floodplain studies are needed in the Round Lake Drain to address flooding associated with inadequate drainage capacity and depressional flooding. Although most of the communities in the watershed are updating their storm sewer inventories, more work is needed. Because much of the watershed still relies on farm tiles for drainage it would help to create a repository for all data that is generated by new development and all known data. The use of GIS could help to organize this data and make it available to all of the communities. Finally, it is important that the current green infrastructure in the watershed is preserved and that channel capacity is maintained to prevent increased flood heights. However, any channel cleaning should be done in a manner that preserves as much aquatic habitat as possible. Guidance specific to the watershed is needed for this and should be developed jointly with LCSMC, the Squaw Creek Drainage District and public works departments.

7.3 WATER QUALITY

The Action Plan for water quality focuses on the attainment of beneficial uses currently impaired by water quality. The recommendations in Table 7-2 call for specific and general actions to address the sources of water quality constituents that are impairing beneficial uses.

7.3.1 Increased Monitoring

The data collection effort by Baxter Healthcare has pointed to the importance of having good data on pollutant sources and stream and lake conditions. To ensure that a baseline of good data is available to monitor watershed health and the impact of remedial measures the following continuing data collection program is recommended.

A Riverwatch program should be instituted for each of the three watersheds. This volunteer effort will provide basic data on stream conditions through school supported programs. It is important that each lake in the watershed have a volunteer lake monitor to record lake clarity and conditions. Participation in the Volunteer Lake Monitoring Program is an excellent way to track lake health.

Additional stream gages to record watershed hydrology would be extremely beneficial. Gages on the Round Lake Drain, Eagle Creek and Long Lake could provide important data for updated flood model calibration.

Water quality monitoring on a periodic basis also would be beneficial to record watershed conditions. Several low flow events and one or more high flow events for each of the three watersheds for TSS, TP, NO3 and perhaps TDS would not require an extensive effort but would provide some data on watershed health. Laboratories at LCHD and LCPWD may be able to assist. Finally, an annual survey of the aquatic ecology of each stream would be the single most important monitoring program because it would give a ready picture of each of the three streams health. This could be supplemented by a fish survey every three years.

7.3.2 Soil Erosion and Sediment Control

The Plan recommends several actions to reduce erosion and to enhance sediment control. The recommendations are divided into urban and agricultural. The urban recommendations are certification of erosion control inspectors and an increased level of effort for monitoring erosion control implementation and Stormwater Pollution Prevention Plans mandated by IEPA for development over one acre. A study of WDO ordinance changes that establish maximum sediment discharge concentrations up to the 10-year event is recommended. The agricultural recommendations are to increase the enrollment of farms in soil erosion programs available through NRCS and LCSWCD such as Conservation Reserve Program and conservation tillage and the second recommendation is the development of increased riparian buffers and grassed waterways in agricultural areas.

7.3.3 Implementation of Stormwater NPDES Phase II

The action recommendations for implementation of NPDES Phase II are recitations of the federal permit requirements for owners of stormwater point (sewers) source discharges. These include identification of sewer locations (under the Drainage recommendations), safe storage, handling and application of chemicals such as road salt, herbicides, pesticides and fertilizers.

7.3.4 Stormwater Management Retrofit Projects

The major focus of these remedial actions is for Long Lake and Round Lake. Preventive actions are recommended for the entire watershed. Action recommendations call for water quality BMP retrofits to detention basins, especially pre-WDO detention basins in the Round and Long Lake watersheds. A detention basin inventory was completed for the watershed, and Appendix G provides a list of suggested detention basin retrofits.

Streambank stabilization is another type of "retrofit" recommended. Eroded streambanks can be stabilized and retrofit to include native vegetation that will help improve water quality. Round Lake Drain has been identified as a prime opportunity to retrofit an existing channel to improve water quality and wildlife habitat.

Several site-specific, wetland-related water quality project opportunities have been identified in the watershed. Potential projects identified for each of the major tributaries include (if feasible):

- Replacing an existing restrictive storm sewer with a treatment wetland on Round Lake Drain at Mayfield Drive,
- Routing Eagle Creek into a treatment wetland near its mouth in the Grant Woods Forest Preserve, and
- Improving the water quality treatment capacity of Mud Lake for Squaw Creek discharges.

7.3.5 Lake Diagnostic Studies

The plan recommends a diagnostic study to supplement the LCHD efforts for Long Lake. The study would focus on selecting the best approach to managing nutrient concentrations in the lake especially from in-lake phosphorus. This diagnostic study would better define the importance of pollutant sources and the benefits of specific remedial actions.

7.4 NATURAL RESOURCES

The natural resources recommendations in the Action Plan focus on the recognition of the existing high quality resources in the watershed and their preservation and enhancement through the adoption of a Squaw Creek Greenway Plan and the implementation of habitat restoration features. Table 7-3 presents the Natural Resources Action Plan recommendations.

7.4.1 Streambank Stabilization

Stabilization of severely eroding streambanks identified in the stream inventory of Chapter 3 is a priority for the plan. Over 6,400 feet of severely eroding streambanks were identified for the Mainstem, 2,400 feet for the Round Lake Drain, and 3,300 feet for Eagle Creek. Most of these areas can be repaired and stabilized using native vegetation and do not require hard-edge protection measures like riprap.

One project location highly recommended for ecological restoration is the Round Lake Drain. Opportunities for streambank stabilization using bioengineered methods exist throughout the stream reach between Round Lake and Long Lake. Due to the nature of the existing channel, this stream reach provides opportunities for streambank stabilization, natural habitat creation, the addition of meanders, and incorporation of pool-riffle complexes.

7.4.2 Habitat Restoration

The Plan recommends a number of specific habitat restoration opportunities that also could benefit water quality and flooding. Along Round Lake Drain, the replacement of

an existing restrictive storm sewer with a constructed wetland is recommended at Mayfield Drive. On the Mainstem these projects include re-connecting wetlands to the agricultural ditch that is Squaw Creek at that point in the watershed and reconnection of Squaw Creek to the Big Sag wetland between Routes 120 and 60. On Eagle Creek the major project recommended for evaluation is the re-connection of the Creek to drained hydric soil within the Grant Woods Forest Preserve. Other smaller projects are possible throughout the watershed as well.

The Plan also recommends the creation of habitat within the channelized sections of the three watersheds. The IDNR has stated and stream surveys confirmed that there is a great lack of habitat in the streams in the watershed. The bottoms of the Mainstem and Round Lake Drain are filled with silt and in many reaches are ditches whose bottoms are soft sediment. The Plan proposes to add pool and riffle complexes to increase habitat diversity. Addition of structure such as cobbles and small changes in elevation will add living space for benthic organisms. This alone could raise the stream ratings to “C” or better in these reaches.

Finally, dredging of channels on Long and Round Lakes needs to be evaluated. This could improve recreation and habitat.

7.4.3 Squaw Creek Greenway Plan

The Greenway Plan recommends a functional linkage of existing and restorable natural resources on the Mainstem. Specific elements would include the incorporation of threatened and endangered species refuges and habitat and the restoration of habitat through reconnection of the streams to wetlands and the restoration of drained hydric soils to wetlands. The Plan is shown in Chapter 8. The creation of the Greenway can be accomplished as follows.

- Define all existing open space parcels in public ownership or already deed restricted.
- Define all "regulated" open space such as wetlands and floodplain and their associated buffers that are effectively protected and conserved by the WDO or the UDO.
- Define all parcels needed to connect the above land areas along stream corridors or around critical habitat.
- Develop zoning regulations for these parcels that preserves density rights in exchange for the necessary linkages defined above.
- Pursue acquisition or conservation easements for parcels or portions of parcels that are critically needed for linkages.

The Plan also recommends the formation of a Squaw Creek Open Space Committee to oversee this process. The construction of this Greenway must recognize the private property rights of the parcels needed for linkages.

7.4.4 Regulatory Changes

From an administrative perspective, the Action Plan calls for adoption of the Greenway Plan by each municipality in the watershed. It also suggests changes in wetland mitigation policy to promote restoration of instream habitat and suggests developer incentives to promote the establishment of the Greenway Plan. Tools that can be used to help implement density trading for open space also are recommended such as Conservation Overlay Districts.

7.5 PLAN IMPLEMENTATION

7.5.1 Funding

The Action Plan recommends a number of possible approaches to funding plan action items. One opportunity to leverage local funding is grant programs. Of particular note are habitat protection and restoration grants available through the NRCS. These small project funds could be used for a number of in-channel habitat improvements such as the pools and riffles described earlier. Grants are available for most of the project types included in the Action Plan.

The role that private funding can play is included in the Action Plan. For example, a sanitary sewer service user fee surcharge or a special service area may be private funding options for funding Long Lake rehabilitation efforts. A sanitary sewer user fee surcharge was suggested due to the historic contribution of sewage treatment plant discharges to Long Lake.

Chapter 9 of this Plan is dedicated to the topic of funding watershed efforts. The prioritized action recommendations related to funding are shown in Table 7-4.

7.5.2 Governmental Coordination and Cooperation

The Action Plan will not be successful without governmental cooperation. This cooperation would be most clearly demonstrated by the adoption of the Squaw Creek Plan and the Greenway Plan by each unit of government in the watershed. The creation of permanent watershed steering committees also would demonstrate commitment to the attainment of Plan goals.

Coordination of stormwater management planning and ecological enhancement plans through the decisions of local governments is the only way that the plan can be successful. The Plan also recommends coordination of municipal and county five-year stormwater management and maintenance budgets to identify economies. Finally, the Plan also recommends the development of a watershed-specific coordinated flood warning and response plan.

Specific action items related to governmental cooperation are presented with conceptual costs in Table 7-4.

7.6 PUBLIC INVOLVEMENT

A key measure of plan success will be public involvement in its implementation. The Action Plan recommends the following action items to foster this involvement and ownership: teacher education; volunteer lake monitoring program participation; watershed management groups for Squaw Creek/Long Lake, Round Lake and Eagle Creek watersheds; watershed web site; and advertising. A key component of the Action Plan, as well, is the adoption of the Plan by each unit of government in the watershed.

The prioritized action items and conceptual costs are presented in Table 7-5.

Recommended Actions

Goal Number 1: Reduce Existing Flood Damage Potential and Prevent the Creation of Increased Flood Damage Potential

Objective 1A: Identify existing sources of flooding, historic damages associated with flooding, and properties with flood damage potential.

Action Items:

1. Solicit input on historic flooding damages from townships, municipalities, and residents.
2. Update the floodplain study for the Round Lake Drain subwatershed.
3. Update the floodplain study for Eagle Creek subwatershed.
4. Combine the Squaw Creek mainstem, Round Lake Drain, and Eagle Creek floodplain models and update the floodplain study for Long Lake.
5. Perform flood damage assessments for subwatersheds with updated floodplain studies.
6. Perform flood audits for structures that have been identified to have frequent historic flooding or potential for frequent flooding.
7. Create a GIS database of storm sewer and drainage map information.
8. Update drain tile mapping as additional information becomes available via drain tile surveys required by the WDO.
9. Perform a capacity analysis of urban drainage systems to identify locations with inadequate drainage system capacity.

Objective 1B: Prevent the creation of new flood damage problems through the implementation of regulatory and non-regulatory provisions.

Action Items:

1. Encourage enforcement officers to attend regular training sessions on applying and enforcing the WDO.
2. Encourage enforcement officers to become Certified Floodplain Managers.
3. Evaluate the effectiveness of existing WDO provisions in preventing the creation of new flood damage problems.
4. Identify and implement additional, watershed-specific regulatory provisions as needed.
5. Evaluate the flood control benefits of supplementing the WDO's existing provisions with runoff volume requirements.

Objective 1C: Reduce existing flood damage potential through the implementation of flood damage reduction projects.

Action Items:

1. Identify and evaluate potential locations for regional, multi-objective flood control facilities.
2. Identify and consider acquisition of repetitively flooded homes from willing sellers.
3. Initiate or improve drainage system maintenance to preserve conveyance capacity
4. Identify solutions for inadequate drainage system capacity in manmade drainage systems.
5. Evaluate the possibility of increasing conveyance of the Round Lake Drain to lower flood levels along Round Lake Drain.
6. Identify structures that are best-suited to individual home floodproofing measures.
7. Evaluate the feasibility of redirecting flood flows from Round Lake Drain to the Mud Lake wetland complex to attenuate peak flows.
8. Evaluate the feasibility of enhancing the flood storage capability of Mud Lake.
9. Evaluate the feasibility of adding flood reduction measures at the Grant Woods Forest Preserve property.
10. Develop a flood warning and response plan for residents along the Round Lake Drain.

Objective 1D: Utilize the "Green Infrastructure" concept to protect and enhance the natural components of the drainage system.

Action Items:

1. Consider adopting conservation overlay districts to protect green infrastructure.
2. Encourage new development to enhance and incorporate existing green infrastructure into development plans rather than replace it with manmade drainage infrastructure.
3. Identify existing green infrastructure
4. Identify potential additions to the existing green infrastructure
5. Identify the maintenance needs for green infrastructure.

Objective 1E: Investigate the management of lake levels to reduce flooding.

Action Items:

1. Evaluate the feasibility of modifying the normal water level in the major lakes to reduce flood damage potential.
2. Evaluate the feasibility of using an adjustable outlet configuration to manage the lake levels and reduce flood damage potential.

Goal Number 2: Improve Water Quality in the Watershed's Streams and Lakes

Objective 2A: Assess the water quality in the watershed's streams and lakes.

Action Items:

1. Have the Lake County Health Department's Lakes Management Unit continue monitoring the lake quality and use impairments on a three to five year cycle.
2. Increase participation in the Volunteer Lakes Monitoring Program (VLMP).
3. Increase participation in the RiverWatch stream monitoring program.
4. Encourage schools to participate in monitoring programs.
5. Identify potential sources of water quality degradation.
6. Develop an overall water quality monitoring plan for the watershed.

Objective 2B: Protect water resources from sedimentation due to soil erosion.

Action Items:

1. Consider certification requirement for all soil erosion and sediment control inspectors.
2. Hold annual seminars for designers and inspectors of erosion and sediment control measures.
3. Increase farmers' participation in voluntary conservation programs that reduce agriculture-related soil erosion.
4. Work with farmers to develop riparian buffer zones and grassed waterways.
5. Require daily inspections of soil erosion and sediment control practices on projects with mass grading that exceeds a chosen size threshold.
6. Develop an erosion and sediment control reminder handout and checklist that can be provided at all pre-construction meetings.
7. Develop maximum suspended solids concentration standards for discharges from a construction site.
8. Evaluate the feasibility of adding on-line sediment storage to Squaw Creek.
9. Identify weaknesses in the existing soil erosion and sediment control requirements and develop recommended improvements.
10. Identify weaknesses in the existing WDO enforcement procedures and develop recommended improvements.

Objective 2C: Maintain or improve the water quality of stream reaches and lakes whose beneficial uses are not currently water quality impaired.

Action Items:

1. Develop and implement a pollutant source control program that, as a minimum, addresses residential use of phosphorus and municipal use of road salt.
2. Require documentation of infiltration and runoff retention feasibility for reviewing a site's drainage plan compliance with the WDO's Runoff Volume Reduction Hierarchy.
3. Consider maximum nutrient concentration standards for discharges from a construction site using the Illinois Environmental Protection Agency's (IEPA's) General Use Water Quality Standards as a starting point.
4. Evaluate the feasibility and benefits of reconnecting Squaw Creek with the Ray Lake wetland complex by diverting it from the Fremont Elementary School property.
5. Identify areas with failing septic systems and work towards repairing or replacing the existing systems.
6. Purchase agricultural production and development rights or purchase property to facilitate water quality improvement projects such as wetland creation.
7. Identify potential regulatory provisions that could be implemented to improve the protection of water quality.
8. Identify high water quality areas in the watershed for the purpose of prioritizing protection efforts.
9. Retrofit existing stormwater storage facilities to increase water quality treatment capabilities.
10. Add BMPs to the Renwood Golf Course to reduce total phosphorus concentrations in the runoff.
11. Stabilize eroded drainage channels and redesign them to provide water quality benefits.
12. Evaluate the feasibility of adding BMPs to the watershed to limit nutrient concentrations in runoff.
13. Consider a ban on fertilizer containing total phosphorus.
14. Develop a plan for evaluating point source contributions to the watershed.

Objective 2D: Improve the water quality of stream reaches and whose beneficial uses are water quality impaired.

Action Items:

1. Prepare an updated bathymetric map of the lake, including sediment depths.
2. Work with property owners to repair shoreline erosion with bioengineered, native landscaping measures.
3. Identify the primary sources of water quality degradation.
4. Develop a long-term plan for controlling in-lake phosphorus regeneration.

5. Evaluate the application of a one time, in-lake phosphorus regeneration control measure.
6. Retrofit existing detention basins, where feasible, to improve total phosphorus removal capabilities.
7. Evaluate the use of the property between Fairfield Road and Long Lake for wetland treatment of stormwater runoff.
8. Implement channel habitat restoration and stabilization projects on Round Lake Drain.
9. Evaluate the feasibility of incorporating natural water quality improvement measures at the Grant Woods Forest Preserve property.
10. Identify and address the source of high Total Dissolved Solids concentrations measured in the Squaw Creek Tributary at Nippersink Road.
11. Develop a plan for evaluating point source contributions to the watershed.
12. Review road salt application rates and procedures and when necessary recommend improvements.

Goal Number 3: Preserve, protect, and enhance existing natural areas; and restore or create new, sustainable natural areas

Objective 3A: Inventory and evaluate open space and natural areas in the watershed, and prioritize protection, preservation, and enhancement efforts.

Action Items:

1. Prepare an open space inventory.
2. Prioritize protection, preservation, and enhancement needs.
3. Prepare a green infrastructure plan.
4. Prepare an open space plan.

Objective 3B: Maintain the functional values of existing natural resources.

Action Items:

1. Create a zoning overlay district template that can be used to develop and maintain the Squaw Creek Green Infrastructure's components.
2. Develop a model stream maintenance program that addresses ecological issues.
3. Modify comprehensive plans to define curb and gutter road drainage zones versus roadside swale drainage zones.
4. Adopt resolutions prioritizing the preservation of the existing Green Infrastructure.
5. Consider adopting an anti-degradation policy for all new development in the watershed using the IEPA's regulations for obtaining a Section 401 water quality certification as a model.
6. Develop an invasive species control program.
7. Perform cleanup of debris and litter in the watershed's streams and lakes.
8. Maintain and protect rare, threatened, and endangered species.

Objective 3C: Enhance all streams in the watershed to a Biological Stream Characterization rating of "C" (Moderate Aquatic Resource) or better.

Action Items:

1. Connect wetland restoration and creation projects to the existing stream systems.
2. Incorporate habitat creation into streambank stabilization projects.
3. Develop example plans for small habitat creation projects that can be constructed inexpensively.
4. Develop and implement an ecologically sensitive stream maintenance program.
5. Implement habitat and streambank stabilization demonstration projects.

6. Coordinate with the wetland banks in the watershed to identify opportunities for upgrading stream habitat as the wetland banks are constructed.

Objective 3D: Develop and implement strategies for balancing the uses and demands on the watershed's resources

Action Items:

1. Evaluate modifying the WDO to grant wetland mitigation credit for the successful restoration of instream and floodplain habitat.
2. Identify site capacity regulations that can be implemented at the municipal level using Lake County's Unified Development Ordinance as a model.
3. Develop habitat preservation and creation requirements for new development. For example, creation might include planting native prairie grasses and including fish habitat in detention ponds.
4. Identify opportunities to install infrastructure that increases the ability of natural resources and wildlife to coexist with development (e.g., wildlife barriers or passageways at high traffic roadway locations).
5. Develop zoning and subdivision code incentives to promote the implementation of the Green Infrastructure Plan:
   - Assign greater weight to habitat preservation in the Green Infrastructure zone if habitat requirements are implemented.
   - Allow density variances based on the level of Green Infrastructure Plan implementation on a site.
   - Allow restoration of instream habitat within the Green Infrastructure zone to offset onsite habitat requirements.
6. Provide developers with watershed plan recommendations applicable to their site at the beginning of their zoning and permitting process.
7. Pursue the construction of regional storage facilities and implement a fee-in-lieu of on-site detention program. Utilize fees to protect the Green Infrastructure.

Objective 3E: Attain full, unimpaired use of the lakes in the watershed.

Action Items:

1. Identify existing use impairments and their sources.
2. Identify wetland restoration and creation projects that would contribute to every ten acres of watershed area being treated by one acre of wetlands capable of treating stormwater runoff.
3. Identify and implement in-lake measures to attain unimpaired use.

Goal Number 4: Develop and Utilize Tools for Plan Implementation

Objective 4A: Develop and pursue funding mechanisms for implementation of the Plan.

Action Items:

1. Consider forming a special service area to fund Long Lake rehabilitation measures.
2. Coordinate acquisition of sites with strategic importance for improving natural resources and water quality (municipalities and the Lake County Forest Preserve District).
3. Identify opportunities to share costs and equipment for plan implementation by coordinating municipal and township governments' public works operating and capital improvement budgets.
4. Seek corporate support and/or sponsorship of Action Plan projects.
5. Identify and pursue grant opportunities.
6. Develop local grants and/or low interest loans to assist homeowner associations and residents with Plan implementation.
7. Develop and distribute educational information on "stormwater utilities" and how a stormwater utility might be an equitable funding source for stormwater management and Plan implementation.
8. Increase the use of the Watershed Management Board grant program (e.g., municipalities and townships could annually set aside matching fund or contribute to the grant fund).
9. Organize letter writing campaigns to local, state, and federal elected officials to express the local support for watershed improvement and the need for funding.
10. Develop strategies for reducing the funding dollars needed to implement projects (e.g., volunteered labor and equipment, donated materials, etc.)
11. Prioritize funding needs on an annual basis.
12. Pursue land dedications, donations, conservation easements, etc.

Objective 4B: Develop cross-coordination between agencies, units of government, and the public.

Action Items:

1. Coordinate municipal and county policies on sewerage and water reclamation expansion with the recommendations in the Squaw Creek Watershed Plan.
2. Determine the sustainable water supply yield for the watershed and adjust future development decisions/regulations accordingly (e.g., impervious area limitations or water conservation regulations).
3. Improve coordination of zoning between units of government.
4. Improve the Facilities Planning Area amendment process for wastewater-related issues.
5. Create a Squaw Creek watershed steering committee.

6. Define and communicate the watershed implications of governmental and drainage district policy decisions.
7. Develop a strategy for storing and sharing watershed data.
8. Establish a commitment by local units of government to attending an annual watershed coordination meeting.
9. Develop tools for improving communication between stakeholders.
10. Create and implement a system for obtaining feedback on watershed issues from residents (surveys, etc.).
11. Publish watershed-related information in local newsletters and newspapers.
12. Develop a plan for the future actions and funding of the Squaw Creek Drainage District.
13. Develop intergovernmental agreements to help achieve cooperation towards Plan implementation.

Objective 4C: Pursue adoption of the Plan at the local level.

Action Items:

1. Meet with local elected officials to explain the benefits of the Plan and answer questions.
2. Develop local resident support for Plan adoption.
3. Display stakeholder support for Plan adoption by attending applicable meetings and contacting local elected officials.

Objective 4D: Develop documents that can supplement the Plan and be used as tools to facilitate plan implementation.

Action Items:

1. Develop informational fact sheets, Plan brochures, and watershed maps.
2. Develop sample ordinance language that could be used at the local level to implement Action Plan recommendations.
3. Develop a list of funding sources for specific types of watershed projects included in the Action Plan.
4. Develop a survey to all residents to assess priorities and motivations as related to watershed issues.
5. Develop a list of potential roadblocks to Plan implementation and a management strategy for those roadblocks.
6. Gather information on the predicted watershed impacts of various development actions.
7. Prepare a document discussing the value of wetland mitigation versus the preservation of existing wetlands based on available information.

Objective 4E: Continue to develop additional strategies for implementing the Plan.

Action Items:

1. Form an implementation team.
2. Adopt interim regulatory provisions to allow local planning to incorporate Plan recommendations.
3. Coordinate watershed efforts with local, county and regional plans, including but not limited to: Lake County's Strategic and Framework Plans, the Fremont Township Open Space Plan, the Common Ground plan by NIPC, the Biodiversity Recovery Plan by Chicago Wilderness, and the Metropolis Plan: Choices for the Chicago Region by Chicago Metropolis.

Objective 4F: Develop a long-term data collection program for the watershed.

Action Items:

1. Identify sources and types of data currently available.
2. Develop a strategy for storing data and making it readily available.
3. Develop a list of data needs.
4. Increase data collection by coordinating local, county, and volunteer efforts.

Objective 4G: Assess Plan implementation and update Plan on a defined schedule.

Action Items:

1. Develop schedules for assessments and updates.
2. Define how updates and assessments should be done.
3. Provide a reporting format for stakeholders to provide implementation assessments.

Objective 4H: Organize the Plan in a usable format to facilitate implementation.

Action Items:

1. Define how each piece of technical data is important to the watershed.
2. Prepare the Plan in a readable format (e.g., paragraphs are not extensively long, utilize appendices for technical data or analyses, main text is written to be understandable to the layman, etc.)
3. Highlight the most important data and conclusions in the Plan.
4. Prepare summary tables and figures for information that may be usable by a large number of stakeholders.

Goal Number 5: Involve the public in the use and stewardship of the Squaw Creek Watershed

Objective 5A: Provide schools with a resource information sheet to assist them with developing watershed-related curriculum.

Action Items:

1. Compile a list of educational materials, websites, and references.
2. Compile a list of school-based project ideas.
3. Identify opportunities for schools to be involved in implementing the Plan.
4. Compile a list of applicable grant opportunities.

Objective 5B: Publicize watershed-related activities and make watershed-related educational materials available to the public.

Action Items:

1. Create a Squaw Creek watershed web site to post Plan implementation status, grant opportunities, educational materials, and general news and information.
2. Provide watershed information in a handout to all new residents of the watershed.
3. Utilize general advertising mailers to inexpensively mass-distribute important watershed information.
4. Develop a list of educational materials available at no cost to the public, including the source.
5. Increase the amount of watershed-related informational signage in the watershed.
6. Develop a list of available references and sample ordinances.
7. Involve developers and the business community in watershed activities.
8. Develop or host training programs.
9. Coordinate watershed Plan goals with parks and Forest Preserve District programs.
10. Monitor point source permit renewals
11. Increase the awareness of free subscription magazines that address topics related to the watershed plan (e.g. “Stormwater” and “Erosion Control” magazines).

Objective 5C: Provide information on what residents can do individually to improve the watershed in a simple format that could be distributed to all residents.

Objective 5D: Attempt to directly involve the public in watershed improvement activities.

Action Items:

1. Encourage locally-oriented planning by homeowner’s associations.
2. Involve the public in fundraising for watershed projects.

3. Organize annual stream and lake cleanup opportunities
4. Develop an adopt-an-area cleanup and/or restoration program
5. Foster group involvement (e.g., Cub Scouts, Lions Club, church groups, etc.) by orienting projects around volunteer participation.
6. Involve stakeholders in natural areas management activities in the watershed.
7. Organize volunteer monitoring activities in the watershed.

Objective 5E: Increase the stakeholder's awareness of the watershed's natural areas and water resources.

Action Items:

1. Develop a list of publicly accessible natural areas in the watershed.
2. Develop and distribute information on invasive species such as zebra mussels and Eurasian milfoil.
3. Develop and distribute information on the control of invasive species and wise use of herbicides and fertilizers.

Objective 5F: Increase the stakeholders' experiential use of the watershed's natural areas and water resources.

Action Items:

1. Increase the number of trails in the watershed.
2. Publicize ways that stakeholders can benefit from the watershed's natural areas.
3. Utilize natural areas as the location for public events.

Table 7-1: Prioritized Action Recommendations with Costs: Flooding

Action	Related Goals	Timeline (years)	Cost [1]	Municipalities	Townships	County Agencies			Other Groups
				Applicable Municipalities	Avon Fremont Grant Lake Villa	Stormwater Management Commission	Forest Preserve District	Planning & Development	
1. Floodplain Studies									
a. Round Lake Drain FIS Restudy		<5	$75,000	Support	Support	Lead	Support	Support	
b. Eagle Creek FIS Restudy		<5	$50,000	Support	Support	Lead	Support	Support	
c. Unified FIS through Long Lake		<5	$25,000	Support	Support	Lead	Support	Support	
2. Flood Audits									
a. Round Lake Drain Flood Audit		<5	$60,000	Support		Lead			
b. Long Lake Flood Audit		<5	$50,000			Lead		Support	
3. Flood Damage Reduction Analysis									
a. Evaluate GRLPD Renwood Golf for Flood Control	Water Quality, Natural Resources	5-10	$25,000	Lead		Support			Round Lake Park District
b. Evaluate Increased Round Lake Drain Conveyance	Water Quality, Natural Resources	5-10	$25,000	Support		Lead			Long Lake Improvement Assoc.
c. Evaluate Mud Lake for Flood Control	Water Quality, Natural Resources	5-10	$25,000	Support		Lead		Support	
d. Evaluate Round Lake Drain Storage Sites									
i. Between Sunset and Lotus		<5	$10,000	Support		Lead		Support	
ii. North of Rollins and West of Cedar Lake Rd		<5	$10,000	Support		Lead		Support	
iii. North of Rolllins and West of Orchard		<5	$10,000	Support		Lead		Support	
e. Evaluate Eagle Creek Storage Sites									
i. North of Monaville Road		<5	$10,000	Support		Lead		Support	
ii. East of Fairfield Road		<5	$10,000	Support		Lead		Support	
f. Evaluate Mainstem Storage Sites									
i. South of Nippersink and West of Fairfield		<5	$10,000	Support		Lead		Support	
ii. Northbrook Sports Club	Water Quality, Natural Resources	<5	$10,000	Support		Lead		Support	
iii. Campbell Airport		<5	$10,000	Support		Lead		Support	
d. Evaluate Levees		5-10	$30,000	Support		Lead	Support	Support	LC Dept. of Transportation
e Evaluate Increased Round Lake Drain Capacity									
i. Lotus to Fairfield		<5	$10,000	Support		Lead		Support	
ii. Round Lake Drain Tributary		<5	$10,000	Support		Lead		Support	
iii. Re-Route High Flows to Mud Lake		<5	$10,000	Support		Lead		Support	
f. Identify Structures for Buyout		<5	$5,000	Lead		Support		Lead	
4. Evaluate Lake Level Management to Reduce Flooding									
a. Round Lake		<5	$10,000	Support		Lead		Support	Round Lake Mgt. Assoc., LC Health Dept. (LCHD)
b. Highland Lake		<5	$10,000			Lead			Highland Lake POA, LCHD
c. Long Lake		<5	$10,000			Lead			Long Lake Imp. Assoc., LCHD
5. Drainage Improvements									
a. Update Storm Sewer Data	NPDES II	5-10	$50,000	Lead	Lead	Support		Lead	
b. GIS Tile Map Base		5-10	$5000/yr	Support		Support		Lead	
c. Round Lake Drain Drainage Study	NPDES II, Water Quality	5-10	$50,000	Lead	Support	Support		Support	
d. Green Infrastructure Guidance	Water Quality, Natural Resources	5-10	$15,000			Lead		Support	
e. Develop Ecologically Friendly Stream Cleaning Guidance	Water Quality, Natural Resources	<5	$20,000	Support	Support	Lead	Support	Support	Squaw Creek Drainage Dist.

(1) All cost estimates are conceptual and may vary significantly as detailed scopes of work are developed.

Table 7-2: Prioritized Action Recommendations with Costs: Improve Water Quality

Action	Related Actions	Timeline (years)	Cost [1]	Municipalities	Townships	County Agencies				Other Groups
				Applicable Municipalities	Avon Fremont Grant Lake Villa	Stormwater Management Commission	Forest Preserve District	Soil & Water Conservation District	Planning & Development	
1. Increase Water Resources Monitoring										
a. Develop River Watch programs		<5	Low	Support		Lead			Support	LC Health Department (LCHD)
b. Attain Full Participation in VLMP		<5	Low							Long Lake Improvement Assoc.(LLIA), Round Lake Mgt. Assoc., Highland Lake Property Owner Assoc. (HLPOA), LCHD
c. Monitor Lakes on a 5-year Schedule		<5	$200,000/yr							Long Lake ISA, Round Lake Mgt. Assoc., Highland Park POA, LCHD
d. Install and Maintain Additional Flow Gages	Flooding	<5	$25,000/yr			Lead			Support	
e. Perform Additional Stream Water Quality Monitoring Annually		<5	$15,000/yr			Support			Support	LCHD
f. Perform Annual Benthic Surveys and Fish Surveys Every Three Years		<5	$15,000/yr			Support			Support	LCHD
2. Soil Erosion and Sediment Control										
a. Urban										
i. Train and Certify SESC Inspectors		<5	Low	Support		Lead		Lead	Support	
ii. Increase WDO and NPDES Review and Inspection Efforts		<5	$50,000/yr	Lead		Support		Lead	Lead	
iii. Evaluate 10-year Zero-Release SESC		<5	$10,000		Lead			Lead		
b. Agricultural										
i. Enroll Farms in Conservation Tillage and CRP		5-10	Low					Lead		NCRS
ii. Develop Riparian Zones and Grassed Waterways		5-10	$50,000/yr					Lead		NCRS
3. Implement Stormwater NPDES Phase II										
a. Road Salt Storage and Application		5-10	Low	Lead	Lead	Support			Lead	LLIA, Round Lake Mgt. Assoc., HLPOA
b. Herbicide and Fertilizer Storage and Application		5-10	Low	Lead						
c. Other Public Works Chemical Storage and Handling		5-10	Low	Lead						
4. Urban Stormwater Management Retrofit Projects										
a. Retrofit Non-WDO Detention in Round Lake Watershed		>10	$20,000 ea	Lead		Support			Support	
b. Retrofit Non-WDO Detention in Highland Lake Watershed		>10	$20,000 ea						Support	
c. Retrofit Non-WDO Detention in Long Lake Watershed		>10	$20,000 ea						Lead	
d. Implement Round Lake Drain COE 206 Restoration Projects		<5	$600,000	Support	Support	Lead				
e. Evaluate Grant Woods for Eagle Creek Water Quality Management	Flooding, Natural Resources	5-10	$50,000				Lead			
f. Evaluate Mud Lake for Water Quality Management	Flooding, Natural Resources	5-10	$20,000							
5. Lake Diagnostic Studies										
a. Study Phosphorus Control for Long Lake		5-10	$40,000							LCHD, LLIA

(1) All cost estimates are conceptual and may vary significantly as detailed scopes of work are developed.

Table 7-3: Prioritized Action Recommendations with Costs: Natural Resources Protection and Restoration

Action	Related Actions	Timeline (years)	Cost [1]	Municipalities	Townships	County Agencies			Other Groups
				Applicable Municipalities	Avon Fremont Grant Lake Villa	Stormwater Management Commission	Forest Preserve District	Planning & Development	
1. Streambank Stabilization									
a. Implement COE 206 Streambank Stabilization Project	Water Quality	<5	$600,000			Lead			U.S. Army Corps of Engineers
b. Stabilize Mainstem Reaches	Water Quality	10-20	$500/LF	Lead	Lead	Support			
c. Stabilize Round Lake Drain Reaches	Water Quality	10-20	$500/LF	Lead	Lead	Support			
d. Stabilize Eagle Creek Reaches	Water Quality	10-20	$500/LF	Lead	Lead	Support			
2. Habitat Restoration Projects									
a. Evaluate Eagle Creek Riparian Wetland Restoration Grant Woods	Flooding, Water Quality	5-10	$50,000	Support		Support	Lead		
b. Evaluate the Re-Connection of the Mainstem to Existing and Drained Wetlands	Flooding, Water Quality	>10	$50,000	Support		Lead	Lead		
c. Evaluate the Re-Connection of Existing and Drained Wetlands to Eagle Creek	Flooding, Water Quality	10-20	$50,000			Support		Support	
d. Create Pool, Riffle and Other Habitat Features in Mainstem Reaches		10-20	$5,000 ea			Lead		Lead	LC Soil & Water Conservation District (SWCD), NRCS
e. Create Pool, Riffle and Other Habitat Features in Round Lake Drain		10-20	$5,000 ea						SWCD, NRCS
f. Evaluate Channel Dredging on Long and Round Lakes		10-20	$10/cubic ft.					Support	Long Lake Improvement Assoc. (LLIA), Round Lake Mgt. Assoc., LC Health Dept. (LCHD)
3. Implement Greenway Plan		5-10	10000 ea	Lead		Support		Lead	
a. Form an Open Space Committee to Oversee Plan Implementation		<5	$5,000/yr	Lead		Support	Lead	Lead	
b. Inventory and Prioritize Open Space Parcels		5-10	$20,000			Lead			
c. Adopt the Greenway Plan		<5	Low	Lead		Support	Support	Lead	
4. Regulatory Changes									
a. Consider Mitigation Credit for Stream Habitat Restoration for IWLC		<5	Low			Lead			
b. Prioritize Stream Habitat Restoration for COE Mitigation Credit		<5	$15,000						U.S. Army Corps of Engineers
c. Provide Development Incentives to Implement the Greenway Plan		5-10	$50,000	Lead				Lead	
d. Consider Conservation Overlay District		10-20	$25,000 ea	Lead				Lead	
e. Consider Zoning and Subdivision Code Changes to Implement Greenway Plan for Developing Parcels		5-10	$25,000 ea	Lead				Lead	
f. Pursue Acquisition of Dedication of Ecologically Sensitive Areas	Water Quality	10-20	Varies	Lead	Lead	Support	Lead	Lead	Greater Round Lake Park District

(1) All cost estimates are conceptual and may vary significantly as detailed scopes of work are developed.

Table 7-4: Prioritized Action Recommendations with Conceptual Costs and Suggested Roles: Plan Implementation

Action	Timeline (years)	Cost (1)	Municipalities	Townships	County Agencies				Other Groups
			Applicable Municipalities	Avon Fremont Grant Lake Villa	Stormwater Management Commission	Forest Preserve District	Soil & Water Conservation District	Planning & Development	
1. Sewer Fee Surcharge for Long Lake Rehabilitation	>10	$500,000	Support					Lead	Round Lake S.D.
2. Consider a Special Service Area for Long Lake Rehabilitation	2003	$25,000						Lead	Long Lake Improvmt Assoc.
3. Evaluate Projects for Private Sponsorship (Clean Up, Monitoring)	10-20	Low							
4. Seek Private Foundation Grant Support for Projects	10-20	Low			Lead			Support	Homeowner's Associations
5. Organize a Grant Committee to Seek at Least One 319 Project Annually	<5	Low	Support		Support				
6. Make Better Use of Available NRCS and SWCD Restoration Funds	<5	Low			Support		Lead	Support	NRCS
Coordination									
1. Continue Support for Squaw Creek Advisory Committee	<5	$5,000/yr	Support		Support			Support	
2. Continue Implementation of Existing WDO	<5	No cost	Lead					Lead	
3. Encourage Certification of Floodplain Managers	10 to 20	Low	Support		Support			Support	
4. Continue Enforecement Officer Training	5 to 10	Low	Support		Support			Support	
5. Develop a Coordinated Flood Warning and Response Plan	5 to 10	$40,000	Support	Support	Support				Lake County ESDA
6. Coordinate 5-year Capital Improvement Drainage Plans	<5	Low	Lead	Lead	Lead		Support	Lead	LC Public Works Dept.
7. Monitor Plan Progress	0 to 20	Low							
8. Support Open Space Committee	5 to 10	$5,000/yr							
9. Coordinate 5-Year Public Works Programs for Savings	<5	$10,000/yr	Lead	Lead	Lead		Lead	Lead	LC Public Works Dept.

(1) All cost estimates are conceptual and may vary significantly as detailed scopes of work are developed.

Table 7-5: Prioritized Action Recommendations with Costs: Public Involvement

Action	Related Actions	Timeline (years)	Cost [1]	Municipalities	Townships	County Agencies				Other Groups
				Applicable Municipalities	Avon Fremont Grant Lake Villa	Stormwater Management Commission	Forest Preserve District	Soil & Water Conservation District	Planning & Development	
1. Train Teachers		5-10	$10,000/yr			Support				School Districts
2. Sponsor a Summer Session to Develop Curriculum		5-10	$25,000			Support				School Districts
3. Develop a Watershed Web Site		<5	$15,000			Support				
4. Prepare Handouts for New Watershed Residents		5-10	$20,000	Lead		Support				
5. Develop River Watch programs		<5	Low	Support		Support				
6. Support the Organization of Stream Clean-Up Programs		5-10	Low	Lead					Lead	
7. Support the Organization of An Annual Watershed Benefit		5-10	$5,000	Support	Support	Support	Support	Support		Round Lake Mgt. Assoc., Highland Lake Property Owners Assoc.
8. Develop Watershed Interpretive Signage		5-10	Low			Lead				
9. Develop and Distribute Information on Invasive Species Identification & Control		<5	Low	Support						Lake County Health Dept.
10. Monitor Point Source Permit Renewals		<5	Low	Support		Support				Lake County Public Works Dept.

(1) All cost estimates are conceptual and may vary significantly as detailed scopes of work are developed.

CHAPTER 8
SQUAW CREEK
GREENWAY PLAN

8.1 INTRODUCTION

The existing WDO effectively mitigates for the direct flooding, natural resources and water quality impacts of new development. It cannot address land use patterns, however, and how much land is used. That is the purview of comprehensive planning and zoning. It must respect private property rights and be implemented by the municipalities and the County.

An opportunity exists to protect and enhance important ecological resources in the Squaw Creek Watershed. This chapter presents a Greenway Plan for the Mainstem. A Greenway Plan presents a strategy for linking parcels of open space into a unit that functions to preserve and enhance drainage, water quality, natural resources, recreational and aesthetic benefits. The parcels are often pieces of existing larger parcels that have diminished value for development because they are wetland or floodplain. The assembly of these parcels can be accomplished by donation, purchase, win-win land development regulations or by acquisition of development rights. This Greenway Plan can function regardless of the development pattern the municipalities choose, if they work to implement it. Figure 8-1 presents resource elements, protected by the WDO, that form the structure for the Greenway Plan. Figure 8-2 adds parcels or portions of parcels that need to be secured and preserved as open space, to form the a Greenway Plan.

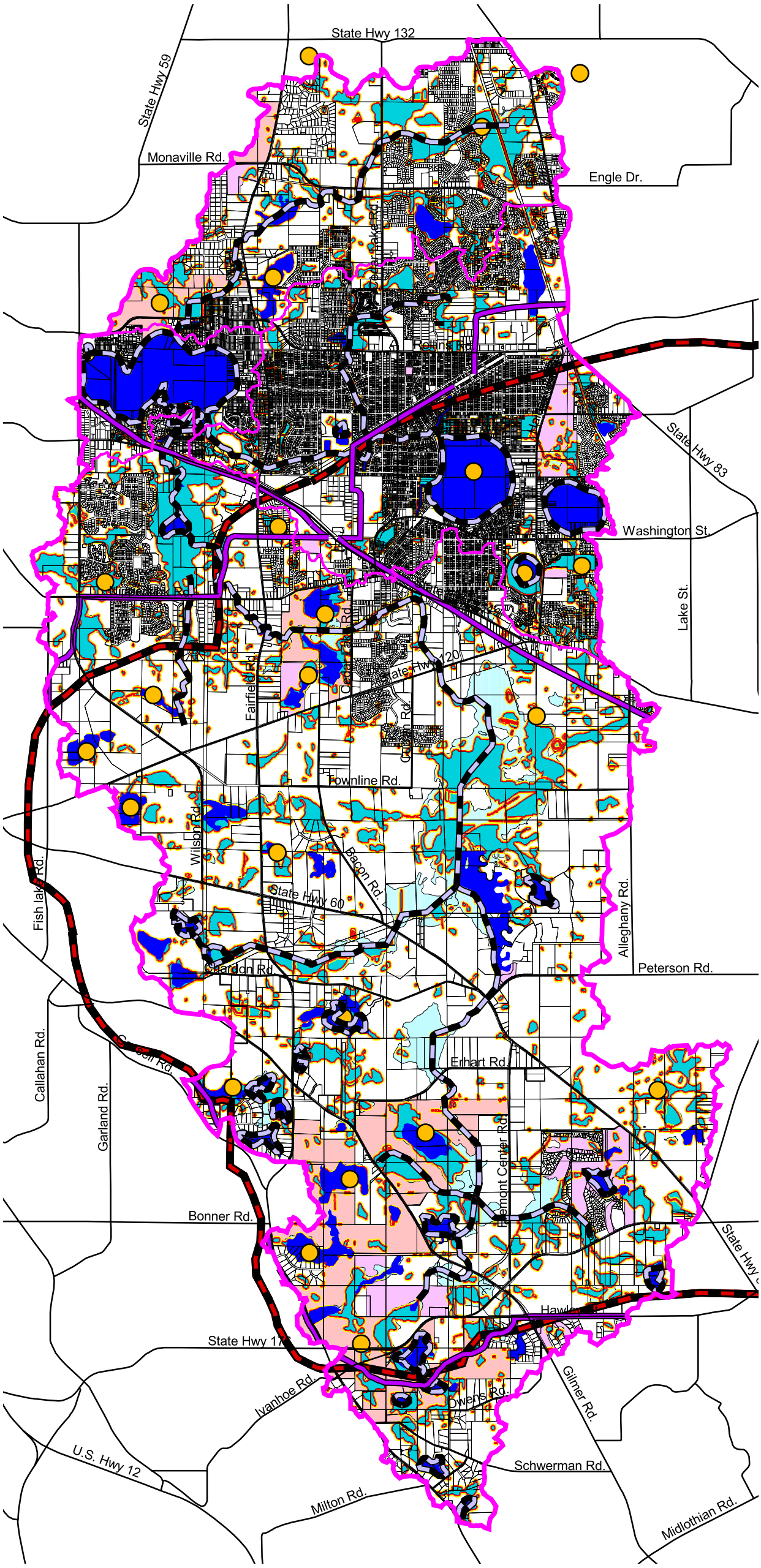
8.2 SQUAW CREEK GREENWAY PLAN

Figure 8-3 presents the Squaw Creek Greenway Plan in relation to key Squaw Creek Plan recommendations. This plan weaves important natural areas into a defined framework of connecting property for the protection of ecological values, green drainage infrastructure, and the creation of permanent open space. The Greenway Plan can be implemented in concert with the existing comprehensive plans. It is important that the communities in

the watershed agree that such a plan is worth implementing and begin working to accomplish it.

A key feature of the Greenway Plan is the assembly (by owner easement dedication or transfer of development rights) of blocks of open space linked together by recreational trails. These blocks will provide open space, green infrastructure, recreation, and natural resource/wildlife habitat protection. Multi-use recreational trails (bicycle, hiking, equestrian) would have access nodes at roadways and would allow for easy access from developing residential neighborhoods in the watershed. They would also eventually allow for connection with the regional trail system that is being developed throughout Lake County. Stream corridors would provide other links between open space tracts and would serve as avenues for movement for wildlife. Efforts should be made to limit human trail access to high quality habitat areas to minimize disturbance by wildlife.

Greenway acquisitions also would focus on enlarging and protecting blocks of significant habitat, including known habitat for threatened and endangered species. In the Squaw Creek watershed, most listed species are associated with wetland or aquatic habitats.



Squaw Creek Watershed

0 1 Miles

N

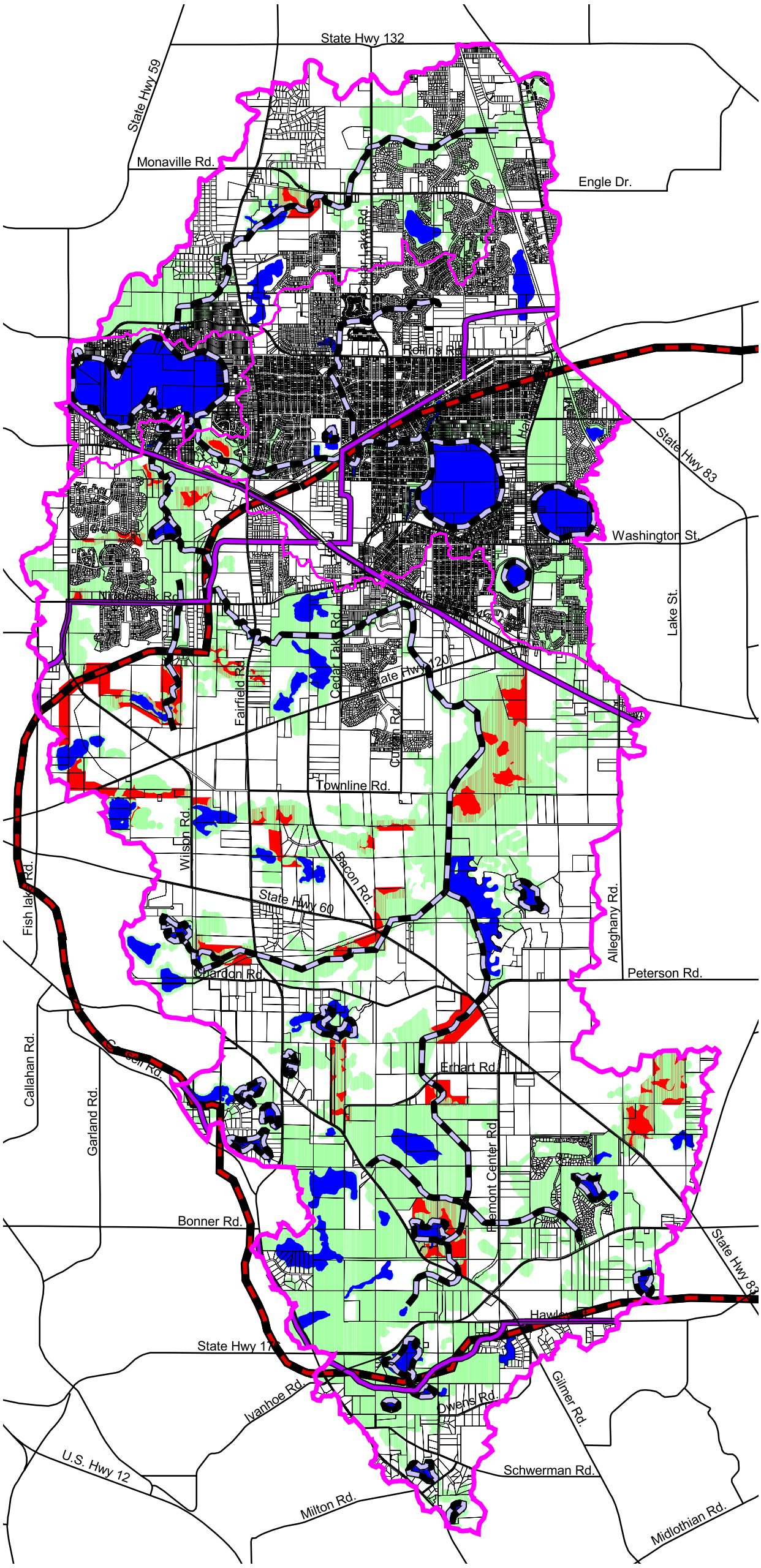
Watershed Boundary
Major Roads
NIPC BicycleTrails
NIPC River Trails
Millenium Trail

T/E Species
Parcels
Wetlands
Floodplains

Regional Water Storage
50 foot Wetland Buffer
100 foot Wetland Buffer
LCFPD Property
Recreational Open Space

Squaw Creek Greenway Elements

Figure No. 8-1



Squaw Creek Watershed

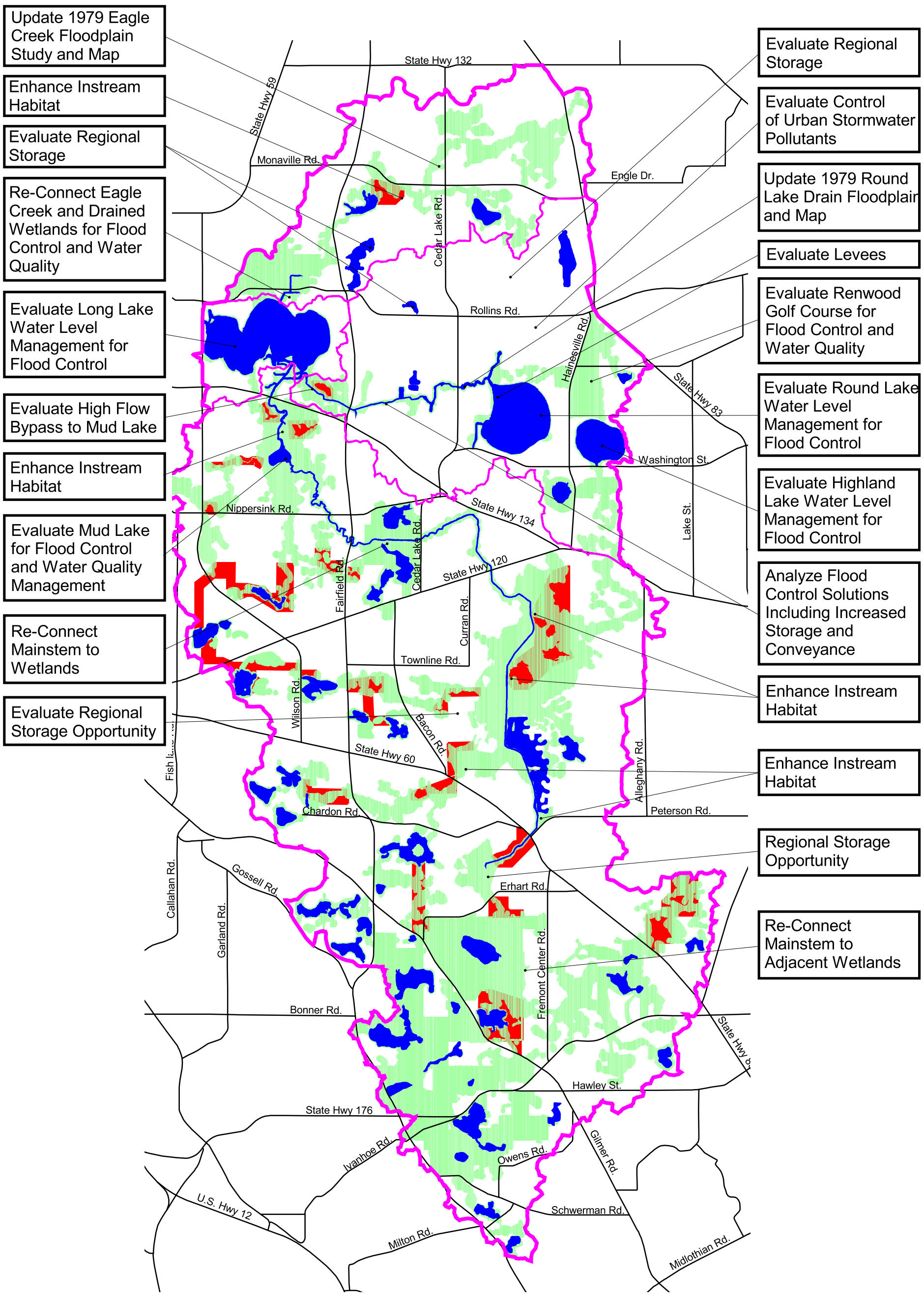
0 1 Miles

N

- Watershed Boundary
- Major Roads
- NIPC BicycleTrails
- NIPC River Trails
- Millenium Trail
- Regional Water Storage
- Parcels
- Regulated Greenway
- Acquisitions

Squaw Creek Greenway Plan

Figure No. 8-2



Squaw Creek Plan In Relation to Greenway Plan

Figure No. 8-3

Any expansion of open space in the vicinity of threatened or endangered species habitat would help buffer that habitat. The preservation of surrounding upland areas as supporting habitat is important to these wetlands. These acquisitions would also offset habitat fragmentation that is occurring elsewhere in the watershed.

The Greenway Plan also incorporates the concepts of landscape ecology. Landscape ecology looks at the spatial and temporal variations in habitat features that influence the use of areas by wildlife. Landscape ecology considers the causes and consequences of land use decisions and tries to predict the effects on the natural resources of a region.

Most of the rare birds that breed within the Squaw Creek watershed require specific wetland habitats (e.g., hemi-marshes) of relatively large size for their successful breeding. These birds include Yellow-headed Blackbird, Least Bittern, Sandhill Crane and Pied-billed Grebe. The habitat requisites that seem to be preferred by this guild of birds generally cannot be fulfilled in smaller patches due to the problems of increased predation by mammals, lack of core habitat and edge disturbances, among others. Small habitat patches usually do not have adequate habitat complexity or lack natural functions (e.g., wet-dry cycles) to provide appropriate habitat. Another key feature of habitats that produce better breeding areas for marsh birds is that these habitats have more extensive upland buffer areas associated with the marshes, providing more opportunities for foraging and rearing of young.

The greenway plan has incorporated the concepts of larger habitat patch size in priority habitat areas, especially those that already contain populations of rare birds. By facilitating the control of new parcels adjacent to existing open space areas, overall regional habitat value is greatly enhanced. This strategy may be the only effective way to limit the long-term negative influences of increased urbanization on open marsh nesting birds that may be brought by more traditional land plans that provide only minimum buffers. It may be difficult to effectively provide habitat for continued breeding within the watershed without the preservation of large habitat blocks with limited incursions of urban uses.

The Squaw Creek Greenway Plan also can benefit drainage and water quality by preserving key elements of the green infrastructure. Significant portions of the Greenway are floodplains, wetlands and depressional storage areas. The Greenway presents a framework for linking these areas. It also presents an opportunity to link areas adjacent to the Greenway using vegetated swales. Full development of the Greenway also would include and support restoration projects such as the re-connection of the existing Mainstem to wetland units. This will help to slow down streamflows and allow the settling of pollutants. Simply creating a green buffer between urban development and the stream will assist in slowing down flow and capturing pollutants. Another possible outcome of the Greenway is its potential use for stormwater management. Win-win drainage solutions with new development can be developed that utilize larger dedicated greenway corridors to satisfy stormwater management needs. This approach is used extensively in Wisconsin where floodplain limits are set in environmental corridors based on future development conditions. Detention on new development can then be reduced to only what is needed for water quality and natural resources protection. This is because the floodplain limits have already been expanded to account for the new development. This approach "takes" land that is currently outside the floodplain that has been mapped based on existing land use. This additional area would need to be added to the greenway by either acquisition, easements or trading of development rights.

Part of the greenway concept considered in this plan was to limit the introduction of human use trails within the core habitat. This strategy was based on the idea that predators often use trail corridors and can bring increased access to and depredation of wildlife resources. These predators include species such as coyote, raccoons and skunks. By limiting the trail access to outer edges of larger habitat blocks or adjacent to areas of limited habitat value (i.e., smaller, more isolated green spaces), possible negative effects on breeding wildlife can be minimized. However, this concept does not unnecessarily compromise the recreational opportunities of the trail for wildlife viewing and aesthetics. Final layout of any proposed trail system should incorporate this conceptual framework following landscape ecology principles.

8.3 IMPLEMENTATION

The tools to implement the Greenway Plan are almost exclusively related to zoning and finance. Protection of large greenway corridors that extend beyond WDO buffer requirements can be implemented through a variety of mechanisms.

- **Land Use Ordinances** Such as USEPA's Model Open Space Ordinance or NIPC's Model Lowland Conservancy Overlay District Ordinance. Both of these ordinances define broad greenway corridors in terms of watercourses, wetlands and hydric soils. They provide a means to promote Greenway Plan components.

- **Easements** It may be cost-effective to purchase conservation easements across portions of properties. This would preserve the development potential of the parcel but still assure that the key greenway component would be protected.

- **Transfer of Development Rights** This approach keeps greenway components free of development by allowing developers greater density in the remainder of the parcel.

- **Zoning Restrictions** Communities already require the reservation of open space in the form of lot setbacks, park donations and recreational donations. The net result of these "open space" restrictions is that typically 50 to 70 percent of a parcel is "open" (not covered by impermeable surfaces) but 80 to 90 percent of the parcel is disturbed. Communities can modify their ordinances to allow the same amount of develop but use this open space to support the Greenway Plan. This will require smaller setbacks and the dedication of specific portions of a parcel that are needed for the greenway but still will result in the same number of development units.

- **Donations** Communities may choose to lessen the density allowed on key parcels by restricting development or requiring donations of important Greenway Plan components. In many cases these will be floodplain or wetland areas that are restricted from development by the WDO. Lake County's Unified Development

Ordinance and the Village of Lake Villa's Subdivision Ordinance are based on this concept by limiting the development of natural resource components. This concept is referred to as performance zoning (Kendig, 1980).

CHAPTER 9

FUNDING

9.1 INTRODUCTION

The funding for the implementation for the Squaw Creek Plan must come from a variety of sources. These sources include municipal and county capital improvement plans, LCSMC project funding, grants, development donations, private sources, and perhaps new programs such as fee-in-lieu programs and stormwater user fees.

9.2 LOCAL GOVERNMENT FUNDS

The key to local government funding of Plan components will be its adoption by the municipalities. The local government's cost share of Plan action items is critical to implementation. Tables 7-1 through 7-6 presented an evaluation of implementation responsibilities by agency. Where units of local government are indicated as leading or supporting an item it should be assumed that some cost-share or in-kind effort will be needed.

Coordination of municipal capital improvement programs for stormwater and ecological management tasks may be important because many of the tasks cross municipal boundaries. Cost savings also should be possible with this level of coordination.

Additional user fees for water and sewer, dedicated to correction of ecological problems in Long Lake, are possibilities that need further research. Since these problems are primarily the result of decades of sewage treatment plant discharge, it seems equitable to use this mechanism to fund lake improvements.

Special Service Areas are another possible funding source for projects in the Plan. These are very cumbersome and difficult to implement and should probably be considered only as a last resort for critically needed improvements. Residents would need to petition their local governments to establish a special service area.

9.3 LCSMC

LCSMC has a limited amount of funds available each year for stormwater management projects. They also have the ability to coordinate funding from a variety of state and federal sources for floodplain and flood audit studies. LCSMC has already invested significant funds to provide additional survey data for the Round Lake Drain. LCSMC also has made it possible for communities to use fee-in-lieu financing to develop regional storage solutions. They also have been investigating and may pursue user fee legislation.

9.4 PRIVATE FUNDS

Commitment of the communities in the watershed to the Plan also will create the possibility of additional private funding. Baxter Healthcare, Inc. already has committed to expanding significant efforts to beneficially re-use its treated wastewater discharges. Baxter also funded a water quality sampling and analysis program for the watershed as discussed in the Plan.

The two wetland banks in the watershed could play a major role for the water quality and natural resources action items for the mainstem. As discussed in previous chapters, the wetland banks have a dis-incentive, from a financial and regulatory perspective, from attempting any instream restoration activities. If they were authorized to sell bank credits for instream and streambank work they may be able to fund the entire instream enhancement and restoration effort needed between Route 60 and 120.

9.5 DEVELOPMENT DONATIONS

The adoption of the Plan and the Greenway Plan by the municipalities creates the opportunity to work with new development to help achieve Plan implementation. This technique is used routinely for other public works improvements such as sanitary sewer and water supply. If developers are aware of the Greenway Plan they will be able to incorporate it into conceptual site plans.

Development incentives can also play a significant role in funding Plan implementations. Density and buffer trading can be particularly helpful for Greenway implementation.

9.6 FEE-IN-LIEU

The use of the fee-in-lieu program presents an opportunity for action item implementation throughout the watershed. An example of how this might have worked can be seen in the Squaw Creek Mainstem between Route 60 and 120. If the Plan had been in place before the mid-1990's it could have been possible to develop a regional storage and ecological restoration plan that utilized the former Big Sag wetland. This plan would have developed a regional storage basin that would have provided the detention needed for the numerous residential developments in this subwatershed. At the same time it would have restored drained wetlands in the Big Sag. The municipalities would have had to work together to prepare and implement the final plan and then charged the developers for the regional detention.

This should have been cheaper to develop than individual detention basins on each development thereby saving the developers money while at the same time providing ecological and water quality benefits by restoring the Big Sag.

Similar opportunities exist in throughout the watershed. Several have been identified in Chapter 5.

9.7 GRANTS

A variety of federal and state grants are available to implement Plan action items. Table 9-1 presents information on commonly used funding programs. The Appendix contains a summary of these and other programs.

Table 9.1: Commonly Used Funding Programs

Grant Program Name	Funding Source	Funding Focus			Cost Share	Typical Award Size
		Water Quality	Flooding	Habitat		
Watershed Management Board	Lake Co. SMC	X	X	X	>50%	$5K to $10K
Section 319	EPA	X			>40%	variable
Lakes Education Assistance grant Program (LEAP)	EPA	X			none req'd	$500
Illinois Clean Lakes Program (ICLP)	EPA	X			>50%	$5K to $30K
Stream Cleanup And Lakeshore Enhancment (SCALE)	EPA	X			none req'd	$2,000
Conservation 2000 (C2000)	IDNR			X	none req'd	$10K to $500K
Streambank Stabilization and Restoration Program (SSRP)	Lake Co. S&WCD	X		X	25%	variable
CAP Section 206: Aquatic Ecosystem Restoration	Corps of Engineers			X	35%	<$1,000,000
Wildlife Habitat Incentives Program	NRCS			X	Land	variable
Unincorporated Lake Co. Drainage Fund	Lake Co. P,B,& D		X		>50%	$5K to $10K
Flood Mitigation Assistance Program	IEMA		X		25%	$200,000
Increased Cost of Compliance Program	NFIP		X		Flood Insurance	$30K
Habitat Restoration Program for the Fox Watershed	Lake Co. S&WCD			X	25%	<$10K
5-Star Challenge Grant	NACo			X	none req'd	$5K to $20K
Conservation Reserve Program	NRCS			X	Land	variable
Wetland Reserve Program	NRCS			X	Land	variable

Lake Co. SMC = Lake County Stormwater Management Commission
EPA = Environmental Protection Agency
IDNR = Illinois Department of Natural Resources
Corps of Engineers = United States Army Corps of Engineers
Lake Co. S&WCD = Lake County Soil and Water Conservation District
NRCS = Natural Resources Conservation Service
Lake Co. P,B,&D = Lake County Planning, Building, and Development Department
IEMA = Illinois Emergency Management Agency
NFIP = National Flood Insurance Program
NACo = National Association of Counties

CHAPTER 10
STORMWATER MANAGEMENT "TOOLBOX"

This chapter is a "toolbox" of watershed beneficial stormwater management techniques. Similor to a carpenter's toolbox, this toolbox provides a centralized place where the tools necessory to complete a job can be found. The tools in this toolbox can be used to improve the watershed's water quality and habitat, as well as reduce flood damage potential. These tools are typically considered "Best Management Practices" (BMPs) for dealing with water resources' issues, and they can be retrofitted to existing developed areas or integrated into new development.

For organizational purposes, the BMPs in this chapter were classified into four categories:

- policy/regulations,
- planning/zoning,
- site stormwater BMPs, and
- landscaping techniques.

Policy/Regulations related practices serve as the first step to ensure that a minimum standard and quality of stormwater management is ochieved. Through policy and legal documentation, significont natural resources and sensitive habitats can be protected and preserved while at the same time proper development can be pursued. Those policy or regulations include Conservation Eosement, Stream/Wetlands Restoration and Management, and Watershed Development Ordinance.

Planning/Zoning related practices serve as the next critical step to achieve high environmental quality in the watershed when development occurs. Significant natural features shall be identified and protected while environmentally sensitive development areas are delineated through planning and zoning process. Floodplain Zoning, Riparian Buffers, and Open Space/Natural Greenway are practices play important roles in achieving natural resources delineation and protection. Conservation Development and Impervious Area Reduction are critical planning and design strategies for environmentally sensitive developments to achieve stormwater management and watershed goals.

Site Stormwater BMPs are site-specific practices to minimize onsite and offsite hydrologic and water quality impacts due to stormwater runoff by attempting to incorporate and re-establish natural hydrologic processes into the built environment. These measures can be designed and implemented in new developments as well as retrofit into existing development in cost effective ways. Site stormwater BMPs have the capability to significantly improve the quality of stormwater runoff as well as quality of life. The practices discussed here include Bioswoles, Filter Strips/Level Spreaders, Green Roofs, Naturalized Detention, Porous Pavement, Rain Barrels/Cisterns, Rainwater Gardens, and Vegetated Swales.

Landscaping, as a BMP, stands olone in its own category due to the importance of vegetation in biodiversity, aesthetics, habitat, cooling of ambient oir, and stormwater management. Native landscapes, including native prairies and wetlands, con improve water quality through infiltration and cleansing of stormwater runoff. Properly designed landscapes that incorporate native plants and hydrologically and ecologically appropriate vegetation can not only facilitate effectiveness of stormwater management but also provide wildelife habitot and quality open space.

This chapter is formatted to provide a 1-page fact sheet for each of the "tools" in the "toolbox." Preceding the fact sheets are two tables that provide: 1) the suitable scales and applicable development types for which each of the BMPs is the most appropriate and 2) the potential effectiveness of each of the BMPs in achieving a number of watershed goals and objectives. At the end of this chapter, a list of additional resources is provided for adding to the toolbox. Appendix J of this Plan is one of the additional resources, and it provides more detailed descriptions of the available tools.

Fact Sheets

Each of the fact sheets begins with a definition for the tool and continues with its range of applicability, associated benefits, and finally some potential design considerations. A more detailed discussion of the items found on the fact sheet is provided below.

Definition - a brief description of the BMP relative to stormwater management.

Applicability - Where and how each BMP is the most applicable is addressed in three aspects: scale, applicable situations, and effectiveness:

Scale

- **Watershed/County:** Applied at a regional scale in watershed or county wide.
- **Town/Village:** Applied at municipal or other scale with common zoning authority.
- **Neighborhood:** Applied at development or other sub-municipal scale.
- **Lot:** Applied within individual residential lot or commercial parcel.

Applications

- **Retrofit:** Applied to existing developed areas, infill, and redevelopment.
- **New:** Applied to new development.
- **Roofs:** Applied on roofs or used to treat roof runoff.
- **Streets:** Applied on or used to treat runoff from public/private streets and roads.
- **Driveways:** Applied on or used to treat runoff from driveways.
- **Parking Lots:** Applied on or used to treat runoff from parking lots.
- **Lawns:** Applied on or used to treat runoff from exitsing open lawns that are generally planted with turfs, such as parks, campuses, individual yards, etc.
- **Sensitive Areas:** Applied on ecologically sensitive areas such as remnant habitats, floodplains, wetlands, steep slopes, and highly erodible soils.

Effectiveness

- **Runoff Rate Control:** Practices that can control or reduce runoff rates.
- **Runoff Volume Control:** Practices that can control or reduce runoff volumes.
- **Physical Habitat Preservation/Creation:** Practices that can preserve, introduce, or provide wildlife habitats.
- **Sediment Pollution Control:** Practices that can remove suspended solids from runoff.
- **Nutrient Control:** Practices that have the ability to reduce or remove nutrients such as nitrogen and phosphorus from runoff.
- **BOD Control:** Practices that can remove constituents that exert a Biological Oxygen Demand (BOD) in runoff.
- **Other Pollutant Control:** Practices that can reduce and remove other pollutants such as heavy metals an and petroleum based hydrocarbons.

Benefits - Other positive effects that the individual or system of practices performs. Benefits can be specific to stormwater management or be more general to various functions and values for the quality of life.

Design Considerations - Design recommendations and suggestions that should be considered when implementing the specific BMP. Drawings are not illustrated for construction, but rather as a general guidance on the components of the practice.

Watershed Stormwater Management Tool Applicability

Tools	Scale				Applications							
	Watershed/ County	Town/ Village	Neighbor-hood	Lot	Retrofit	New	Roofs	Streets	Drive-ways	Parking Lots	Lawns	Sensitive Areas
Policy/Regulations												
Conservation Easement	X	X	X	X	X	X						X
Stream/Wetlands Management and Restoration	X	X	X	X	X	X						X
Watershed Development Ordinance	X	X			X	X	X	X	X	X	X	X
Planning/Zoning												
Conservation Development	X	X	X			X		X	X	X	X	X
Floodplain Zoning	X	X			X	X						X
Impervious Area Reduction		X	X	X		X	X	X	X	X		
Open Space/Natural Greenway	X	X	X		X	X						X
Riparian Buffer	X	X	X	X	X	X					X	X
Site Stormwater BMPs												
Bioswales			X	X	X	X		X		X		
Filter Strips/Level Spreaders			X	X	X	X			X	X	X	X
Green Roofs				X	X	X	X					
Naturalized Detention	X	X	X		X	X	X	X	X	X	X	X
Porous Pavement			X	X	X	X		X	X	X		
Rain Barrels/Cisterns				X	X	X	X					
Rainwater Gardens				X	X	X	X		X		X	
Vegetated Swales			X	X	X	X	X	X	X	X	X	
Landscaping												
Native Landscaping			X	X	X	X	X	X	X	X	X	X

"X" = practices that are applicable to corresponding scale and applications

Watershed Stormwater Management Tool Effectiveness

Tools	Effectiveness						
	Runoff Rate Control	Runoff Volume Control	Physical Habitat Preservation/ Creation	Sediment Pollution Control	Nutrient Control	BOD Control	Other Pollutant Control
Policy/Regulations							
Conservation Easement	-	-	H	-	-	-	-
Stream/Wetlands Management and Restoration	-	-	H	H	M	-	-
Watershed Development Ordinance	H	H	H	H	H	H	H
Planning Process							
Conservation Development	H	H	H	H	H	H	H
Floodplain Zoning	H[1]	-	H	-	-	-	-
Impervious Area Reduction	H	H	-	H	H	H	H
Open Space/Natural Greenway	-	-	H	-	-	-	-
Riparian Buffer	M	-	H	M	M	M	M
Site Stormwater BMPs							
Bioswale	H	H	-	H	H	H	H
Filter Strips/Level Spreader	M	M	-	H	H	H	H
Green Roof	H	H	-	-	-	-	-
Naturalized Detention	H	-	M	H	H	H	H
Porous Pavement	H	H	-	H	M	M	H
Rain Barrels/Cistern	-	M	-	-	-	-	-
Rainwater Garden	M	M	-	-	-	-	-
Vegetated Swale	M	M	-	M	M	M	M
Landscaping							
Native Landscaping	-	M	M	M	M	M	M

1 Prevents flood damage as a result of high flow rates

"H" = High effectiveness; "M" = Moderate effectiveness; " –" = Not Applicable

conservation easement

conservation easements provide mechanism for long term protection of morphologically based corridors

Definition

- Legal mechanism for landowners to place voluntary restrictions on the future use of their land. Generally requires landowner to sell, permanently relinquish, or donate the rights of development.

Applicability

Scale	☒ Watershed/ County	☒ Town/Village	☒ Neighborhood	☒ Lot
Applications	☒ Retrofit	☒ New		
	☐ Roofs	☐ Streets	☐ Driveways	
	☐ Parking Lots	☐ Lawn	☒ Sensitive Areas	
Effectiveness	☐ Runoff Rate Control	☐ Runoff Volume Control	☒ Physical Habitat Preservation/ Creation	☐ Sediment Pollution Control
	☐ Nutrient Control	☐ BOD Control	☐ Other Pollutant Control	

Benefits

- Preserves significant natural features and open space.
- Protects created/restored natural areas from development and other disturbances.
- Provides opportunity to protect morphologically and ecologically based corridors that may be more difficult to protect with fixed width buffers in many stormwater ordinances.
- Can be used as a tool to create interconnected network of open space to improve ecological functioning of overall system.

Design Considerations

- Conservation easements, along with floodplain/open space zoning, ordinance buffer requirements, and conservation design should be used to preserve and create natural resource networks.
- Conservation easements are best suited to areas not subject to land use change and therefore cannot readily be protected through the devlopment process.
- Conservation easements may also be used to protect high quality uplands and other areas not readily protected through zoning and/or stormwater ordinaces.

one's backyard may be wildlife's treasure habitat

Policy/Regulations

stream / wetland restoration & management

Coffee Creek streambank restoration (Chesterton, IN)
(Conservation Design Forum)

Definition

- Practices that maintain a healthy ecosystem and/or restore a deteriorated ecosystem to its natural state.

Applicability

Scale	☒ Watershed/ County	☒ Town/Village	☒ Neighborhood	☒ Lot
Applications	☒ Retrofit	☒ New		
	☐ Roofs	☐ Streets	☐ Driveways	
	☐ Parking Lots	☐ Lawn	☒ Sensitive Areas	
Effectiveness	☐ Runoff Rate Control	☐ Runoff Volume Control	☒ Physical Habitat Preservation/ Creation	☒ Sediment Pollution Control
	☒ Nutrient Control	☐ BOD Control	☐ Other Pollutant Control	

Benefits

- Preserves significant natural features and their habitat, runoff moderation, and water quality benefits.
- Reduces the impact to natural systems of floods and other natural perturbations and improves recovery from these disturbances by preserving natural processes and functions.

Design Considerations

- Conduct a thorough analysis of existing and historic conditions of the restoration site, surrounding area, and watershed to understand system processes and functions.
- Establish stewardship program with local governments, stakeholders, interest groups, and communities to ensure sustained management and monitoring efforts on managed/restored ecosystems.
- Management and stewardship activities should be recognized as ongoing activities. Intensiveness of stewardship activities will decrease as system health and processes are restored.

a successful wetland restoration ensures the healthiness of ecosystems and promotes a good quality of life for both human and wildlife

Policy/Regulations

watershed development ordinance

Watershed development ordinances are designed to preserve and enhance natural site features and protect downstream areas from stormwater impacts

Definition

- Ordinance to regulate development for the purpose of minimizing onsite and offsite impacts to flooding and water quality.

Applicability

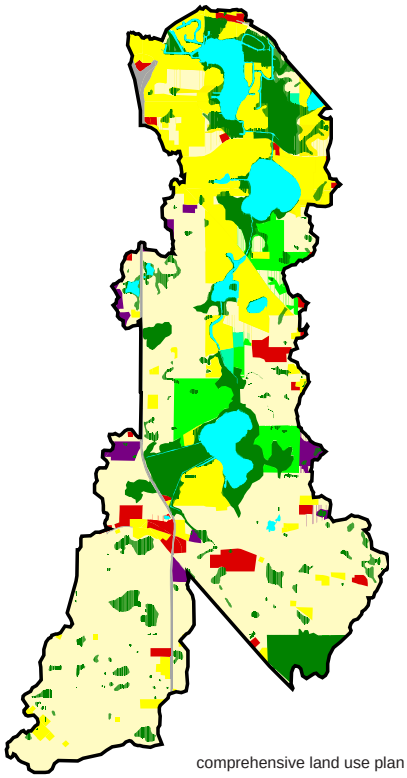
Scale	☒ Watershed/ County	☒ Town/Village	☐ Neighborhood	☐ Lot	
Applications	☒ Retrofit	☒ New			
	☒ Roofs	☒ Streets	☒ Driveways		
	☒ Parking Lots	☒ Lawn	☒ Sensitive Areas		
Effectiveness	☒ Runoff Rate Control	☒ Runoff Volume Control	☒ Physical Habitat Preservation/ Creation	☒ Sediment Pollution Control	
	☒ Nutrient Control	☒ BOD Control	☒ Other Pollutant Control		

Benefits

- Provides consistent level of protection throughout watershed
- Prevents/minimizes degradation of watershed resources
- Establishes orderly rules and procedures for development activities

Design Considerations

- Ordinances should comprehensively address stormwater management, floodplain management, stream and wetland protection, and soil erosion and sediment control.
- Ordinances should include standards to address runoff volumes, runoff rates, and water quality.
- Ordinances should provide flexibility in methods of meeting standards.
- Ordinances should facilitate watershed resources restoration activities.



comprehensive land use plan

the watershed development ordinance is a critical element of Fish Lake Drain watershed management plan (Conservation Design Forum)

conservation development

residential conservation development
(Prairie Crossing, IL)

Definition

- Site planning and design approach that preserves existing natural areas and utilizes naturalized drainage and detention measures for stormwater management.

Applicability

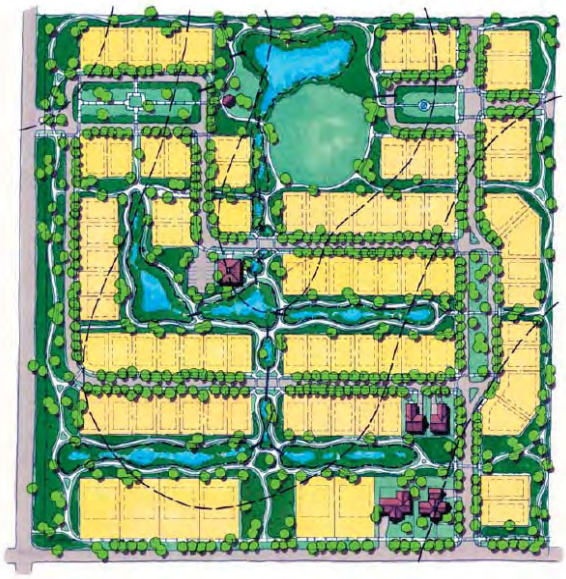
Scale	☒ Watershed/ County	☒ Town/Village	☒ Neighborhood	☐ Lot
Applications	☐ Retrofit	☒ New		
	☐ Roofs	☒ Streets	☒ Driveways	
	☒ Parking Lots	☒ Lawn	☒ Sensitive Areas	
Effectiveness	☒ Runoff Rate Control	☒ Runoff Volume Control	☒ Physical Habitat Preservation/ Creation	☒ Sediment Pollution Control
	☒ Nutrient Control	☒ BOD Control	☒ Other Pollutant Control	

Benefits

- Preserves significant natural features and open space.
- Minimizes changes in runoff volumes, rates, and water quality typically associated with urban development.
- Improves views and site aesthetics, while at the same time providing site drainage and water quality functions.

Design Considerations

- Onsite natural areas should be identified and preserved.
- Existing natural drainageways should be incorporated into site plan.
- Roadway should generally follow ridge lines.
- Impervious runoff should be routed through naturalized drainage systems integrated into the site plan.
- Use of native vegetation adapted to expected hydrologic conditions will improve runoff reduction and water quality benefits
- Naturalized drainage systems should be protected from construction site runoff during establishment.



conservation moderate density residential site plan
(Conservation Design Forum)

floodplain zoning

floodplain zoning prevents development from occurring in floodprone areas (Blackberry Creek, IL)

Definition

- Zoning regulations established to protect stream corridors and floodplains from urban development and other encroachments.

Applicability

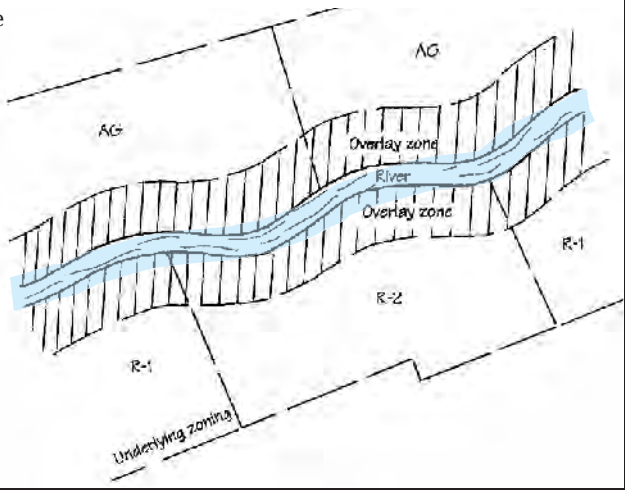
Scale	☒ Watershed/ County	☒ Town/Village	☐ Neighborhood	☐ Lot
Applications	☒ Retrofit	☒ New		
	☐ Roofs	☐ Streets	☐ Driveways	
	☐ Parking Lots	☐ Lawn	☒ Sensitive Areas	
Effectiveness	☒ Runoff Rate Control	☐ Runoff Volume Control	☒ Physical Habitat Preservation/ Creation	☐ Sediment Pollution Control
	☐ Nutrient Control	☐ BOD Control	☐ Other Pollutant Control	

Benefits

- Preserves stream corridors and riparian wetlands and provides natural buffer.
- Enhances safety and quality of life.
- Protects properties from flood damages.
- Protects natural floodplain functions.

Design Considerations

- Zoning regulations should allow for and encourage riparian corridor restoration.



floodplain zoning overlays with pre-existing zoning (source: SEMCOG)

impervious area reduction

reduce impervious areas by reducing street width (Seattle, WA)

Definition

- Impervious area reduction can be achieved by reducing street widths and building setbacks, examining parking lot requirements, and through building design alternatives.

Applicability

Scale	☐ Watershed/ County	☒ Town/Village	☒ Neighborhood	☒ Lot
Applications	☐ Retrofit	☒ New		
	☒ Roofs	☒ Streets	☒ Driveways	
	☒ Parking Lots	☐ Lawn	☐ Sensitive Areas	
Effectiveness	☒ Runoff Rate Control	☒ Runoff Volume Control	☐ Physical Habitat Preservation/ Creation	☒ Sediment Pollution Control
	☒ Nutrient Control	☒ BOD Control	☒ Other Pollutant Control	

Benefits

- Reduces runoff volumes and rates and associated pollutants.
- Reduces urban heat island effect and thermal impacts to waterbodies.
- Reduces development and maintenance costs.

Design Considerations

- Impervious area reductions can be achieved through reduced road widths, shared parking, reduced setbacks and other measures. These reductions will often require changes in subdivision code.
- Street length can often be reduced by clustering development onto portions of the site.
- Benefits of impervious area reduction are enhanced when combined with methods to "disconnect" impervious surfaces, e.g. vegetated swales, bioswales, filter strips/level spreaders, etc..

impervious areas reduced by lessening road length through clustering of development (Plano, IL) (Conservation Design Forum)

open space / natural greenway

open space greenways can provide recreational as well as habitat and water quality benefits

Definition

- Designation of linear open space and/or natural areas as greenways to preserve significant natural features and to accommodate aesthetic, recreational, and/or transportation uses.

Applicability

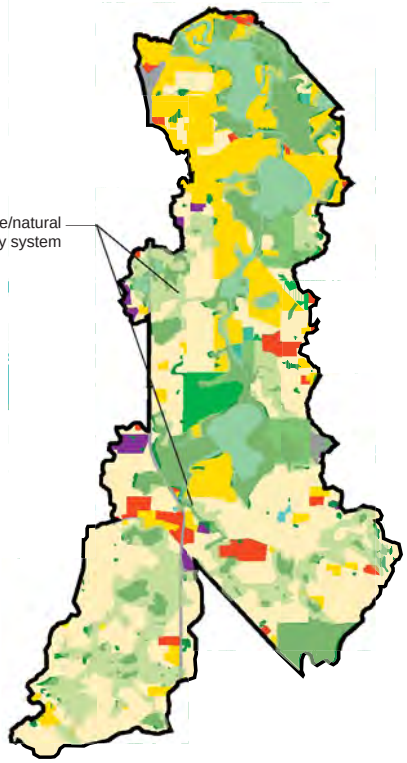
Scale	☒ Watershed/ County	☒ Town/Village	☒ Neighborhood	☐ Lot
Applications	☒ Retrofit	☒ New		
	☐ Roofs	☐ Streets	☐ Driveways	
	☐ Parking Lots	☐ Lawn	☒ Sensitive Areas	
Effectiveness	☐ Runoff Rate Control	☐ Runoff Volume Control	☒ Physical Habitat Preservation/ Creation	☐ Sediment Pollution Control
	☐ Nutrient Control	☐ BOD Control	☐ Other Pollutant Control	

Benefits

- Preserves large contiguous natural areas and resources.
- Provides opportunity for wildlife movement and habitat within an ecological network.
- Provides alternative and connected passive recreation and transportation opportunities.

Design Considerations

- A natural resources inventory should be completed to identify significant natural features and functioning ecological networks.
- Significant cultural features should also be integrated into the network.
- Buffer requirements, open space/floodplain zoning, conservation easements, and conservation design should be used together to implement greenway networks.



a open space/natural greenway system is designated to protect key natural resources in the Fish Lake Drain Watershed area. (Conservation Design Forum)

riparian buffer

buffers of native vegetation along streams and wetlands provide natural stabilization and pollutant filtering

Definition

- A buffer of native vegetation along lakes, streams, and wetlands that provides water quality and habitat benefits.

Applicability

Scale	☒ Watershed/ County	☒ Town/Village	☒ Neighborhood	☒ Lot
Applications	☒ Retrofit	☒ New		
	☐ Roofs	☐ Streets	☐ Driveways	
	☐ Parking Lots	☒ Lawn	☒ Sensitive Areas	
Effectiveness	☒ Runoff Rate Control	☐ Runoff Volume Control	☒ Physical Habitat Preservation/ Creation	☒ Sediment Pollution Control
	☒ Nutrient Control	☒ BOD Control	☒ Other Pollutant Control	

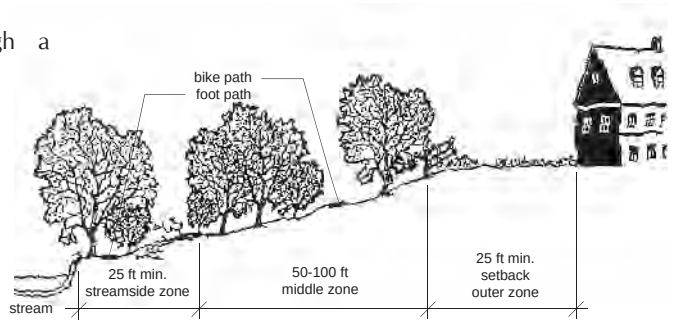
Benefits

- Preserves and protects natural functions of lakes, streams, and wetlands.
- Naturally attenuates flow rates.
- Provides filtering of lateral surface and groundwater inflows.
- Helps stabilize streambanks and shorelines against erosion.

riparian buffers preserve and protect riparian habitat (Blackberry Creek, IL)(Conservation Design Forum)

Design Considerations

- Riparian buffer width should be dependent on lake, stream, or wetland quality, ground slope, and size of feature.
- Buffer should be planted with native riparian vegetation.
- Buffers are often established/protected through a watershed development ordinance.



the three-zone urban stream buffer system (source: Center for Watershed Protection)

bioswale

bioswale in a parking lot (Tellabs, Napeville, IL) (Conservation Design Forum)

Definition

- Vegetated swale system with an infiltration trench designed to retain and temporarily store stormwater. Bioswales are planted with native grasses and forbs that enhance filtration, cooling, and cleansing of water in order to improve water quality and prevent sealing of subsoils.

Applicability

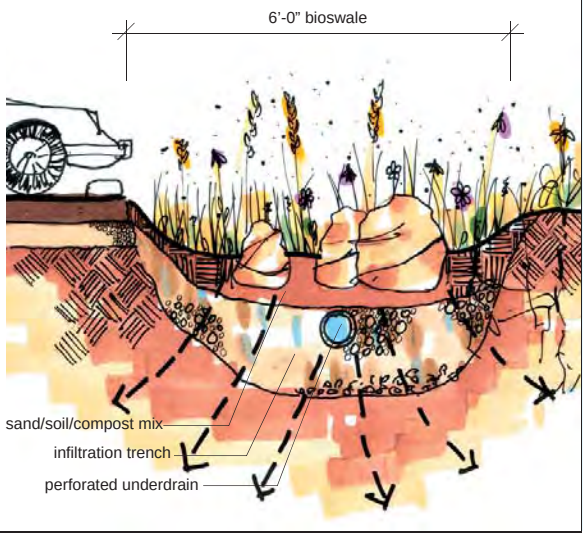
- Scale: ☐ Watershed/County ☐ Town/Village ☒ Neighborhood ☒ Lot
- Applications: ☒ Retrofit ☒ New
  - ☐ Roofs ☒ Streets ☐ Driveways
  - ☒ Parking Lots ☐ Lawn ☐ Sensitive Areas
- Effectiveness: ☒ Runoff Rate Control ☒ Runoff Volume Control ☐ Physical Habitat Preservation/Creation ☒ Sediment Pollution Control
  - ☒ Nutrient Control ☒ BOD Control ☒ Other Pollutant Control

Benefits

- Reduces impervious runoff volumes and rates.
- Recharges groundwater and sustains base flows.
- Reduces sediment and nutrient runoff.
- Can reduce detention needs.

Design Considerations

- Bioswales must be sized and designed to account for drainage area and soils.
- Filtration benefits can be improved by planting native deep-rooted vegetation.
- Infiltration storage should be designed to drain in 24 hours to prevent sealing of subsoils.
- Topsoil should be amended with compost and/or sand to improve organic content for filtering and to achieve adequate infiltration rates.
- Bioswales should be protected from construction site runoff to prevent sealing of topsoil and/or subsoils.
- Direct entry of stormwater runoff into infiltration trench should be prevented to protect groundwater quality and to prevent sealing of subsoils.
- Underdrain should be sufficiently low in the trench to provide adequate drainage of aggregate base of adjacent paved areas but sufficiently high to provide infiltration storage.



cross section of bioswale (Conservation Design Forum)

filter strip/ level spreader

Coffee Creek Center level spreader installation (Chesterton, IN) (Conservation Design Forum)

Definition

- A **filter strip** is an area with dense, preferably native vegetative cover used to filter and absorb runoff from impervious areas. A **level spreader** is a trench laid on the contour to distribute runoff over filter strip areas.

Applicability

Scale	☐ Watershed/ County	☐ Town/Village	☒ Neighborhood	☒ Lot
Applications	☒ Retrofit	☒ New		
	☐ Roofs	☐ Streets	☒ Driveways	
	☒ Parking Lots	☒ Lawn	☒ Sensitive Areas	
Effectiveness	☒ Runoff Rate Control	☒ Runoff Volume Control	☐ Physical Habitat Preservation/ Creation	☒ Sediment Pollution Control
	☒ Nutrient Control	☒ BOD Control	☒ Other Pollutant Control	

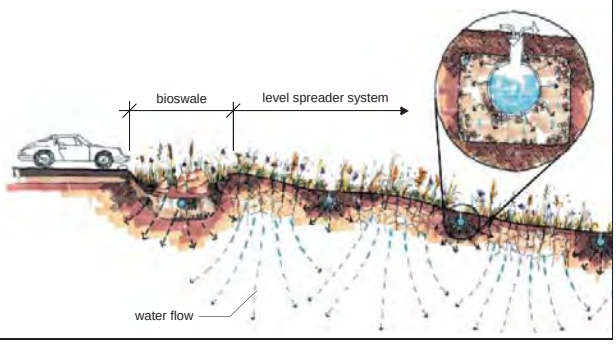
Benefits

- Reduces runoff volumes and rates by allowing runoff to infiltrate over a large area.
- Recharges groundwater and sustains base flows.
- Reduces sediment and nutrient runoff.
- Deconcentrate storm sewer and detention basin discharges to dissipate energy, reduce scour, and better mimic historic runoff patterns to receiving waterbody.
- Can reduce detention needs.

filter strips/level spreader

Design Considerations

- Filter strips/level spreaders must be sized and designed to account for drainage area, slope and soils. Chronic hydraulic overloading of filter strips may cause erosion.
- Filtration benefits can be improved by planting native deep-rooted vegetation and by minimizing the slope.
- Infiltration storage within the level spreader trench should be designed to drain in 24 hours to prevent sealing of subsoils.
- Compaction of filter strips should be avoided and/or topsoil should be amended with leaf compost and coarse sand to improve filtration, infiltration and plant establishment.
- Runoff should be diverted away from filter strips during construction until vegetation is established.



cross section of level spreader (Conservation Design Forum)

green roof

green roof (Chicago City Hall, IL) (Conservation Design Forum)

Definition

- Vegetated roof system designed to retain and slow rainwater runoff on the top of roofs. Green roofs are generally planted with drought and wind tolerant vegetation.

Applicability

Scale	☐ Watershed/ County	☐ Town/Village	☐ Neighborhood	☒ Lot
Applications	☒ Retrofit	☒ New		
	☒ Roofs	☐ Streets	☐ Driveways	
	☐ Parking Lots	☐ Lawn	☐ Non-Buildable	
Effectiveness	☒ Runoff Rate Control	☒ Runoff Volume Control	☐ Physical Habitat Preservation/ Creation	☐ Sediment Pollution Control
	☐ Nutrient Control	☐ BOD Control	☐ Other Pollutant Control	

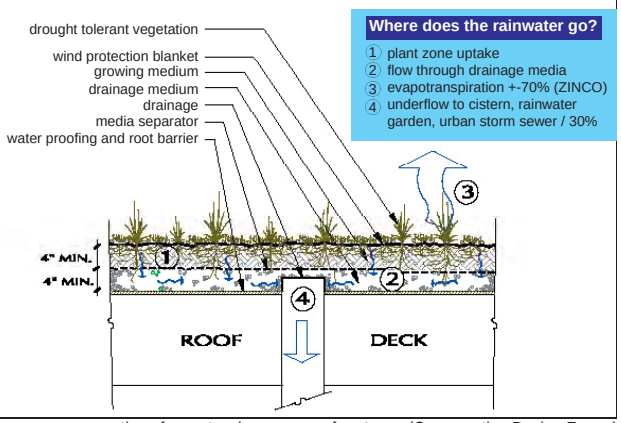
Benefits

- Significantly reduces runoff volumes and rates as well as thermal impacts (50 - 90% reduction in annual runoff).
- Can reduce detention needs.
- Contributes to reduction in urban heat island effect.
- Can reduce energy requirements associated with heating and cooling.
- Creates opportunities for outdoor space as roof top gardens.

greenroof can be applied on various roofs and scales (Germany)

Design Considerations

- Structural load capacity of existing roof system must be evaluated.
- Plant material, such as succulents, that are drought tolerant, should be used on lightweight "extensive" green roof systems.
- A wider range of vegetation may be used on heavier, "intensive" green roof systems with deeper growing medium.
- Use of a granule drainage layer will improve retention and detention benefits relative to drain boards.



cross section of an extensive green roof systems (Conservation Design Forum)

naturalized detention

naturalized wetland detention on Tellabs industrial campus (Bolingbrook, IL) (Conservation Design Forum)

Definition

- Naturalized detention basins are used to temporarily store runoff and release it at a rate allowed by ordinances. Native wetland and prairie vegetation improves water quality and habitat benefits. Naturalized detention may also be used as a retrofit to achieve water quality benefits.

Applicability

Scale	☒ Watershed/ County	☒ Town/Village	☒ Neighborhood	☐ Lot
Applications	☒ Retrofit	☒ New		
	☒ Roofs	☒ Streets	☒ Driveways	
	☒ Parking Lots	☒ Lawn	☒ Sensitive Areas	
Effectiveness	☒ Runoff Rate Control	☐ Runoff Volume Control	☒ Physical Habitat Preservation/ Creation	☒ Sediment Pollution Control
	☒ Nutrient Control	☒ BOD Control	☒ Other Pollutant Control	

Benefits

- Reduces runoff rates.
- Recognized by virtually all stormwater agencies as approved method of controlling stormwater runoff.
- Very effective at removing sediment and associated pollutants.
- Provides attractive site amenity when properly designed and not used as sole BMP on sites with high pollutant/ nutrient runoff.

Design Considerations

- Should be sized to control release to allowable rate.
- Size should reflect use of upstream BMPs.
- Water level fluctuations should be limited to 3-4 feet (during 100-year storm) to maximize plant diversity.
- Shallow water entry angles will minimize shoreline erosion, improve water quality benefits, increase aquatic habitat and plant diversity and provide safety ledge.
- May be used as retrofit along stream corridors to prevent direct discharge of stormwater runoff.

a well designed naturalized wet detention provides extra open space and resting place

porous pavement

porous pavement driveway

Definition

- Permeable or perforated paving materials or pavers with spaces that allow transmission of water to aggregate base and subsoils. Runoff is temporarily stored in the base for infiltration into the subsoils and/or slow release to storm drain system.

Applicability

Scale	☐ Watershed/ County	☐ Town/Village	☒ Neighborhood	☒ Lot
Applications	☒ Retrofit	☒ New		
	☐ Roofs	☒ Streets	☒ Driveways	
	☒ Parking Lots	☐ Lawn	☐ Sensitive Areas	
Effectiveness	☒ Runoff Rate Control	☒ Runoff Volume Control	☐ Physical Habitat Preservation/ Creation	☒ Sediment Pollution Control
	☒ Nutrient Control	☒ BOD Control	☒ Other Pollutant Control	

Benefits

- Reduces runoff volumes and rates.
- Recharges groundwater and sustains base flow.
- Filters sediments and associated pollutants from runoff.
- Can reduce detention needs.

porous pavement allows infiltration through the paving material

Design Considerations

- Base and subbase materials should be coarse aggregate with no fines to allow adequate drainage and prevent frost heave.
- Subgrade should be graded at minimum 1% slope to allow drainage when water entry rate exceeds infiltration capacity of subsoils.
- Subsoils should be compacted to the minimum level necessary to achieve structural stability.
- Geotextiles should be used between base and subgrade to improve structural stability and separate base from subgrade.
- Underdrains should be placed at edge of pavement to provide drainage as necessary to prevent ponding in the base for periods greater than 24 hours.

porous pavement in parking lot

rain barrel/ cistern

rain barrels in back yard (Conservation Design Forum)

Definition

- A vessel used to capture and temporarily store rainwater for various uses, including greywater reuse and irrigation.

Applicability

Scale	☐ Watershed/ County	☐ Town/Village	☐ Neighborhood	☒ Lot
Applications	☒ Retrofit	☒ New		
	☒ Roofs	☐ Streets	☐ Driveways	
	☐ Parking Lots	☐ Lawn	☐ Sensitive Areas	
Effectiveness	☐ Runoff Rate Control	☒ Runoff Volume Control	☐ Physical Habitat Preservation/ Creation	☐ Sediment Pollution Control
	☐ Nutrient Control	☐ BOD Control	☐ Other Pollutant Control	

Benefits

- Reduces runoff volumes.
- Conserves water for reuse.
- Provides irrigation water during watering restrictions.

Design Considerations

- At the residential scales, rain barrels located at downspouts will typically be used.
- One inch of rainfall over 1,000 square feet of roof area is equivalent to 625 gallons of rainwater.
- Rain barrels can be used in combination with rainwater gardens, green roofs and other stormwater BMPs to increase stormwater benefits.
- Larger cisterns in some settings may be used to provide greywater for use in toilet flushing and other non-portable uses.

a cistern system collects rainwater from Chicago Center for Green Technology (Chicago, IL) (Photo: Conservation Design Forum)

rainwater garden

rainwater garden planted with vegetation that attracts butterflies (Maplewood, MN)

Definition

- A landscaped garden designed to retain and detain stormwater runoff from individual lots and roofs.

Applicability

Scale	☐ Watershed/ County	☐ Town/Village	☐ Neighborhood	☒ Lot
Applications	☒ Retrofit	☒ New		
	☒ Roofs	☐ Streets	☒ Driveways	
	☐ Parking Lots	☒ Lawn	☐ Sensitive Areas	
Effectiveness	☒ Runoff Rate Control	☒ Runoff Volume Control	☐ Physical Habitat Preservation/ Creation	☐ Sediment Pollution Control
	☐ Nutrient Control	☐ BOD Control	☐ Other Pollutant Control	

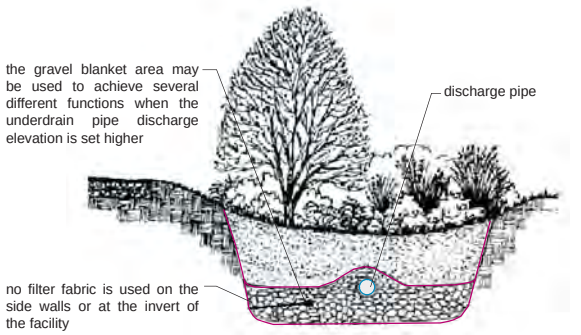
Benefits

- Reduces runoff volumes and rates from lawns, roofs, and driveways.
- Recharges groundwater and sustains base flows.
- Reduces sediment and nutrient runoff.
- Can reduce detention needs.
- Can increase aesthetic value for the properties.
- Can provide wildlife habitat.

roof down spout connects to rainwater garden (Glen Ellen, IL)

Design Considerations

- Rainwater gardens must be sized and designed based on drainage area, soils, and desired runoff volume reduction.
- Filtration and nutrient control benefits can be improved by planting native vegetation.
- The soils in the top 18″ to 24″ should be amended with leaf compost and coarse sand to enhance organic content and improve permeability.
- Where subsoil infiltration rates are low (less than 0.5 to 1.0 in/hr), a gravel trench with underdrain should be used to encourage drainage between events.
- Maximum ponding depths should generally be limited to 6″ to 12″ unless underdrains are used.



rainwater garden cross section (Low Impact Development Center)

vegetated swale

vegetated swales planted with native grasses and forbs along the street

Definition

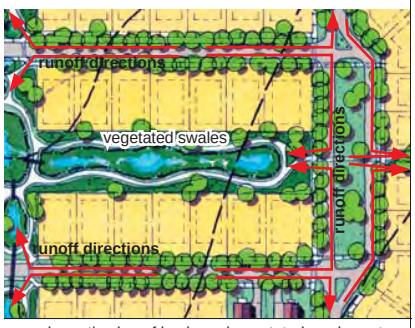
- Vegetated swales are planted stormwater features that convey, retain, infiltrate, and cleanse stormwater.

Applicability

Scale	☐ Watershed/ County	☐ Town/Village	☒ Neighborhood	☒ Lot
Applications	☒ Retrofit	☒ New		
	☒ Roofs	☒ Streets	☒ Driveways	
	☒ Parking Lots	☒ Lawn	☐ Sensitive Areas	
Effectiveness	☒ Runoff Rate Control	☒ Runoff Volume Control	☐ Physical Habitat Preservation/ Creation	☒ Sediment Pollution Control
	☒ Nutrient Control	☒ BOD Control	☒ Other Pollutant Control	

Benefits

- Reduces runoff volumes and rates.
- Provides conveyance and water quality benefits in one stormwater feature.
- Reduces sediment and nutrient runoff.
- With proper design, can reduce detention needs.



schematic plan of back yard vegetated swale system (Conservation Design Forum)

Design Considerations

- Vegetated swales must be sized to convey design runoff rate (typically 10-year storm).
- Filtration benefits can be substantially improved by planting native deep-rooted grasses and forbs and by minimizing the slope.
- Topsoil may be amended with compost and/or coarse sand to improve organic content for filtering and to improve infiltration and retention of runoff.
- Vegetated swales should be protected from construction site runoff to prevent sealing of topsoil and/or subsoils.

back yard vegetated swales

native landscaping

prairie planted in residential development area (Mill Creek, IL)

Definition

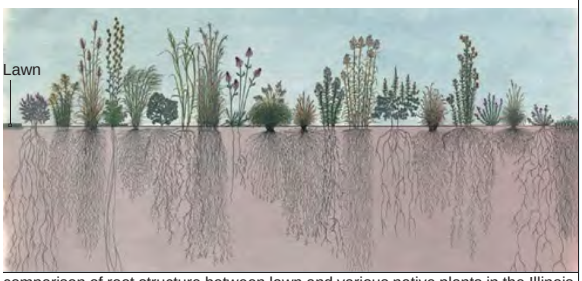
- Establishment of native vegetation in either large restoration projects or smaller gardening projects. Native landscaping is often a component of other BMPs such as detention, filter strips, bioswales, and rainwater gardens.

Applicability

Scale	☐ Watershed/ County	☐ Town/Village	☒ Neighborhood	☒ Lot
Applications	☒ Retrofit	☒ New		
	☒ Roofs	☒ Streets	☒ Driveways	
	☒ Parking Lots	☒ Lawn	☒ Sensitive Areas	
Effectiveness	☐ Runoff Rate Control	☒ Runoff Volume Control	☒ Physical Habitat Preservation/ Creation	☒ Sediment Pollution Control
	☒ Nutrient Control	☒ BOD Control	☒ Other Pollutant Control	

Benefits

- Reduces runoff volumes.
- Increases infiltration rates.
- Increases ability to remove nutrients.
- Increases organic content of soils.
- Increases permeability of compacted soils.
- Reduces irrigation and fertilization requirements.
- Reduces use of fossil fuels and air pollution relative to turf landscapes that require regular mowing and maintenance.
- Provides wildlife habitat.



comparison of root structure between lawn and various native plants in the Illinois and Mid West Region (Conservation Research Institute)

Design Considerations

- Some local "weed" ordinances may need to be amended to allow native and taller vegetation.
- Plant diversity and health is maximized by annual burning. Plots may be mowed and then burned to prevent spread of fire on small sites. Fall burning will select for prairie wildflowers.
- On compacted soils, amendment may be necessary to increase organic content, improving success of establishment.

Blackwell Prairie (IL)

Stormwater BMPs Resources

Planning / Zoning

- Center for Watershed Protection, *Better Site Design*
  http://www.cwp.org/better_site_design.htm
- Northern Illinois Planning Commission (NIPC)
  www.nipc.cog.il.us
- Prince George's County Planning Department
  www.mncppc.org/pgco
- The Conservation Fundation
  http://www.theconservationfoundation.org/tcf/lp/
- The Countryside Program
  http://www.countrysideprogram.org/

Stormwater BMPs

- Center for Watershed Protection, *Stormwater Manager's Resource Center*
  www.stormwatercenter.net
- Kane County Department of Environmental Management, 2001, Kane County Stormwater Technical Guidance Manual.
  http://www.co.kane.il.us/kcstorm/manuals/Technical_FINAL.pdf
- Low Impact Development (LID) Center
  www.lowimpactdevelopment.org
- Maryland Stormwater Design Manual Volumes I & II, 2000.
  http://www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/stormwater_design/index.asp
- Northern Illinois Planning Commission (NIPC)
  www.nipc.cog.il.us
- Portland Stormwater Management Manual 2002
  http://www.cleanrivers-pdx.org/tech_resources/2002_swmm.htm
- Prince George's County Planning Department
  http://www.pgcounty.com/Government/AgencyIndex/DER/PPD/lid.asp?h=&s=&n=50&n1=160
- Green Roof

  Greenroofs.com
  www.greenroofs.com

  Green Roofs for Healthy Cities
  www.peck.ca/grhcc

  Pennsylvania State University, Center for Green Roof Research
  http://hortweb.cas.psu.edu/research/greenroofcenter/
- Rainwater Garden

  RainGardens.org
  www.raingardens.org
- Porous Pavement

  Paveloc Ltd.
  www.paveloc.com

  Unilock Ltd.
  www.unilock.com

Landscaping

- Native Landscaping

  Chicago Wilderness
  http://www.chicagowilderness.org/wildchi/landscape/index.cfm

  EPA
  www.epa.gov/glnpo/greenacres/nativeplants

All Categories

- Appendix J of this Plan

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Resources/Organizations

Planning /Watershed Planning

- Northerneastern Illinois Planning Commission (NIPC),
  www.nipc.cog.il.us
- Prince George's County Planning Department
  www.mncppc.org/pgco
- The Countryside Program
  www.countrysideprogram.org/
- Center for watershed Protection
  www.cwp.org
- Fox River Ecosystem Partnership
  www.foxriverecosystem.org/

Stormwater BMPs/Conservation Design

- Center for Watershed Protection
  www.cwp
- Low Impact Development (LID) Center
  www.lowimpactdevelopment.org
- Prince George's County Department of Environmental Resources
  www.goprincegeorgescounty.com
- Puget Sound Action Team
  www.wa.gov/puget_sound
- Green Roofs

  Greenroofs.com
  www.greenroofs.com

  Green Roofs for Healthy Cities
  www.peck.ca/grhcc

  Pennsylvania State University, Center for Green Roof Research
  http://hortweb.cas.psu.edu/research/greenroofcenter/
- Rain Gardens

  University of Wisconsin Extension Water Resources Programs
  http://clean-water.uwex.edu/pubs/raingarden

  City of Maplewood, Minnesota
  http://www.maplewoodmn.govoffice.com/index.asp?Type=B_BASIC&SEC={1305A6BC-1D9C-48D1-81FE-6226AF4BD322}

  Rain Gardens of West Michigan
  www.raingardens.org

Stormwater BMPs (continued)

- Porous Pavement

  Paveloc Ltd.
  www.paveloc.com

  Unilock Ltd.
  www.unilock.com

Landscaping

- Native Landscaping

  Chicago Wilderness
  www.chicagowilderness.org/wildchi/landscape/index.cfm

  EPA
  www.epa.gov/glnpo/greenacres/
  nativeplants

Floodproofing

- Illinois Association for Floodplain and Stormwater Management
  http://www.illinoisfloods.org
- Federal Emergency Management Agency
  www.fema.gov

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Model Stormwater Drainage and Detention Ordinance: A Guide for Local Officials. Northeastern Illinois Planning Commission. July 1990.
Model Floodplain Ordinance for Communities within Northeastern Illinois. Illinois Department of Natural Resources, Office of Water Resources and Northeastern Illinois Planning Commission. July 1996.

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Model Stream and Wetland Protection Ordinance for the Creation of a Lowland Conservancy Overlay District: A Guide for Local Officials. Northeastern Illinois Planning Commission. October 1988.

Conservation Design Resource Manual: Language and Guidelines for Updating Local Ordinances. Northeastern Illinois Planning Commission. March 2003.

WHO TO CALL IN LAKE COUNTY, IL

DRAINAGE ISSUES

Refer To:	When the Calls Relate To:	Additional Information:
Lake County Stormwater Management Commission **(847) 918-5260** **www.co.lake.il.us/smc**	**1.** Neighborhood, watershed or regional scale problems **2.** Interjurisdictional issues **3.** Involves a violation of the Lake County Watershed Development Ordinance [related to new development and in non-certified communities]	Relies on other governmental units to respond to smaller scale problems; has field staff to investigate drainage complaints in non-certified communities; funding available for repair or maintenance of drainage facilities and drainage problems; compiles drainage data for watershed planning and should be notified by Certified Communities of major problems.
Lake County Planning, Building, & Development Department, Engineering and Environmental Services Division (E&ES) **(847) 377-2600**	1. Complaint is on a parcel located in an unincorporated area. 2. Drainage complaints, erosion control, Site Development Permits 3. Individual, neighborhood, watershed scale problems 4. Involves a violation of the Lake County Unified Development Ordinance (related to older or new development).	Has field staff to inspect and respond to drainage complaints in unincorporated areas; can require remedial activity if in violation of the Lake County Unified Development Ordinance; funding available for repair or maintenance of drainage facilities; provides notification to SMC of regional scale problems.
Local Municipalities	1. Lot and Neighborhood level drainage concerns 2. Emergency response: sandbags, evacuation procedures	Usually have staff or budget through public works to handle common problems; have authority to enter lands to remove blockages even outside own boundaries.
Township Highway Departments **(See below for phone #'s)**	1. Drainage concerns are within the right-of-way of a township road.	Sometimes staff is able to reduce local flooding problems by improvements along ROW but is not common; policies vary from Township to Township; not able to assist in areas outside its own ROW.
Lake County Division of Transportation (LCDOT) **(847) 362-3950**	1. Bridges, culverts, and ditches located within the right-of-way of county roads.	Maintains all bridges, culverts and ditches within the ROW of county highway signs signified by blue and gold route markers saying Lake County.
Lake County Health Department (LCHD), Division of Environmental Health **(847) 360-6740**	1. Contamination of an individual well 2. Failure of individual septic	Primary concern for water quality specifically public beaches, individual wells & septics; will assist if flooding problem results in failure of septic or contamination of well.
Lake County Soil and Water Conservation District (SWCD) **(847) 223-1056**	1. Agricultural drainage issues or drainage issues related to soil erosion.	Provides technical assistant and education; has some information on farm tiles; field staff to make site visits in severe ag/soil erosion situations.
Drainage Districts **(See below for phone #'s)**	1. Problem associated with drainage ditches and streams within a drainage district.	Provides information, technical assistance; field staff may be available for site visits in cases of severe drainage, soil erosion.
Fox Waterway Agency **(847) 587-8540**	1. Debris removal, shoreline protection, flood control, flood warning for Chain area.	Primarily responsible for dredging, debris removal, shoreline protection, flood control, flood warning for Chain O'Lakes area; has staff to do site visits.
Lake County Emergency Management Agency (LCEMA) (Sheriffs Office) **(847) 377-7100**	1. Request for sandbags and evacuation procedures is coordinated by municipal EMA coordinators and township officials.	Primarily responsible for emergency services in a disaster; works closely with local ESDA coordinators during a disaster/flood event. Refer requests for sandbags and evacuation procedures to local municipality or to township; does not distribute insurance claims.
US Geological Survey – Urbana, IL **(217) 344-0037**	1. Provides real-time, unofficial river/stream stage information, rain totals (SMC rain/stream gages are the same as USGS gages)	Data available at: http://il.water.usgs.gov

For updates to this contact sheet, please go to the following website:
http://www.co.lake.il.us/smc/pdfs/citizen/Whotocall_02.pdf

DRAINAGE ISSUES – WHO TO CALL IN LAKE COUNTY, IL

TOWNSHIP HIGHWAY ROAD COMMISSIONERS		HIGHWAY DEPARTMENT	TOWNSHIP OFFICE
Antioch Township	Mark Ring	395-2070	395-3378
Avon Township	Patrick Anderson	546-7480	546-1446
Benton Township	Lawrence Savage	746-2070	746-2100
Cuba Township	Tom Gooch	381-7793	381-1924
Ela Township	Bill Kruckenberg	438-2371	438-7823
Fremont Township	William Grinnell	223-2858	223-2847
Grant Township	Kim Kiesgen	740-7623	740-2233
Lake Villa Township	Jim Jorgensen	356-5831	356-2116
Libertyville Township	Bill Morgan	362-3350	816-6800
Newport Township	Kevin Zupec	336-9698	623-1168
Shields Township	Don Rogers	234-0888	234-0802
Vernon Township	Bryant Schroeder	634-4600	634-4600
Warren Township	Gerald Rudd	244-1101	244-1101
Wauconda Township	Frank Gossell	526-8085	526-2631
Waukegan Township	Michael Hewitt	662-7208	244-4900

Townships Without Highway Commissioners (Lake County has 18 Townships)

Moraine Township	432-3240
West Deerfield Township	945-0614
Zion Township	872-2811

ACTIVE DRAINAGE DISTRICTS*			GENERAL AREAS OF COVERAGE
Avon-Fremont Drainage District	Dennis Sandri, Chairman	(847) 223-2037	Avon and Fremont Townships
Beach Park Drainage District	Vincent Varsek, Chairman	(847) 336-2985	Beach Park, Park City, North Chicago, Waukegan
East Skokie Drainage District	James Bradner, Chairman	(847) 606-6760	Highland Park, Lake Forest, Highwood, Lake Bluff, North Chicago, Waukegan
Grubb School Drainage District	Thomas Doolittle, Chairman	(847) 395-5787	Antioch
Slocum Drainage District	Ed McGlade, Chairman	(847) 526-1355	Cuba and Wauconda Townships
Squaw Creek Drainage Districts	Pete Tekampe. Chairman	(847) 223-2847	Avon, Grant and Fremont Townships
Union Drainage Dist 1 (West Fork)	Gordon McKavanagh, Chairman	(847) 945-0600	West Deerfield, Lake County; Northfield, Cook County
Union Drainage Dist 1 (Middle Fork)	Karl Halperin, Chairman	(773) 481-2700	
West Skokie Drainage District	James Cunningham, Chairmam	(312) 782-4780	Libertyville, Moraine, and Vernon Townships

* Members and Chairmen appointed and reappointed by County Board

FOR MORE INFORMATION CALL:
LAKE COUNTY STORMWATER MANAGEMENT COMMISSION
(847) 918-5260

For updates to this contact sheet, please go to the following website:
http://www.co.lake.il.us/smc/pdfs/citizen/Whotocall_02.pdf

WATER QUALITY ISSUES

Refer To:	When the Calls Relate To:	Additional Information:
Lake County Planning, Building, & Development Department, Engineering and Environmental Services Division (E&ES) **(847) 377-2600**	1. Construction site soil erosion and sediment control problems in Unincorporated Lake County.	Has field staff to inspect and respond to water quality complaints in unincorporated areas; can require remedial activity if in violation of the Lake County Unified Development Ordinance; provides notification to SMC of regional scale problems.
Local Municipalities	1. Construction site soil erosion and sediment control problems in incorporated areas.	Usually have staff or budget through public works to handle common problems in addition to construction site problems. If construction activity is in a non-certified community, may be referred to LCSMC.
Lake County Health Department (LCHD), Division of Environmental Health **(847) 360-6740**	1. Well & septic-related problems. 2. Lake water quality issues.	Primary concern for water quality specifically public beaches, individual wells & septics; will assist if flooding problem results in failure of septic or contamination of well.
Lake County Soil and Water Conservation District (SWCD) **(847) 223-1056**	1. Technical assistance on soil erosion issues.	Agricultural, urban, and water body-related technical guidance; Provides technical assistant, education, and information on cost-share programs; field staff may make site visits in severe soil erosion situations.
Illinois Environmental Protection Agency **Joan.Muraro@epa.state.il.us** **(217) 782-0610** **Chris Kalis**	1. Water pollution problems.	Enforce stormwater pollution prevention plan on development sites greater than 1 acre in size; address contaminant spills, point source discharges, etc. Secondary contact: Chris Kalis (847) 294-4000
Lake County Stormwater Management Commission (LCSMC) **(847) 918-5260**	1. As referred by entities listed above.	Relies on other governmental units to respond to smaller scale problems; has field staff to investigate construction-related water quality concerns in non-certified communities; funding available for repair or maintenance of drainage facilities and drainage problems; compiles drainage data for watershed planning and should be notified by Certified Communities of major problems.

NATURAL AREAS ISSUES

Refer To:	When the Calls Relate To:	Additional Information:
Natural Resource Conservation Service of the U.S. Dept. of Agriculture (NRCS) **(847) 223-1056**	1. Technical assistance on natural resource issues. 2. Information about cost-share programs.	Can prepare Natural Resource Inventories for a property.
Illinois Department of Natural Resources (IDNR) **(217) 782-6302**	1. State natural areas. 2. Wildlife and fisheries. 3. Regulatory requirements.	
Lake County Forest Preserve District (LCFPD) **(847) 367-6640**	1. Lake County Forest Preserve properties and programs. 2. Technical assistance for vegetative issues in natural areas. 3. Volunteer opportunities.	Numerous natural areas owned by the residents of Lake County are managed by the LCFPD.
Chicago Wilderness **http://www.chicagowilderness.org**	1. The region's natural lands and the plants and animals that inhabit them	Serves northwestern Indiana, northeastern Illinois, and Southeastern Wisconsin. Focus is on protection of natural plant communities and biodiversity.
U.S. Army Corps of Engineers **(312) 353-6400**	1. Wetlands.	Requires for activities within most wetlands. May refer some questions to LCSMC.

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