Thorn Creek Watershed Based Plan Addendum

Prepared for

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December 2014

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1. Introduction

Thorn Creek flows north from its origin near Monee in eastern Will County to its confluence with the Little Calumet River in South Holland in Cook County. Thorn Creek and its major tributaries — Deer Creek, Butterfield Creek, and North Creek — form a 107 square mile subwatershed of the Little Calumet River watershed, including approximately 3 square miles in Indiana. Thorn Creek itself runs through the Illinois municipalities of University Park, Park Forest, South Chicago Heights, Chicago Heights, Glenwood, Thornton, and South Holland.

In 2003, using funding from the Illinois Environmental Protection Agency (Illinois EPA), the Northeastern Illinois Planning Commission (NIPC) initiated the development of a pilot watershed based plan for the Thorn Creek Watershed. Completed in 2005, the *Thorn Creek Watershed Based Plan* (2005 Watershed Based Plan) focused on nonpoint source pollution, particularly in the 26 square mile watershed of the Thorn Creek main stem, but also identified a range of issues adversely affecting the area of study. The most pressing watershed issues emerged from early meetings with stakeholders, which were combined with additional information to develop a set of goals and objectives for the watershed that were categorized as either resource-based goals, such as habitat restoration, or watershed coordination goals, such as improved education and outreach. The Thorn Creek Watershed Based Plan focused closely on the goal of protecting and enhancing surface water quality to support uses designated for Thorn Creek by Illinois EPA. Other resource-based goals were considered, including protecting and restoring aquatic and terrestrial habitat, protecting and enhancing groundwater quality and quantity, and reducing flooding and flood-related damages. The watershed coordination goals included improving cooperation among stakeholders in the watershed, such as businesses, universities, and governments, and educating stakeholders about their role in protecting the watershed.

Water quality sampling data from several sources were analyzed to determine the extent of impairment by various contaminants. A land use pollutant loading model was also employed to relate water quality problems back to the mix of land uses and the amount of impervious surface in the watershed. Watershed stakeholders reviewed the results and concluded that the water quality constituents most in need of attention included the presence of pathogenic organisms (as indicated by fecal coliform), low dissolved oxygen, hydrologic modification, dumping and debris, and road salt runoff.

A set of Watershed Management Recommendations (WMRs) was developed to address the goals stakeholders identified as most important to them. From there, a smaller subset of WMRs directed at surface water quality was selected for further elaboration, with estimates of their effectiveness and cost to implement. Stakeholders then prioritized these water quality related WMRs.

1.1 Watershed Update Components

In 2013, the Chicago Metropolitan Agency for Planning (CMAP) received funds from Illinois EPA to update the 2005 Watershed Based Plan. Illinois EPA specifically requested a watershed-wide summary of BMPs recommended for implementation within the Thorn Creek Watershed. This information will be used, in part, to support the development of a Thorn Creek TMDL (total maximum daily load) implementation plan by Illinois EPA. This update focuses on an evaluation of nonpoint source pollution control best management practices (BMPs) appropriate to address a variety of water quality issues identified in this watershed. Major tasks undertaken to support this update included:

1. Updating nonpoint source pollutant load estimates for the watershed by land use and by subwatershed, using more-current (2010) land use data. Fecal coliform and chloride pollutant load reductions were evaluated in addition to the parameters listed in Illinois EPA's Financial

Assistance Agreement No. 604121. Chloride pollutant loads were evaluated from a source-reduction perspective.

2. Identifying a preferred suite of BMPs to be evaluated for inclusion within the watershed analysis. Appropriate pollutant removal efficiencies for each BMP type identified were validated based on current literature and other sources, such as the International BMP Database[1].
3. Conducting a focused assessment of the Thorn Creek Watershed to evaluate other types of watershed improvement projects identified in the 2005 Watershed Based Plan, such as opportunities for buffer establishment in agricultural areas and streambank stabilization. This assessment combined desktop data analysis and on-the-ground evaluation of sites on Thorn Creek and its tributaries. The results were used to develop watershed-wide estimates for the total extent of each type of BMP opportunity.
4. Compiling appropriate criteria for BMP designs at the site-scale that were then extrapolated to the implementation of BMPs at the subwatershed and watershed scales.
5. Developing and analyzing a BMP implementation scenario and estimating pollutant load reductions and implementation costs of this scenario at the subwatershed scale. The total extent of the recommended BMPs (e.g., total acres of recommended bioretention areas, etc.), the total estimated pollutant load reductions and the implementation costs at the subwatershed and watershed scales are summarized as a part of this update.

[1] *International BMP Database*, 2012. http://www.bmpdatabase.org/

2. Existing Conditions Analyses

Collecting and analyzing existing information for the Thorn Creek Watershed is an important element in reducing uncertainty in the recommendations provided in this plan update. Existing land use information is summarized in the following section to serve as the basis for the recommendations included in the remaining sections of the plan update. In this analysis of existing conditions, nonpoint sources of total nitrogen, total phosphorus, total suspended solids (TSS), fecal coliform, and chloride to the Thorn Creek watershed were evaluated and are discussed in subsequent subsections.

2.1 Thorn Creek Watershed Land Use

CMAP supplied its preliminary 2010 land use data for the Cook and Will County portions of the Thorn Creek Watershed for this report. CMAP also provided the Northwestern Indiana Regional Planning Commission's 2010 land use data for the Indiana portion of the watershed. In 2010, land use within the Thorn Creek Watershed was comprised primarily of urban land (57%).[2] The remaining land was classified as agriculture (19%), open space (16%), or vacant or under construction (7%). Urban land use was primarily comprised of low- and mid-density residential areas (46%), followed by areas categorized as transportation, communication, utilities or waste (29%).

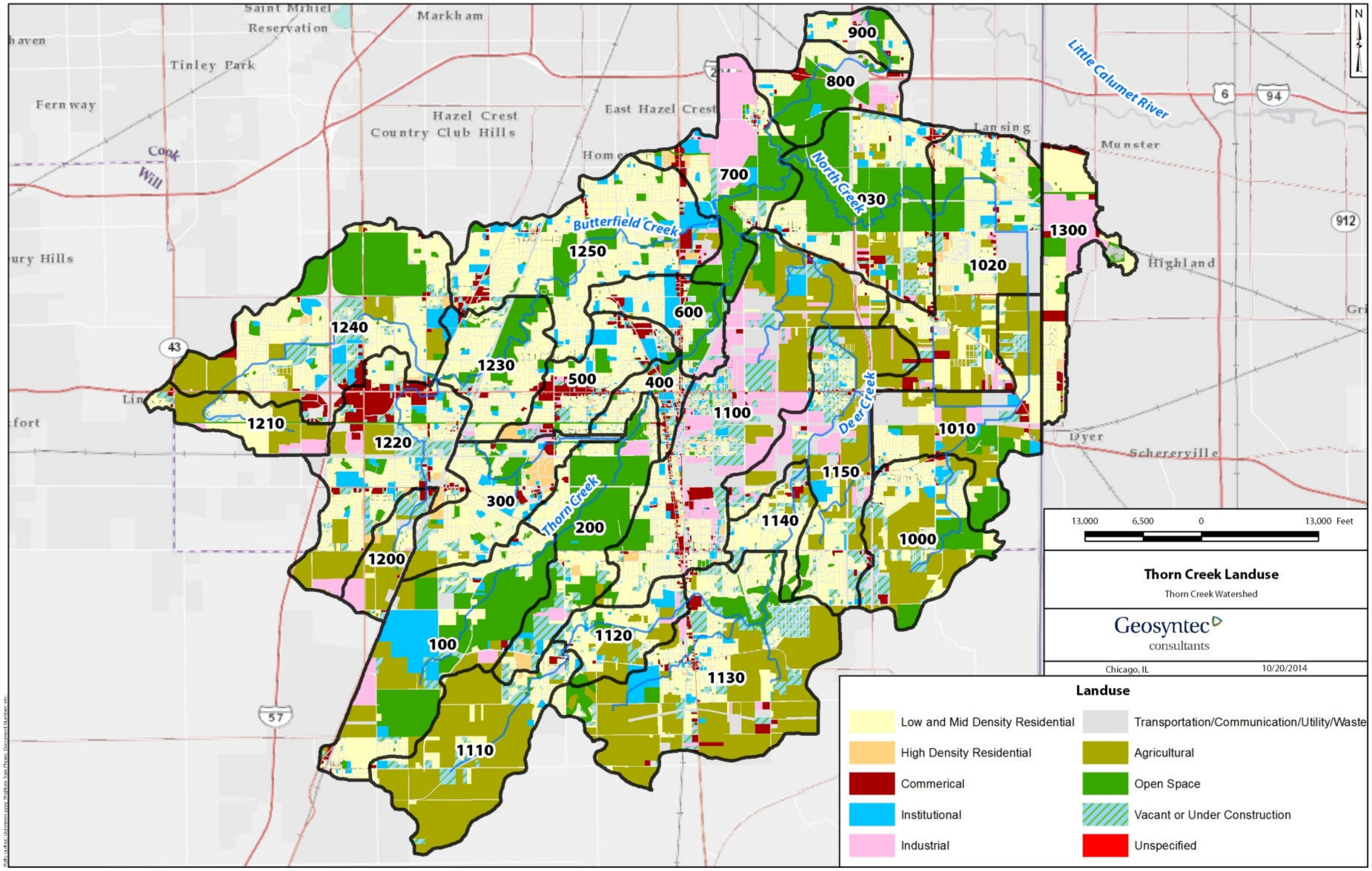
Table 2.1 and Figure 2.1 provide a "snapshot" of land use within the watershed based on the most recent (2010) publicly available information. This same information was also incorporated into the watershed plan development process, such as developing pollutant load estimates (Section 2.4). Appendix A provides a breakdown of the land use by subwatershed.

Table 2.1 Land Use within Thorn Creek Watershed.

Land Use	Acres	Percent of Watershed
Low- and Mid-Density Residential	18,169	26%
Agriculture	13,304	19%
Transportation, Communication, Utility or Waste	11,385	16%
Open Space	11,241	16%
Vacant or Under Construction	4,823	7%
Industrial	3,590	5%
Institutional	3,255	5%
Commercial	2,232	3%
High-Density Residential	891	1%
Not Classifiable	149	<1%
Total	**69,041**	**100%**

[2] Urban uses include the following land use types: Residential; Commercial; Institutional; Industrial; and Transportation, Communication, Utilities or Waste.

Figure 2.1 Land Use within Thorn Creek Watershed.



2.2 Existing Conditions Pollutant Load Analysis

A critical step in providing recommendations within this plan is the identification of the different pollutant sources within the watershed and the relative magnitude of pollutant loads from those sources. In this analysis, nonpoint sources of total nitrogen, total phosphorus, total suspended solids (sediment), and fecal coliform are quantified as pollutant loads. (A chloride analysis is provided in Section 2.3.)

In an effort to refine the pollutant load estimates for the watershed, the pollutant load estimates were developed at the subwatershed level using delineated watershed boundaries, which separates the Thorn Creek watershed into 26 subwatersheds (Figure 2.2). Estimating the pollutant loads at the subwatershed level, as well as at the watershed level, provides the opportunity to evaluate subwatersheds on a relative pollutant load contribution basis and to better target the recommendations included in this plan and in future planning efforts within the Thorn Creek Watershed.

Total nitrogen, total phosphorus, total suspended solids, and fecal coliform pollutant load calculations were performed in a Microsoft Excel® spreadsheet model.[3] The model is a simple planning tool with common limitations. It is not an in-stream response model and is an un-calibrated tool that only estimates watershed pollutant loading based on coarse data, such as event mean concentrations. Other considerations and limitations of the spreadsheet model include the following:

- annual nutrient loading based on the runoff volume and runoff pollutant concentrations is based on land use;
- a single event mean concentration is utilized to represent pollutant concentration for all storm events;
- pollutant loads are estimated for storm events only and are based on average rainfall amount;
- stream channel erosion is not accounted for as a pollutant source;
- drain tiles are not included as a pollutant source; and
- construction sites are not included as a pollutant sources.

The Microsoft Excel® spreadsheet model is based on the following equation:

Export coefficient (lb/ac/yr) = $P \times CF \times Rv \times C \times F$

where P = Annual precipitation (in/yr)

CF = Correction factor adjusting for storms with no runoff

Rv = Runoff coefficient = $0.05 + (0.009 \times I)$

I = Percent impervious

C = Event mean concentration (mg/l for chemical constituents or colonies/100 mL for bacteria.

F = Unit conversion factor of 0.226 for chemical constituents and 1.03E-3 for bacteria.

Export coefficients for total nitrogen, total phosphorus, and total suspended solids were calculated for each subwatershed. Inputs to these calculations included CMAP's land use inventory for 2005 (area per land use), an annual rainfall of 39.6 inches per year, and a correction factor of 0.9. Land use-specific event

[3] The model was developed by Geosyntec in large part based on a study performed in 1993 by Tom Price of NIPC for the Lake County Stormwater Management Commission. A similar approach was used in the 2005 Thorn Creek Watershed Based Plan.

mean concentrations for these three chemical constituents were back-calculated and adopted from the 2005 Thorn Creek Watershed Based Plan. Similarly, impervious percentages of land-use categories were adopted from the 2005 Watershed Based Plan.

Similarly, fecal coliform export coefficients were estimated for each subwatershed in the Thorn Creek Watershed. However, event mean concentrations were evaluated and adopted from various literature sources including another regional watershed, the North Mill Creek/Dutch Gap Canal Subwatershed in Lake County, Illinois.[4] An event mean concentration for the transportation land use category was not available for the North Mill Creek/Dutch Gap Canal Subwatershed. Therefore, this value was estimated to be 1800 colonies per 100 mL based on the literature review. The total annual pollutant loading for each constituent in the Thorn Creek Watershed is equal to the sum of the pollutant loadings in the subwatersheds (Table 2.2). Visual representations of the total nitrogen, total phosphorus, total suspended solids, and fecal coliform pollutant loads on subwatershed basis are illustrated figures presented in Appendix A. These results indicate that based on existing watershed conditions, urban land is the largest nonpoint source contributor of sediment (92%), total phosphorus (86%), total nitrogen (89%) and fecal coliform (94%).

[4] North Mill Creek/Dutch Gap Canal Watershed-Based Plan, Lake County, Illinois and Kenosha County, Wisconsin. November 2011. Prepared by NorthWater Consultants on behalf of Lake County Stormwater Management Commission. Available at http://www.lakecountyil.gov/Stormwater/LakeCountyWatersheds/DesPlainesRiver/Pages/NorthMillCreek.aspx.

Figure 2.2 Thorn Creek Subwatersheds.

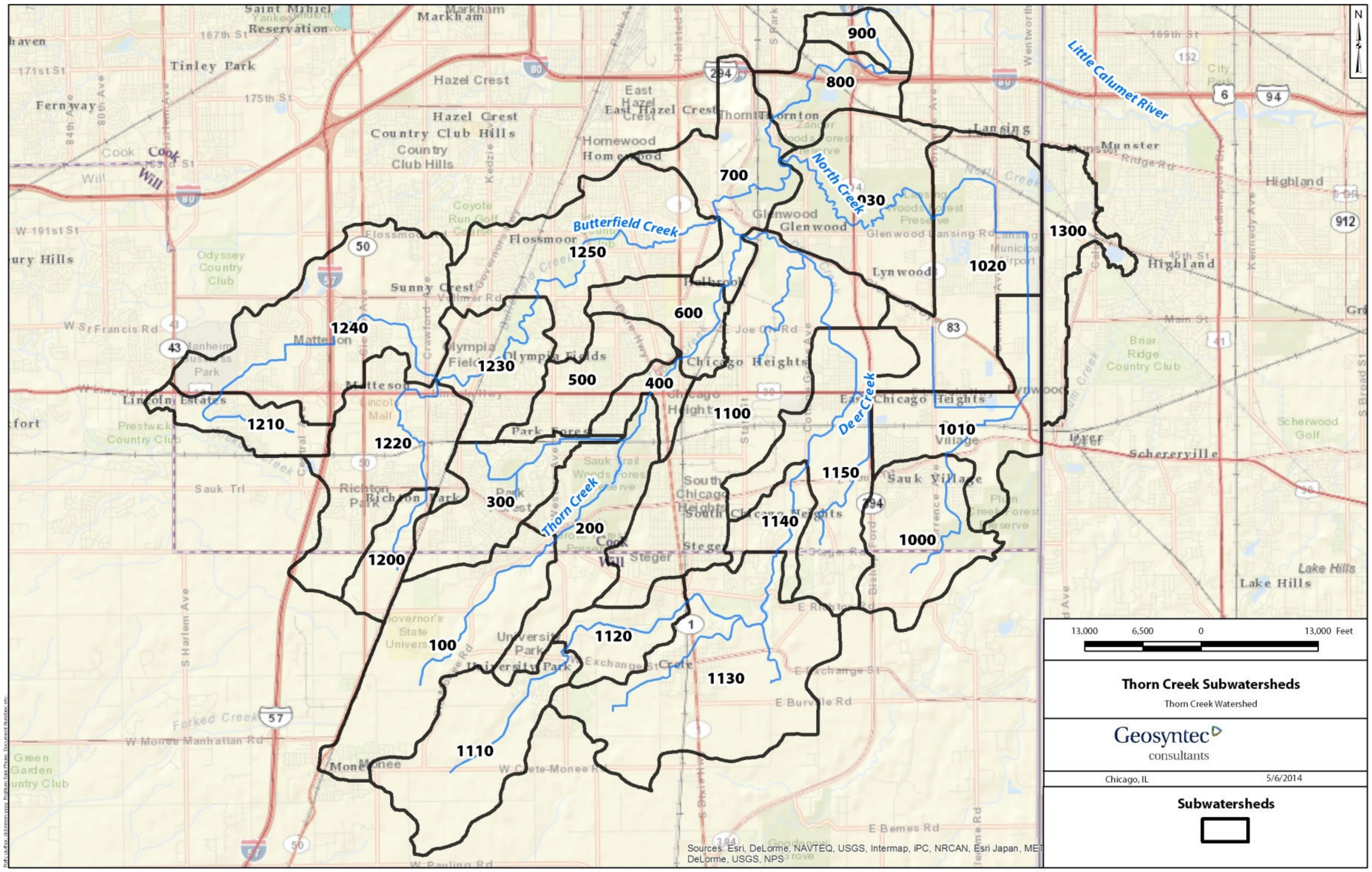


Table 2.2 Existing Conditions Nonpoint Source Pollutant Load Estimates (per acre per year)

Subwatershed	Total Nitrogen Load Estimate (lb/ac/yr)	Total Phosphorus Load Estimate (lb/ac/yr)	Sediment Load Estimate (t/ac/yr)	Fecal Coliform Load Estimate (billion colonies/ac/yr)
(Indiana)	11.5	1.2	0.4	45.0
100	6.1	0.9	0.3	16.7
200	5.1	0.8	0.3	19.6
300	9.3	1.2	0.5	35.9
400	10.6	1.3	0.6	35.2
500	11.4	1.3	0.6	37.7
600	9.6	1.3	0.5	27.5
700	9.3	1.2	0.5	30.6
800	8.2	1.2	0.5	24.2
900	8.4	1.2	0.5	30.4
1000	5.6	0.7	0.3	18.4
1010	7.1	0.9	0.4	20.3
1020	8.4	1.1	0.5	29.3
1030	5.9	0.9	0.3	18.5
1100	9.8	1.2	0.6	30.3
1110	4.4	0.5	0.2	13.4
1120	6.5	0.8	0.3	24.0
1130	5.9	0.7	0.3	17.5
1140	7.8	1.0	0.4	32.1
1150	8.2	1.0	0.5	25.2
1200	7.7	0.9	0.4	25.1
1210	7.0	0.8	0.3	26.3
1220	10.3	1.2	0.5	31.0
1230	7.8	1.1	0.4	28.9
1240	7.2	1.0	0.4	23.9
1250	9.2	1.2	0.5	33.9

2.3 Chloride Loading Analysis

It is expected that a significant portion of the chloride loading in the Thorn Creek Watershed is from roadway, parking lot, and sidewalk deicing activities. Because municipalities are responsible for purchasing and applying the significant amounts of chloride-based deicers, chloride loads are estimated for each municipality in the watershed. However, no data are readily available on the amount of chloride-based deicing compounds currently being used throughout the watershed. Therefore, Geosyntec obtained survey information collected by the DuPage River Salt Creek Workgroup for several local municipalities to estimate the current amount of chloride-based deicers applied.

Usable responses of the surveys were received from the following Illinois units of local government: Addison, Bloomingdale, Bolingbrook, DuPage County, Hanover Park, Naperville, West Chicago, and Woodridge. For the winter of 2011-2012, they reported using between 230 and 1,070 pounds of salt per lane-mile per salt application event. The reported mean, standard deviation, and median were 490, 313, and 327 pounds of salt per lane-mile per salt application event, respectively. Therefore, an analysis of the current chloride load to the Thorn Creek Watershed was performed assuming applications of 300, 400, 500, and 800 pounds per lane-mile per salt application event as displayed in Table 2.3.

Table 2.3 Chloride Loading Scenarios.

	Lane Miles[1]	**@ 300 lb/lane-mile** (tons/year)	**@ 400 lb/lane-mile** (tons/year)	**@ 500 lb/lane-mile** (tons/year)	**@ 800 lb/lane-mile** (tons/year)
County Roads	199	543	724	905	1,447
Chicago Heights	287	784	1,045	1,307	2,091
Country Club Hills	15	41	55	68	109
Crete	111	303	405	506	809
Flossmoor	83	226	301	377	603
Ford Heights	36	98	130	163	261
Frankfort	4	10	14	17	28
Glenwood	65	179	238	298	476
Homewood	62	169	225	281	450
Lansing	114	311	415	519	830
Lynwood	101	276	368	460	737
Matteson	214	585	780	974	1,559
Monee	28	77	103	129	206
Olympia Fields	94	257	343	429	686
Park Forest	153	418	557	696	1,114
Richton Park	91	248	331	414	663
Sauk Village	80	218	290	363	581
South Chicago Height	45	124	165	206	330
South Holland	50	137	182	228	364
Steger	102	278	371	464	742
Thornton	42	114	153	191	305
University Park	62	169	226	282	452
	Total	**5,565**	**7,421**	**9,276**	**14,841**

1) The quantity of lane-mile in each of the 21 municipalities within Thorn Creek Watershed were identified in an Illinois Department of Transportation Geographic Information System (GIS) layer (http://gis.dot.illinois.gov/gist2/).

3. Stream Assessment

Geosyntec conducted a limited stream assessment in April 2014 of Thorn Creek and its tributaries. The streams were generally assessed at bridges or other structures crossing Thorn Creek or its major tributaries: Butterfield, Deer, and North Creeks. Where possible, information also was gathered at major confluences or headwater locations. Data collected included a visual assessment of stream condition, adjacent land use, and environmental factors that could be attributed to altered flows and nonpoint source pollution. Sixty (60) locations were evaluated during the reconnaissance. Prior to the field reconnaissance, the stream channels were evaluated remotely through a desktop analysis. Aerial photography was used to identify possible large scale issues within the watershed, such as stream alterations, land uses that could contribute to nonpoint source pollution impairments, presence or absence of stream buffers, evidence of streambank erosion, in-channel impoundments, or other features of interest. The findings of the desktop analysis, field notes, and photographs of conditions at each location visited were compiled as a part of the evaluation. General conclusions on concerns and opportunities in the Thorn Creek Watershed are noted in this section of the watershed plan update.

3.1 General Stream Observations

Figure 3.1 Thorn Creek main stem showing typical bank scour and erosion.

Thorn Creek and its major tributaries flow through portions of Will and Cook Counties that have a wide range of land uses and development levels. Many portions of Thorn Creek are contained within county forest preserves or local parks. These areas are characterized by floodplain forests, well developed stream buffers, and few stream alterations. A large portion of the creek passes through Chicago Heights where it is mostly buffered by city parks. The upper portions of Thorn Creek consist mostly of agricultural land uses with some smaller residential developments. The main stem of Thorn Creek shows evidence of heavy stormwater flows (Figure 3.1). Much of the stream observed has a fairly well established riparian corridor, at least 25 feet from the top of the bank on both banks at many sites. However, at the majority of sites where agriculture was noted as a dominant land use, minimal riparian corridor was present. Seventy percent of the sites had clearly visible culverts discharging to the stream indicating the stream is receiving a large amount of stormwater.

Butterfield Creek: The confluence of Butterfield Creek and Thorn Creek is well buffered and dominated by floodplain forest. Further upstream, the creek appears moderately degraded and contains minimal buffering as it flows through portions of several community golf courses. Portions of stream banks appeared eroded within the golf courses, with turf grass dominating the majority of the corridor. Further upstream in Matteson, the stream receives direct runoff from residential lawns, agriculture, and commercial development. Portions of Butterfield Creek and its tributaries have been straightened and channelized to accommodate parking lots, roads, and new subdivisions. Little buffer exists in those sections of the creek.

Deer Creek: The confluence of Deer Creek and Thorn Creek is dominated by floodplain forest. Sections surrounding Ford Heights have minimal buffer and appear to have been modified by agricultural and light industrial uses. The tributaries to Deer Creek appeared to have similar characteristics. In the sections of Deer Creek located downstream from Crete, buffers are narrow but present; agriculture and two golf courses have altered portions of the riparian corridor. The portions of Deer Creek and its tributaries upstream of Crete flow mostly through agricultural areas – minimal buffering was observed in this section of the watershed. Headwater areas are also dominated by agriculture land use.

Figure 3.2 North Creek main stem on north side of Lansing Municipal Airport.

North Creek: The lower half of North Creek, running upstream from the confluence of Thorn Creek, is located within several county forest preserves with an abundant forested floodplain. The upper half of the stream appeared to be mostly channelized and modified with minimal buffering as it passes through the Lansing Municipal Airport (Figure 3.2). At Lynwood, the creek passes a large Metropolitan Water Reclamation District regional stormwater facility.

The following is a summary of the observations from the sixty locations visited during the stream assessment effort.

- A completely forested cover was noted at 30 percent of locations.
- Thirty (30) percent of the locations received agricultural runoff.
- Bank erosion and sedimentation were noted at over 50 percent of the locations.
- No riparian corridor or natural buffer was noted at 22 percent of the locations.
- Fifty (50) percent of the locations appeared to have evidence of widening to accommodate stream flows through bridges, culverts, or other roadway crossings.
- At many locations where private homes were observed, maintained lawns typically reached to the edge of the bank with little to no buffer.
- Locations that intersected a golf course appeared to be severely channelized with minimal buffering.

3.2 Stream-Related Water Quality Improvement Opportunities

Results from the desktop analysis and stream assessment were compiled to form a set of possible opportunities for improvement. These improvement areas are focused to address nonpoint source pollution sources and stream restoration. The primary opportunities observed were stream buffer enhancement, streambank stabilization, and stream channel restoration. These possible water quality improvement opportunities were geo-located within the watershed and estimates of the overall amounts of each opportunity were developed as summarized in Table 3.1. It is important to note that these are estimates and the feasibility of implementing any of the identified BMPs is contingent on stakeholder participation, availability of funding, governmental approvals, and technical feasibility.

Table 3.1 Observed Stream-Related BMP Opportunities.

Observed Opportunities	Approximate Quantity Observed
Buffer Enhancement (urban)	24 miles
Buffer Enhancement (ag)	14 miles
Streambank Stabilization	1.5 miles
Stream Restoration	27 miles

Watershed-wide, Thorn Creek and its tributaries would benefit from a comprehensive program to address in-channel debris. An annual watershed "stream sweep," focused on the removal of trash, litter, and debris, would help alleviate blockages and fish passage impediments, but would also serve as an opportunity to educate stakeholders on important issues in this watershed. Additionally, implementing a stream maintenance program, which is discussed in more detail in Section 4.4, could help correct small issues before they became larger problems.

4. BMP Recommendations

4.1 Urban Stormwater Infrastructure Retrofits

Approximately 57 percent of the Thorn Creek Watershed that has already been developed is classified as "Urban" land. In the developed portion of the watershed, stormwater is generally routed directly from impervious surfaces to stormwater collection and conveyance systems with minimal water quality treatment or stormwater volume reductions. In more recently-developed portions of the watershed, stormwater detention has been incorporated into the sites; however, the majority observed did not provide a water quality benefit. Consistent with current stormwater regulations, the primary goal of providing detention is to reduce the discharge rate of stormwater to decrease downstream flooding. However, the outflow volume from most detention basins remains higher than the pre-developed condition. The increased volume, coupled with the elevated flows from such detention basins during an extended drawdown period, is a major cause of increased streambank erosion in urban streams. Additionally, the use of traditional detention basins does not address the environmental impacts (i.e. increased pollutant concentrations and runoff volume) of increased imperviousness. The urban retrofit projects are intended to provide examples of projects that should be implemented in urban areas to allow for improved pollutant removal or stormwater volume reductions.

Many of the project recommendations center on retrofit opportunities within the watershed. It is important to reiterate that incorporating BMPs into new construction is much more cost-effective and efficient than retrofitting existing systems. Site stormwater BMPs should be incorporated at the time of initial design and built during initial construction. This approach offers the most options from the palette of BMPs, providing the engineer more flexibility and more cost-effective solutions. However, current ordinances do not mandate the use of stormwater BMPs to specifically address the pollutants of concern in the Thorn Creek Watershed. For this reason, the plan update focuses on retrofit opportunities within the watershed.

A variety of urban BMPs could be used throughout the watershed, many of which could provide multiple benefits. This plan update proposes the installation of bioretention (and biofiltration), vegetated swales, detention basin retrofits, and building retrofits – such as planter boxes and green roofs – as the primary retrofit practices.[5] Three objectives guided the identification of urban retrofit projects included in this plan update:

- Manage stormwater at the source;
- Use plants and soil to absorb, slow, filter, and cleanse runoff; and
- Recommend stormwater facilities that are simple, cost-effective, and enhance community aesthetics.

[5] Stormwater BMPs are routinely grouped into categories based upon their unit processes. However, there is no set standard for grouping BMPs, nor should they be isolated into any single category when their use is evaluated. Individuals evaluating the use and applicability of BMPs should tailor the design to blend the benefits of various BMPs. For example, a vegetated swale (which provides settling and filtration of suspended solids by flowing through the surface vegetation) could be modified to include amended soil in the bottom of the swale along with check dams to improve infiltration and filtration through the soil media (which is a process more commonly associated with bioretention).

4.1.1 BIORETENTION

Bioretention areas, or rain gardens, are landscaped shallow depressions that store and filter stormwater runoff. These facilities normally consist of a ponding area, mulch layer, amended soils, and plantings. For areas with low permeability soils or steep slopes, bioretention areas can be designed with amended soils and an optional underdrain system that routes the treated runoff to the storm drain system rather than depending entirely on infiltration.

Bioretention areas function as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. As stormwater passes down through the planting soil, pollutants are filtered, adsorbed, and biodegraded by the soil and plants. Bioretention areas have a wide range of applications and can be easily incorporated into existing residential, commercial, and industrial areas. These facilities can also be used within roadway right-of-ways. Runoff from the site is typically conveyed in shallow engineered open conveyances, shallow pipes, curb cuts, or other innovative drainage structures. Where underlying soils have limited infiltration capacity, an underdrain should be included. Additional volume losses may be realized if the perforated pipe is placed above the bottom of the gravel drainage layer.

An alternative to bioretention retrofits for highly urbanized locations are the Filterra Bioretention Systems (Figure 4.1). These bio*filtration* systems are designed to treat stormwater pollution by incorporating trees and shrubs into curb inlet boxes to trap and treat the stormwater before entering the system. Expected pollutant removal ranges from as much as 70% for phosphorus, 45% for nitrogen, and up to 85% for TSS. A specialized Filterra unit, Bacterra, is expected to remove as much as 98% fecal coliform. While these systems are designed to treat smaller drainage areas they can be an effective urban retrofit to treat water quality.

Figure 4.1 Filterra system. (Source: Filterra.com)

4.1.2 VEGETATED SWALE (CONVEYANCE) RETROFITS

Figure 4.2 Vegetated swale. (Source: werf.org)

Vegetated swales are shallow, open conveyance channels with low-lying vegetation covering the side slopes and bottom that collect and slowly convey runoff through the vegetated bottom to downstream discharge points. Swales remove stormwater pollutants by filtering flows through vegetation (usually grasses) and by allowing suspended pollutants to settle due to the shallow flow depths and slow velocities in the swale. Biochemical processes also provide treatment of dissolved constituents. Vegetated swales can also provide effective volume reduction through infiltration and evapotranspiration processes. An effective vegetated swale achieves uniform sheet flow through a densely vegetated area for a period of at least 10 minutes. The vegetation in the swale can vary depending on its location within a development project, is the choice of the designer, and is based upon the relevant functional criteria for the project. When appropriate, swales that are integrated within a project may use turf or other more intensive landscaping, while swales that are located on the project perimeter, within a park, or close to an open space area are encouraged to be planted with a more naturalistic plant palette.

Swales have a wide range of applications and can be used in residential, commercial, and industrial areas as well as treatment for linear projects such as roadways. A vegetated swale can be designed either on-line or off-line. On-line vegetated swales are used for conveying high flows as well as providing treatment of the water quality design flow rate, and can replace curbs, gutters, and storm drain systems. Off-line swales are the preferred practice, but in densely developed areas off-line swales may not always be feasible. In this case, limiting drainage areas and periodically providing outlets along the length of the swale to prevent the accumulation of excessive flows from inputs along the swale can improve the performance of on-line swales. Check dams are also recommended where longitudinal slopes exceed six percent. Check dams enhance sediment removal by causing stormwater to pond, allowing coarse sediment to settle out.

4.1.3 DETENTION BASIN RETROFITS

Myriad detention basins have been constructed throughout the Thorn Creek Watershed, particularly in the central and southern portions of the watershed that were developed more recently. Both dry and wet detention facilities are common. Dry basins were typically vegetated with turf grass and designed to drain completely after storm events. Dry basins also commonly had low flow channels that route flows from basin inlets to the basin outlet with little or no water quality treatment.

Figure 4.3 Traditional wet detention basin.

Figure 4.4 Traditional dry detention basin with low flow channel.

A common dry detention basin retrofit to enhance water quality is to modify the design to incorporate sections of wetland vegetation. Wetland type detention basins typically include components such as an inlet with energy dissipation structures, a sediment forebay to settle out coarse solids and to facilitate maintenance, perimeter areas with shallow sections (0 to 2 feet deep) planted with wetland vegetation, deeper areas or micro pools (3 to 5 feet deep), and a two stage outlet structure to improve water quality treatment. Meandering swales can also be incorporated into the basins to increase the residence time during low flow conditions.

The interactions between the incoming stormwater runoff, aquatic vegetation, wetland soils, and the associated physical, chemical, and biological unit processes are a fundamental part of wetland basin designs. Detention basin wetlands are generally designed as plug flow systems in which the water already present in the permanent pool is displaced by incoming flows with minimal mixing and no short circuiting. Plug flow describes the hypothetical condition of stormwater moving through the wetland in such a way that older slugs of water (meaning discreet volumes of water that have been in the wetland a longer duration) are displaced by incoming slugs of water. This concept assumes there is little or no mixing of slugs in the direction of flow. Short circuiting occurs when quiescent areas or dead zones develop in the wetland where pockets of water remain stagnant, causing other volumes to bypass using shorter flow paths through the basin (e.g., incoming stormwater slugs bypass these dead zones).

Enhancements that maximize residence time, aid in trapping and uptake of pollutants, or assist with volume reduction are the main categories of enhancements available for wetland basins. Water quality benefits can be improved with a larger permanent pool, shallower depths, and denser vegetation. Wetland vegetation with known pollutant uptake potential may also enhance wetland performance. Outlet controls may be used to seasonally change wet pool depths and flow rates through the system to increase residence time. Extended detention flow control may also be integrated into the design to improve peak flow reductions.

4.1.4 BUILDING RETROFITS

Building retrofits are effective BMP techniques that can be viable options in many settings, including in urban areas that are dominated by impervious surfaces and roof tops. Three common techniques include the use of planter boxes, green roofs, and blue roofs.

Figure 4.5 Example raingarden.

Planter boxes are bioretention treatment control measures that are completely contained within an impermeable structure with an underdrain. The boxes can be comprised of a variety of materials, such as brick or concrete, and are filled with gravel on the bottom, planting soil media, and vegetation. Planter boxes require splash blocks for flow energy dissipation and geotextile filter fabric or choking stone to reduce clogging of the underdrain system.

Figure 4.6 Example green roof.

Green roofs (also known as eco-roofs and vegetated roof covers) are roofing systems that layer a soil/vegetative cover over a waterproofing membrane. There are two types of green roofing systems; extensive, which is a light-weight system, and intensive, which is a heavier system that allows for larger plants but requires additional structural support. Green roofs rely on highly porous media and moisture retention layers to store intercepted precipitation and to support vegetation that can reduce peak flows and the volume of stormwater runoff via evapotranspiration. Reduced flows may also limit contaminant mobilization and allow other downstream BMPs to perform more effectively by increasing the percent of runoff volume captured.

Figure 4.7 Example blue roof.

Blue roofs are yet another form of green infrastructure, but unlike green roofs they are non-vegetated systems that focus on collecting stormwater. A blue roof system detains rainwater directly on a rooftop and slowly releases that water to the sewer system, allowing for some depression storage and evaporation losses. The water collected can be used for irrigation, a site infiltration system, a rain garden, or slowly discharge into the sewer system. Blue roofs are less costly than green roofs due to the lack of materials required are most effective and practical when installed on relatively flat surfaces, which are often associated with commercial or industrial buildings. Blue roofs do not provide benefits such as energy use reduction or habitat and aesthetic appeal, but they do slightly outperform green roofs for stormwater reduction. Due to the light colored roofing material they can also provide sustainability benefits through rooftop heat reduction. In some cases, special structural considerations are necessary to ensure that adequate support is provided for the detained water and blue roof materials themselves.

4.1.5 PERMEABLE PAVEMENT

Figure 4.8 Example permeable pavement.

Permeable pavement in its many variations contains small voids that allow water to pass through to a stone base where runoff is retained and sediments and metals are treated to some degree. Porous asphalt and porous concrete are poured in place while pavers are typically precast and installed in an interlocking array to create a surface. The use of permeable pavement in lieu of conventional pavement surfaces reduces the runoff volume and flow rates while maintaining functionality. Permeable pavement can be applied to residential, commercial, and industrial areas as an alternative to traditional impermeable surfaces like sidewalks and parking lots. Permeable pavements typically are applied to infiltrate stormwater. In soils that prohibit infiltration, an underdrain system will likely be required. These pavements also remove stormwater pollutants through limited sorption and filtration. The paving surface, subgrade, and installation requirements of permeable pavements are more complex than those for conventional asphalt or concrete surfaces.

4.1.6 ESTIMATED LOAD REDUCTIONS AND IMPLEMENTATION COSTS

BMP scenarios were chosen to estimate the potential load reductions throughout the watershed. The scenarios modeled treat 18-20% of the watershed using a combination of urban and suburban BMP distributions. (i.e., the urban sub-basins contain more retrofit and distributed BMPs while the suburban sub-basins contain more retention basins and regional BMPs). The BMP distributions are displayed in Table 4.1.

Table 4-1. BMP Distributions.

BMP Type	Urban	Non-Urban
Bioretention/Raingarden	5%	5%
Vegetated Swale Retrofits	5%	5%
Detention Basin Retrofits	5%	10%
Green Roof	0.5%	0%
Filterra	0.5%	0%
Bacterra	0.5%	0%
Permeable Pavement	2%	0%
Total	**18.5%**	**20%**

Pollutant load reductions estimates for the implementation of a select few from of the suite of BMPs recommended in this section were calculated with a watershed model by using literature estimates of pollutant removal efficiencies.[6] BMPs were selected based on a combination of the pollutant analysis, field assessment, and land use. A summary of the pollutant load reduction estimates are also presented in Appendix C. The reader should recognize the use of pollutant removal efficiencies, or percent removal, to

[6] The model was developed by Geosyntec in large part based on a study performed in 1993 by Tom Price of NIPC for the Lake County Stormwater Management Commission. A similar approach was used in the 2005 Thorn Creek Watershed Based Plan.

estimate pollutant load reductions has several shortcomings.[7] As a result, the estimates derived from the analyses described above do not represent absolute expected results from the implementation of BMPs recommended in this plan, and are only planning-level estimates. BMP costs were developed from cost information derived through various Geosyntec projects and from other sources such as the USDA Forest Service and Milwaukee Metropolitan Sewer District.

4.2 Stream Channel and Riparian Corridor Restoration

As noted in Section 3, several watershed opportunities were identified for stream channel and riparian corridor restoration. These opportunities included stream buffer enhancement, streambank stabilization, and stream restoration (i.e., remeandering channelized segments). The following paragraphs provide brief summaries of the opportunities identified for watershed-wide implementation.

Figure 4.9 Example streambank stabilization project.

Instability of stream channels was observed several locations during the watershed reconnaissance effort. This evidence included portions of the stream channels with variable degrees of stream bank erosion, ranging from moderate to severe. These eroding streams can be a significant source of sediment as well as sediment-bound nutrients. Eroding stream banks and downcutting channels can also detrimentally affect property and infrastructure. Remedial actions to address channel stability concerns require a detailed understanding of the processes causing the channel instability. For example, an exposed stream bank may be the result of bank erosion by stream flows or may be caused by downcutting of the stream channel and subsequent slumping of the stream bank. Remedial actions need to account for the severity of the channel instability. Moderate cases of stream bank instability may be addressed through relatively simple methods, including minor grading and establishment of deep-rooted vegetation as opposed to mowed turf grass. Areas with severe erosion will typically require more involved evaluation and remedies.

Riparian buffers are vegetated areas next to streams that protect the water body from nonpoint source pollution, provide bank stabilization, and provide aquatic and wildlife habitat. Ideally riparian buffers should be composed of native vegetation including grasses or trees, or both. Along many reaches of the stream channels within in the Thorn Creek Watershed, the riparian corridor has been impacted by human activities. Some of these activities include turf grass management up to the stream, agricultural uses, and commercial and industrial facilities immediately adjacent to the stream. The establishment of new riparian buffers in the watershed will likely present challenges given that the buffer areas are generally impacted in order to meet the needs of the property owners. However, opportunities exist within the watershed where buffers can be established.

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[7] As Jones et al. writes, "[p]ercent removal is primarily a function of influent quality. In almost all cases, higher influent pollutant concentrations into functioning BMPs result in reporting of higher pollutant removals than those with cleaner influent. In other words, use of percent removal may be more reflective of how 'dirty' the influent water is than how well the BMP is actually performing." Jones, J.E., J. Clary, E. Strecker, and M. Quigley. 2008, "15 Reasons You Should Think Twice Before Using Percent Removal to Assess BMP Performance," *Stormwater*, January-February 2008.

One of the objectives of the stream assessment effort was to identify opportunities within the watershed for stream restoration. The primary method for identifying these opportunities was through the physical stream characteristic assessment. From this assessment, several stream segments stood out as having relatively degraded physical stream characteristics, such as channelization. Project elements for the identified stream restoration opportunities would include remeandering the stream channel; improving the riparian zone through planting native vegetation, including trees; and installing in-stream structures such as rock riffles with the goals of improving habitat for aquatic organisms and sediment transport.

Table 4.2 identifies the estimated extent and costs of the stream channel and riparian corridor restoration opportunities on a watershed-wide scale. It should be noted here that in addition to grant funding opportunities, wetland mitigation funds from regulated wetland impacts in other portions of the watershed may be a viable funding source for these types of projects.

Table 4.2 Watershed-Wide Stream Channel and Riparian Corridor Restoration Pollutant Load Reduction and Cost Estimates.

BMP	Amount Identified	Nitrogen Reduction (lb/year)	Phosphorus Reduction (lb/year)	Sediment Reduction (lb/year)	BOD Reduction (lb/year)	Estimated Cost[1]
Buffer Installation (urban)	24 miles	355.1	61.1	1,950.0	16.6	$ 2,530,000
Buffer Installation (non-urban)	14 miles	1,990.4	552.9	2,003.3	313.0	$ 1,480,000
Stream Stabilization	1.5 miles	948.7	365.2	1,897.4	515.6	$ 190,080
Stream Restoration	27 miles	ND	ND	ND	ND	$ 9,970,440
Total		**3,294.3**	**979.2**	**5,850.7**	**845.2**	**$14,170,500**

[1] Costs were derived from cost information derived through various Geosyntec projects and from other sources such as the USDA Forest Service.
ND - not determined or insufficient data

4.3 Chloride Reduction Strategies

The removal of chloride from stormwater runoff through implementation of typical stormwater BMPs presents a challenge in that the effectiveness of most BMPs for chloride removal is limited. As a result, the preferred approach for addressing chloride loading within the watershed is through source reduction. The recommendation to address chloride in the Thorn Creek Watershed is separated into two components to target chloride loadings from roadway deicing activities and from commercial and residential sources.

The first component of the recommendation is for watershed communities to evaluate and implement alternative roadway snow and ice management methods. This may include the use of alternative products that have lower, or no, chloride content to supplement road salt usage, such as beet juice. Alternative approaches of snow and ice management should also be included, such as pretreatment of road surfaces with liquid anti-icing products in advance of winter storm events. Admittedly, public safety is of the utmost importance in the evaluation of alternative snow and ice management methods. Therefore, the watershed municipalities should carefully evaluate the effectiveness of alternative products and approaches.

The DuPage River Salt Creek Workgroup formed a Chloride Committee and the Chloride Education and Reduction Program to develop and promote alternatives to conventional roadway deicing practices and guide the implementation of alternatives. An element of their program was gathering information from the 80 municipal deicing programs via survey questionnaires and evaluating alternative anti-icing programs that reduce chloride runoff. As mentioned in Section 2 of this report, the mean salt application rate from the survey was 490 pounds/lane mile.

Assuming similar application rates were applied from the municipalities within the Thorn Creek Watershed, the estimated chloride loading would be approximately 9,000 tons/year. If alternative anti-icing programs were implemented throughout the watershed to reduce mean salt application rates to 300 pounds/lane mile, an estimated 3,500 tons/year, or 40 percent, of chloride loading could be reduced to Thorn Creek and its tributaries.

4.4 Stream Maintenance and Restoration

Reaches of Thorn Creek and its tributaries are in need of debris and trash removal that contributes to overbank flooding and streambank erosion. While debris removal is often necessary, some amount of large woody debris is important, since it provides fish habitat and substrate for the aquatic insects that break down organic debris in the stream.

The recommendation for the Thorn Creek Watershed and its tributary watersheds is that communities should work cooperatively with park districts, forest preserve districts, school districts, and private land owners in the long-term ecological management of stream corridors, wetlands, and upland natural areas. In particular, watershed communities should work cooperatively to implement a regular stream maintenance program that balances improved conveyance with habitat considerations. This effort should entail the enlistment of ecologists, biologists and engineers from organizations operating within the watershed in providing on-going input into the stream maintenance program activities.8 This input should include evaluations of maintenance needs and the methods employed for the maintenance activities. An example of the latter is that the implementation of appropriate soil erosion and sediment control measures should be a critical consideration for stream maintenance activities.

4.5 Farmed Wetland Restoration

Figure 4.10 Farmed wetland site within Thorn Creek Watershed.

Farmed wetlands are wetlands that were partially drained or altered to improve crop production before the Wetland Conservation Compliance provisions (Swampbuster) were enacted in the 1985 Farm Bill. Restoring farmed wetlands improves groundwater quality, helps trap and break down pollutants from runoff, prevents soil erosion, reduces downstream flood damage, and provides habitat for waterfowl and other wildlife. Restoring wetlands is typically accomplished by breaking drainage tiles and building an embankment to pond runoff.

Using a comparison of CMAP's 2005 and 2010 land use data, three farmed wetlands were identified within the Thorn Creek Watershed. One of the farmed wetlands identified is shown in Figure 4.10. An EPA Spreadsheet Tool to Estimate Pollutant Loads (STEPL) was used to estimate the potential pollutant reductions if the wetlands were restored. Table 4.3 displays the estimated pollutant reductions and cost for these projects.

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[8] An example of a stream maintenance program that claims to address both conveyance and habitat concerns is provided at: http://www.scwa.ca.gov/stream-maintenance-program/

Table 4.3 Farmed Wetland Restoration Pollutant Load Reduction and Cost Estimates.

BMP Type	Wetland Area (acres)	Nitrogen Reduction (lb/year)	Phosphorus Reduction (lb/year)	Sediment Reduction (lb/year)	BOD Reduction (lb/year)	Estimated Cost[1]
Wetland 1	3.2	218.2	81.9	580.9	58.9	$ 46,096
Wetland 2	5.3	340.5	127.7	918.9	91.0	$ 76,347
Wetland 3	6.5	661.1	245.1	1,977.3	164.3	$ 93,633
Total	**15**	**1,219.8**	**454.8**	**3,477.1**	**314.2**	**$ 216,076**

1) BMP costs were derived through various sources such as the USDA and the Ecosystem Marketplace.

Appendix A

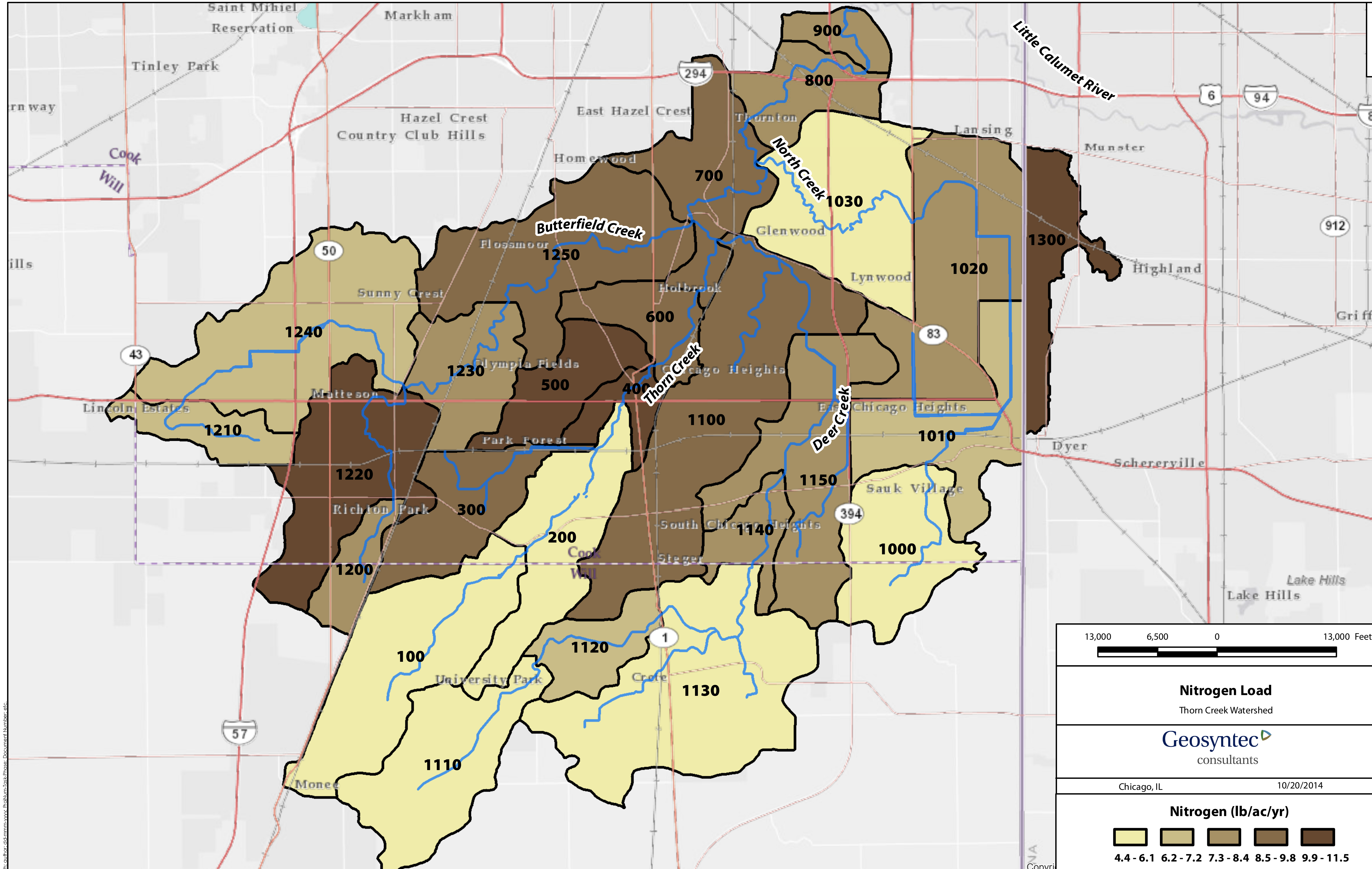
Subwatershed Land Use

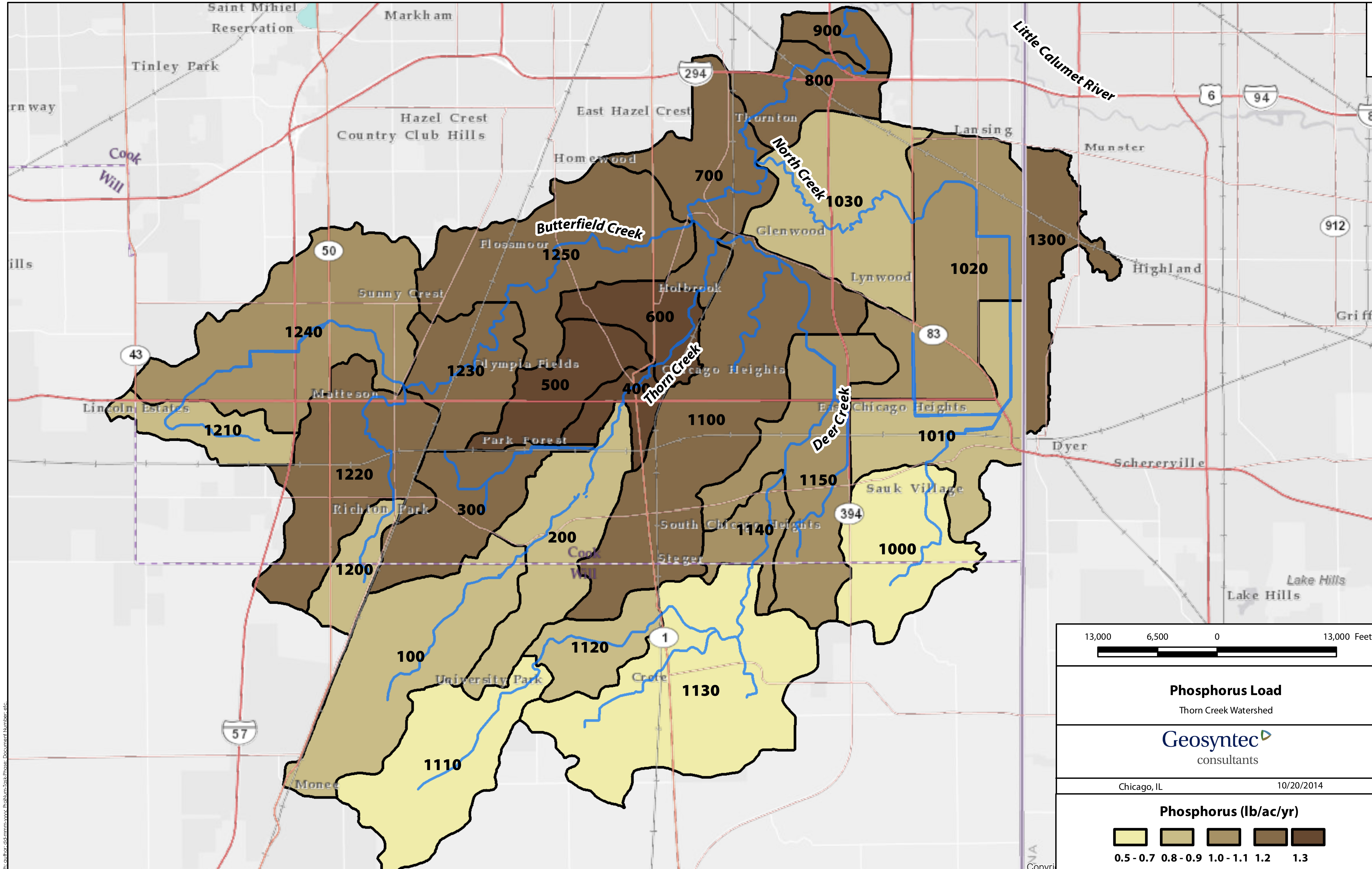
Thorn Creek Landuse Breakdown

Watershed ID	Low and Mid Density Residential	Agriculture (ac/percent)	Transportation/ Communications/ Utility/Waste	Open Space	Vacant or Under Construction	Industrial	Institutional	Commercial	High Density Residential	Not Classifiable	Total
	Ac (%)	Ac (%)	Ac (%)	Ac (%)	Ac (%)	Ac (%)	Ac (%)	Ac (%)	Ac (%)	Ac (%)	Ac
Indiana	860 (51%)	7 (0%)	0 (0%0	147 (9%)	0 (0%)	423 (25%)	0 (0%)	219 (13%)	14 (1%)	0 (0%)	1671
100	713 (18%)	596 (15%)	355 (9%)	1470 (37%)	180 (4%)	146 (4%)	532 (13%)	27 (1%)	2 (0%)	0 (0%)	4023
200	571 (21%)	49 (2%)	245 (9%)	1359 (49%)	278 (10%)	103 (4%)	65 (2%)	11 (0%)	81 (3%)	0 (0%)	2762
300	809 (39%)	143 (7%)	487 (23%)	195 (9%)	117 (6%)	14 (1%)	148 (7%)	56 (3%)	126 (6%)	0 (0%)	2097
400	224 (32%)	0 (0%)	190 (27%)	89 (12%)	50 (7%)	2 (0%)	59 (8%)	57 (8%)	41 (6%)	0 (0%)	712
500	562 (36%)	0 (0%)	314 (20%)	109 (7%)	108 (7%)	35 (2%)	171 (11%)	192 (12%)	90 (6%)	2 (0%)	1583
600	340 (27%)	2 (0%)	270 (21%)	299 (23%)	46 (4%)	81 (6%)	173 (14%)	55 (4%)	6 (0%)	0 (0%)	1274
700	282 (11%)	0 (0%)	247 (10%)	915 (37%)	73 (3%)	704 (28%)	159 (6%)	54 (2%)	51 (2%)	1 (0%)	2488
800	286 (19%)	10 (1%)	380 (26%)	603 (41%)	3 (0%)	99 (7%)	28 (2%)	43 (3%)	9 (1%)	7 (0%)	1471
900	279 (42%)	5 (1%)	136 (21%)	15 (23%)	9 (1%)	31 (5%)	31 (5%)	10 (1%)	1 (0%)	4 (1%)	661
1000	571 (23%)	914 (37%)	286 (11%)	317 (13%)	289 (12%)	4 (0%)	70 (3%)	35 (1%)	14 (1%)	0 (0%)	2501
1010	485 (17%)	1015 (36%)	581 (21%)	374 (13%)	115 (4%)	83 (3%)	97 (3%)	42 (1%)	6 (0%)	0 (0%)	2798
1020	1397 (33%)	834 (19%)	945 (22%)	415 (10%)	167 (4%)	82 (2%)	146 (3%)	129 (3%)	101 (2%)	66 (2%)	4284
1030	770 (21%)	284 (8%)	531 (14%)	1675 (45%)	148 (4%)	26 (1%)	110 (3%)	103 (3%)	38 (1%)	9 (0%)	3695
1100	907 (15%)	1069 (18%)	1435 (24%)	367 (6%)	652 (11%)	967 (16%)	201 (3%)	171 (3%)	97 (2%)	6 (0%)	5873
2220	397 (13%)	2192 (71%)	193 (6%)	19 (1%)	229 (7%)	0 (0%)	37 (1%)	17 (1%)	11 (0%)	0 (0%)	3096
1120	459 (37%)	336 (27%)	114 (9%)	63 (5%)	159 (13%)	27 (2%)	85 (7%)	11 (1%)	1 (0%)	0 (0%)	1256
1130	1055 (18%)	2672 (47%)	677 (12%)	398 (7%)	549 (10%)	48 (1%)	191 (3%)	139 (2%)	9 (0%)	0 (0%)	5740
1140	508 (55%)	67 (7%)	152 (17%)	39 (4%)	117 (13%)	1 (0%)	10 (1%)	23 (3%)	0 (0%)	0 (0%)	919
1150	703 (19%)	1063 (29%)	782 (21%)	60 (2%)	506 (14%)	381 (10%)	101 (3%)	45 (1%)	4 (0%)	3 (0%)	3648
1200	119 (14%)	360 (42%)	135 (16%)	2 (0%)	109 (13%)	95 (11%)	1 (0%)	26 (3%)	20 (2%)	0 (0%)	867
1210	362 (32%)	463 (41%)	145 (13%)	22 (2%)	40 (4%)	85 (8%)	0 (0%)	6 (1%)	0 (0%)	0 (0%)	1125
1220	959 (27%)	551 (16%)	739 (21%)	132 (4%)	310 (9%)	113 (3%)	169 (5%)	407 (12%)	87 (2%)	22 (1%)	3490
1230	850 (44%)	2 (0%)	386 (20%)	463 (24%)	77 (4%)	9 (0%)	92 (5%)	30 (2%)	6 (0%)	0 (0%)	1915
1240	1520 (31%)	633 (13%)	852 (17%)	1055 (22%)	384 (8%)	1 (0%)	199 (4%)	175 (4%)	38 (1%)	24 (0%)	4882
1250	2181 (52%)	36 (1%)	808 (19%)	501 (12%)	109 (3%)	29 (1%)	378 (9%)	148 (3%)	40 (1%)	3 (0%)	4234
TOTAL	**18169 (26%)**	**133304 (19%)**	**11385 (16%)**	**11241 (16%)**	**4823 (7%)**	**3590 (5%)**	**3255 (5%)**	**2232 (3%)**	**891 (1%)**	**149 (0%)**	**69041**

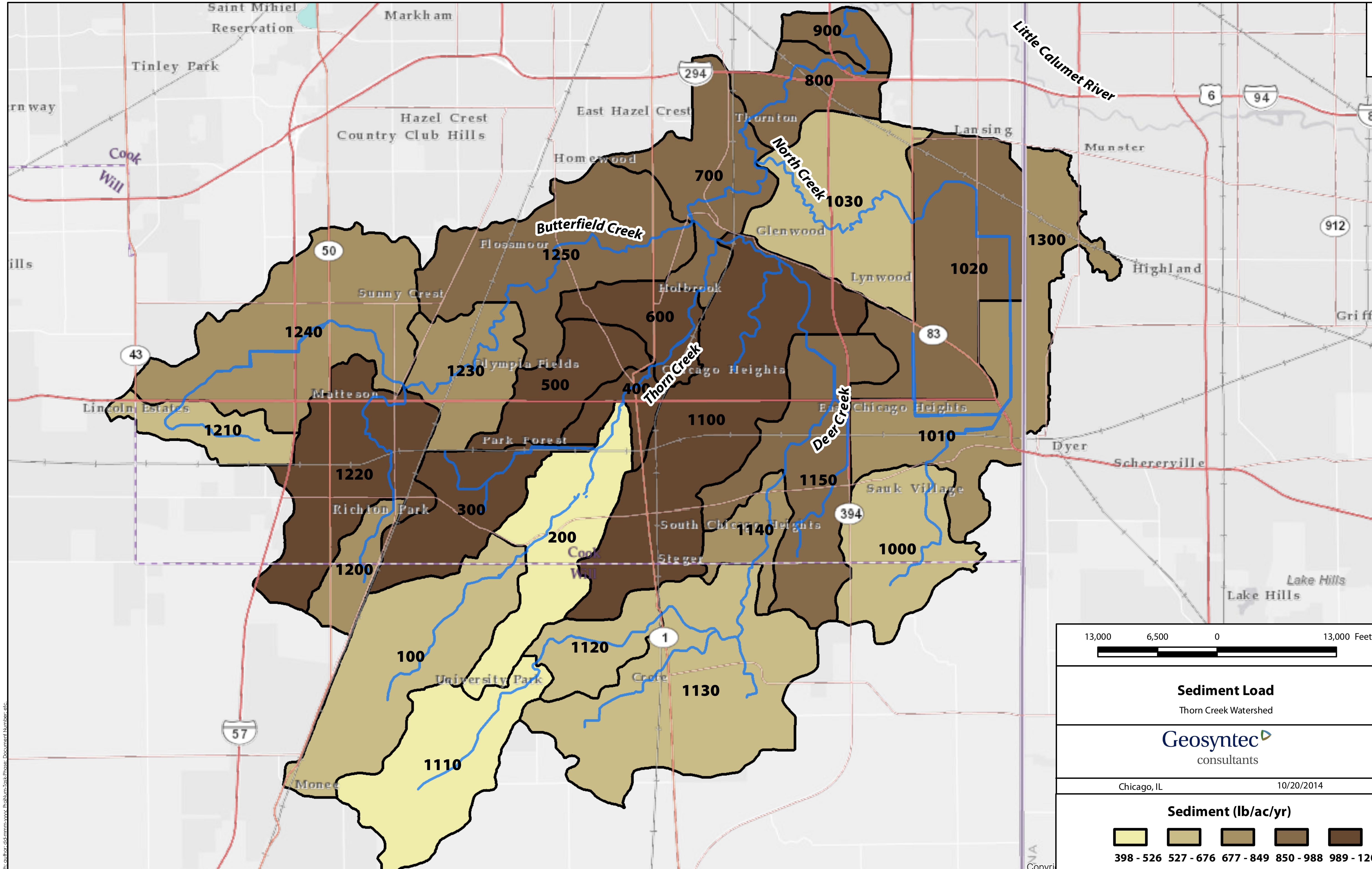
Appendix B

Existing Conditions NPS Pollutant Load Estimates – Maps


Nitrogen Load
Thorn Creek Watershed
Geosyntec consultants
Chicago, IL
10/20/2014
Nitrogen (lb/ac/yr)
4.4 - 6.1
6.2 - 7.2
7.3 - 8.4
8.5 - 9.8
9.9 - 11.5
13,000
6,500
0
13,000 Feet
N
Little Calumet River
Butterfield Creek
North Creek
Thorn Creek
Deer Creek
100
200
300
400
500
600
700
800
900
1000
1010
1020
1030
1100
1110
1120
1130
1140
1150
1200
1210
1220
1230
1240
1250
1300
Saint Mihiel Reservation
Markham
Tinley Park
Hazel Crest
Country Club Hills
East Hazel Crest
Homewood
Thornton
Lansing
Munster
Glenwood
Lynwood
Highland
Flossmoor
Sunny Crest
Holbrook
Olympia Fields
Chicago Heights
Matteson
Lincoln Estates
East Chicago Heights
Park Forest
Dyer
Schererville
Sauk Village
Richton Park
South Chicago Heights
Steger
Lake Hills
University Park
Crete
Monee
Cook
Will
294
6
94
80
912
50
43
83
394
1
57



Phosphorus Load
Thorn Creek Watershed
Geosyntec consultants
Chicago, IL
10/20/2014
Phosphorus (lb/ac/yr)
0.5 - 0.7
0.8 - 0.9
1.0 - 1.1
1.2
1.3
13,000
6,500
0
13,000 Feet
N
Butterfield Creek
Thorn Creek
North Creek
Deer Creek
Little Calumet River
100
200
300
400
500
600
700
800
900
1000
1010
1020
1030
1100
1110
1120
1130
1140
1150
1200
1210
1220
1230
1240
1250
1300
Saint Mihiel Reservation
Markham
Tinley Park
Hazel Crest
Country Club Hills
East Hazel Crest
Homewood
Thornton
Lansing
Munster
Glenwood
Lynwood
Highland
Flossmoor
Sunny Crest
Holbrook
Olympia Fields
Chicago Heights
Matteson
Lincoln Estates
Park Forest
East Chicago Heights
Dyer
Schererville
Sauk Village
Richton Park
South Chicago Heights
Steger
Cook
Will
University Park
Crete
Monee
Lake Hills


Sediment Load
Thorn Creek Watershed
Geosyntec consultants
Chicago, IL
10/20/2014
Sediment (lb/ac/yr)
398 - 526
527 - 676
677 - 849
850 - 988
989 - 1206
13,000
6,500
0
13,000 Feet
N
Little Calumet River
North Creek
Butterfield Creek
Thorn Creek
Deer Creek
900
800
700
1030
1300
1020
1250
600
1240
1230
500
400
1100
1010
1210
1220
1150
300
200
1140
1000
1200
100
1120
1130
1110
Saint Mihiel Reservation
Markham
Tinley Park
Hazel Crest
Country Club Hills
East Hazel Crest
Homewood
Thornton
Lansing
Munster
Glenwood
Flossmoor
Sunny Crest
Holbrook
Lynwood
Highland
Olympia Fields
Chicago Heights
Matteson
Lincoln Estates
East Chicago Heights
Park Forest
Dyer
Schererville
Sauk Village
Richton Park
South Chicago Heights
Steger
Cook
Will
Lake Hills
University Park
Crete
Monee
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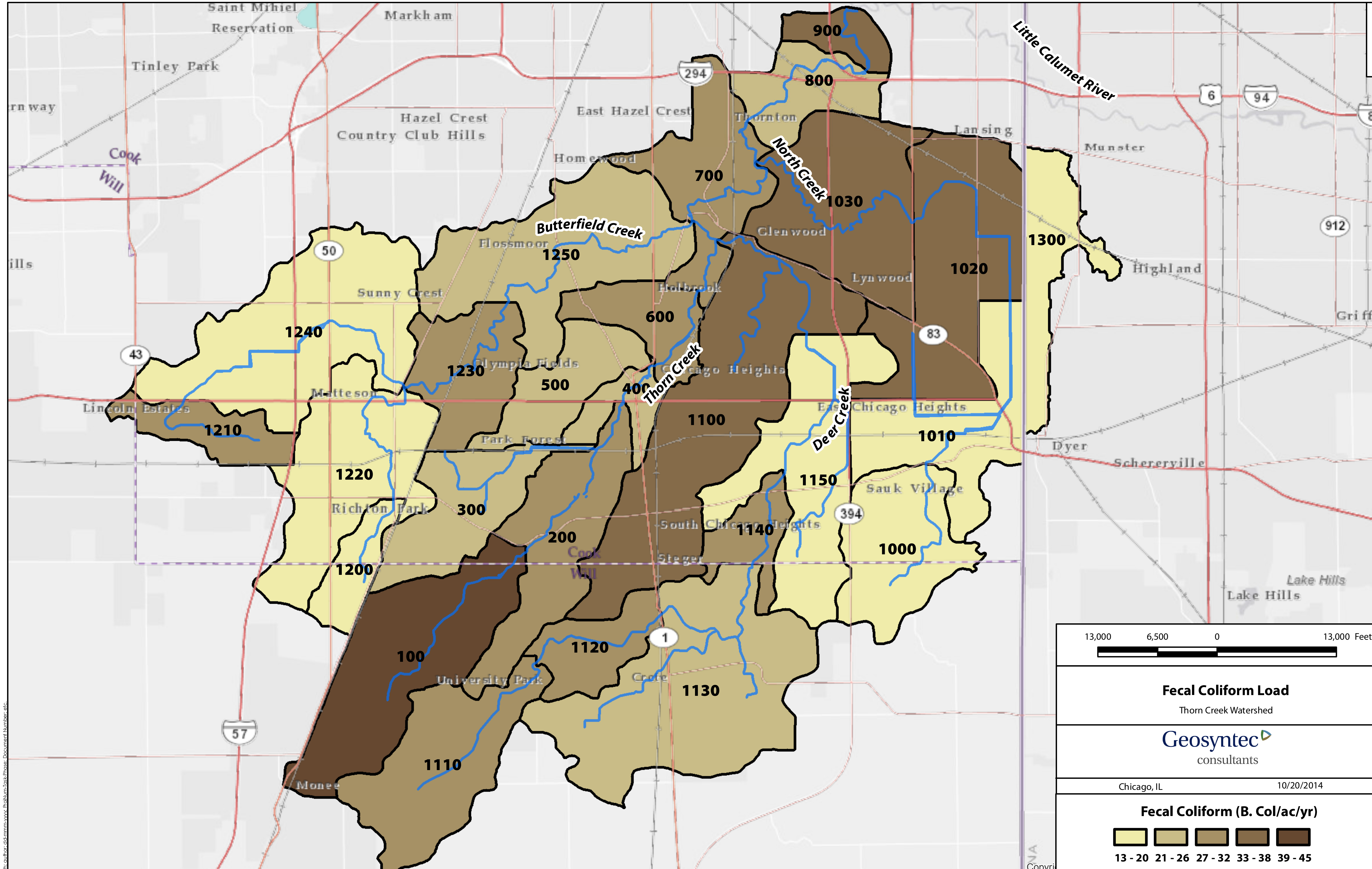
912
50
43
83
394
1
57



Fecal Coliform Load
Thorn Creek Watershed
Geosyntec consultants
Chicago, IL
10/20/2014
Fecal Coliform (B. Col/ac/yr)
13 - 20
21 - 26
27 - 32
33 - 38
39 - 45
13,000
6,500
0
13,000 Feet
N
Little Calumet River
North Creek
Butterfield Creek
Thorn Creek
Deer Creek
900
800
700
1030
1020
1300
1250
600
1240
1230
500
400
1100
1210
1220
1010
1150
300
200
1140
1000
1200
100
1120
1130
1110
Saint Mihiel Reservation
Markham
Tinley Park
Hazel Crest
Country Club Hills
East Hazel Crest
Thornton
Lansing
Munster
Homewood
Glenwood
Flossmoor
Sunny Crest
Holbrook
Lynwood
Highland
Olympia Fields
Chicago Heights
Matteson
Lincoln Estates
East Chicago Heights
Park Forest
Dyer
Schererville
Sauk Village
Richton Park
South Chicago Heights
Steger
Cook
Will
Lake Hills
University Park
Crete
Monee
294
6
94
80
912
50
43
83
394
1
57

Appendix C

Subwatershed BMP Scenarios – Estimated Pollutant Load Reductions and Costs

Subwatershed BMP Scenarios – Estimated Pollutant Load Reductions and Costs

Subwatershed	Subwatershed Treated	BMP	Nitrogen Reduction (lb/yr)	Phosphorus Reduction (lb/yr)	Sediment Reduction (t/yr)	Fecal Reduction (B. Col/yr)	Estimated Cost[1] ($)
Indiana	5.0%	Bioswales	n/a	n/a	n/a	n/a	-
	5.0%	Bioretention	409	80	0.4	570	2,641,643
	5.0%	Retention Pond	523	67	0.4	599	528,329
	0.5%	Filterra	43	7	n/a	n/a	3,302,053
	0.5%	Bacterra	n/a	n/a	n/a	93	3,302,053
	2.0%	Porous Pavement	n/a	16	0.2	n/a	3,962,464
	0.5%	Green Roof	24	2	n/a	n/a	759,472
Total			**998**	**172**	**1.0**	**1,262**	**14,496,014**
100	5.0%	Bioswales	n/a	n/a	n/a	n/a	-
	5.0%	Bioretention	449	108	0.4	626	2,167,975
	10.0%	Retention Pond	1,148	183	0.9	1,315	867,190
	0.0%	Filterra	n/a	n/a	n/a	n/a	-
	0.0%	Bacterra	n/a	n/a	n/a	n/a	-
	0.0%	Porous Pavement	n/a	n/a	n/a	n/a	-
	0.0%	Green Roof	n/a	n/a	n/a	n/a	-
Total			**1,597**	**290**	**1.3**	**1,942**	**3,035,165**
200	5.0%	Bioswales	n/a	n/a	n/a	n/a	-
	5.0%	Bioretention	255	62	0.2	356	1,760,513
	10.0%	Retention Pond	652	105	0.5	747	704,205
	0.0%	Filterra	n/a	n/a	n/a	n/a	-
	0.0%	Bacterra	n/a	n/a	n/a	n/a	-
	0.0%	Porous Pavement	n/a	n/a	n/a	n/a	-
	0.0%	Green Roof	n/a	n/a	n/a	n/a	-
Total			**907**	**167**	**0.7**	**1,103**	**2,464,718**
300	5.0%	Bioswales	n/a	n/a	n/a	n/a	-
	5.0%	Bioretention	402	98	0.4	561	2,601,317
	5.0%	Retention Pond	514	83	0.4	589	520,263
	0.5%	Filterra	42	8	n/a	n/a	3,251,646
	0.5%	Bacterra	n/a	n/a	n/a	92	3,251,646
	2.0%	Porous Pavement	n/a	19	0.1	n/a	3,901,976
	0.5%	Green Roof	23	3	n/a	n/a	747,879
Total			**982**	**211**	**1.0**	**1,242**	**14,274,728**
400	5.0%	Bioswales	1	3	0.5	n/a	70,963
	5.0%	Bioretention	158	36	0.1	221	894,666
	5.0%	Retention Pond	202	30	0.2	232	178,933
	0.5%	Filterra	17	3	n/a	n/a	1,118,332
	0.5%	Bacterra	n/a	n/a	n/a	36	1,118,332
	2.0%	Porous Pavement	n/a	7	0.1	n/a	1,341,998
	0.5%	Green Roof	9	1	n/a	n/a	257,216
Total			**388**	**81**	**0.9**	**489**	**4,980,440**
500	5.0%	Bioswales	1	2	0.2	n/a	30,413
	5.0%	Bioretention	383	82	0.3	534	2,078,306

Subwatershed	Subwatershed Treated	BMP	Nitrogen Reduction (lb/yr)	Phosphorus Reduction (lb/yr)	Sediment Reduction (t/yr)	Fecal Reduction (B. Col/yr)	Estimated Cost[1] ($)
	5.0%	Retention Pond	490	69	0.4	561	415,661
	0.5%	Filterra	40	7	n/a	n/a	2,597,882
	0.5%	Bacterra	n/a	n/a	n/a	87	2,597,882
	2.0%	Porous Pavement	n/a	16	0.1	n/a	3,117,459
	0.5%	Green Roof	22	3	n/a	n/a	597,513
Total			**936**	**179**	**1.1**	**1183**	**11,435,116**
600	5.0%	Bioswales	1	2	0.3	n/a	35,482
	5.0%	Bioretention	253	59	0.2	353	1,310,692
	5.0%	Retention Pond	324	50	0.3	371	262,138
	0.5%	Filterra	26	5	n/a	n/a	1,638,365
	0.5%	Bacterra	n/a	n/a	n/a	58	1,638,365
	2.0%	Porous Pavement	n/a	12	0.1	n/a	1,966,038
	0.5%	Green Roof	15	2	n/a	n/a	376,824
Total			**619**	**128**	**0.9**	**782**	**7,227,906**
700	5.0%	Bioswales	n/a	1	0.1	n/a	10,138
	5.0%	Bioretention	470	102	0.4	656	2,331,865
	5.0%	Retention Pond	601	86	0.5	688	466,373
	0.5%	Filterra	49	9	n/a	n/a	2,914,832
	0.5%	Bacterra	n/a	n/a	n/a	107	2,914,832
	2.0%	Porous Pavement	n/a	20	0.2	n/a	3,497,798
	0.5%	Green Roof	27	3	n/a	n/a	670,411
Total			**1,148**	**220**	**1.2**	**1,451**	**12,806,250**
800	5.0%	Bioswales	2	4	0.6	n/a	96,307
	5.0%	Bioretention	242	57	0.2	337	1,424,793
	5.0%	Retention Pond	309	48	0.2	354	284,959
	0.5%	Filterra	25	5	n/a	n/a	1,780,992
	0.5%	Bacterra	n/a	n/a	n/a	55	1,780,992
	2.0%	Porous Pavement	n/a	11	0.1	n/a	2,137,190
	0.5%	Green Roof	14	2	n/a	n/a	409,628
Total			**592**	**128**	**1.2**	**747**	**7,914,861**
900	2.0%	Bioswales	n/a	1	0.1	n/a	15,206
	5.0%	Bioretention	114	28	0.1	160	795,872
	5.0%	Retention Pond	146	24	0.1	168	159,174
	0.5%	Filterra	12	2	n/a	n/a	994,840
	0.5%	Bacterra	n/a	n/a	n/a	26	994,840
	2.0%	Porous Pavement	n/a	6	n/a	n/a	1,193,808
	0.5%	Green Roof	7	1	n/a	n/a	228,813
Total			**280**	**61**	**0.4**	**353**	**4,382,555**
1000	5.0%	Bioswales	1	2	0.3	n/a	48,154
	5.0%	Bioretention	229	56	0.2	319	1,586,325
	10.0%	Retention Pond	585	94	0.5	671	634,530
	0.0%	Filterra	n/a	n/a	n/a	n/a	-
	0.0%	Bacterra	n/a	n/a	n/a	n/a	-

Subwatershed	Subwatershed Treated	BMP	Nitrogen Reduction (lb/yr)	Phosphorus Reduction (lb/yr)	Sediment Reduction (t/yr)	Fecal Reduction (B. Col/yr)	Estimated Cost[1] ($)
	0.0%	Porous Pavement	n/a	n/a	n/a	n/a	-
	0.0%	Green Roof	n/a	n/a	n/a	n/a	-
Total			**815**	**152**	**0.9**	**990**	**2,269,009**
	5.0%	Bioswales	1	3	0.4	n/a	58,291
	5.0%	Bioretention	352	86	0.3	491	2,084,169
	10.0%	Retention Pond	900	145	0.7	1,031	833,668
1010	0.0%	Filterra	n/a	n/a	n/a	n/a	-
	0.0%	Bacterra	n/a	n/a	n/a	n/a	-
	0.0%	Porous Pavement	n/a	n/a	n/a	n/a	-
	0.0%	Green Roof	n/a	n/a	n/a	n/a	-
Total			**1,253**	**233**	**1.4**	**1,521**	**2,976,128**
	5.0%	Bioswales	1	3	0.4	n/a	65,894
	5.0%	Bioretention	703	169	0.6	981	4,625,027
	5.0%	Retention Pond	899	143	0.7	1,030	925,005
1020	0.5%	Filterra	74	15	0.1	n/a	5,781,284
	0.5%	Bacterra	n/a	n/a	n/a	160	5,781,284
	2.0%	Porous Pavement	n/a	33	0.3	n/a	6,937,541
	0.5%	Green Roof	41	5	0.1	n/a	1,329,695
Total			**1,718**	**367**	**2.1**	**2,171**	**25,445,731**
	5.0%	Bioswales	2	4	0.6	n/a	101,376
	5.0%	Bioretention	405	95	0.4	564	2,558,097
	10.0%	Retention Pond	1,035	161	0.8	1,185	1,023,239
1030	0.0%	Filterra	n/a	n/a	n/a	n/a	-
	0.0%	Bacterra	n/a	n/a	n/a	n/a	-
	0.0%	Porous Pavement	n/a	n/a	n/a	n/a	-
	0.0%	Green Roof	n/a	n/a	n/a	n/a	-
Total			**1,441**	**261**	**1.8**	**1,750**	**3,682,712**
	5.0%	Bioswales	2	5	0.7	n/a	96,307
	5.0%	Bioretention	1,148	263	1.0	1,602	6,232,316
	5.0%	Retention Pond	1,469	222	1.1	1,682	1,246,463
1100	0.5%	Filterra	120	23	0.1	0	7,790,395
	0.5%	Bacterra	n/a	n/a	n/a	262	7,790,395
	2.0%	Porous Pavement	n/a	52	0.4	n/a	9,348,474
	0.5%	Green Roof	67	8	0.1	n/a	1,791,791
Total			**2,806**	**573**	**3.5**	**3,546**	**34,296,141**
	5.0%	Bioswales	n/a	n/a	n/a	n/a	-
	5.0%	Bioretention	149	37	0.1	208	1,077,410
	10.0%	Retention Pond	382	62	0.3	437	430,964
1110	0.0%	Filterra	n/a	n/a	n/a	n/a	-
	0.0%	Bacterra	n/a	n/a	n/a	n/a	-
	0.0%	Porous Pavement	n/a	n/a	n/a	n/a	-
	0.0%	Green Roof	n/a	n/a	n/a	n/a	-
Total			**531**	**99**	**0.4**	**645**	**1,508,374**

Subwatershed	Subwatershed Treated	BMP	Nitrogen Reduction (lb/yr)	Phosphorus Reduction (lb/yr)	Sediment Reduction (t/yr)	Fecal Reduction (B. Col/yr)	Estimated Cost[1] ($)
1120	5.0%	Bioswales	n/a	n/a	0.1	n/a	10,138
	5.0%	Bioretention	149	37	0.1	208	1,065,169
	10.0%	Retention Pond	382	62	0.3	437	426,068
	0.0%	Filterra	n/a	n/a	n/a	n/a	-
	0.0%	Bacterra	n/a	n/a	n/a	n/a	-
	0.0%	Porous Pavement	n/a	n/a	n/a	n/a	-
	0.0%	Green Roof	n/a	n/a	n/a	n/a	-
Total			**531**	**99**	**0.5**	**646**	**1,501,375**
1130	5.0%	Bioswales	1	3	0.4	n/a	70,963
	5.0%	Bioretention	540	127	0.5	753	3,360,122
	10.0%	Retention Pond	1,381	214	1.1	1,581	1,344,049
	0.0%	Filterra	n/a	n/a	n/a	n/a	-
	0.0%	Bacterra	n/a	n/a	n/a	n/a	-
	0.0%	Porous Pavement	n/a	n/a	n/a	n/a	-
	0.0%	Green Roof	n/a	n/a	n/a	n/a	-
Total			**1,922**	**344**	**2.0**	**2,334**	**4,775,135**
1140	5.0%	Bioswales	n/a	n/a	n/a	n/a	-
	5.0%	Bioretention	145	36	0.1	203	1,192,929
	5.0%	Retention Pond	186	30	0.1	213	238,586
	0.5%	Filterra	15	3	n/a	n/a	1,491,161
	0.5%	Bacterra	n/a	n/a	n/a	33	1,491,161
	2.0%	Porous Pavement	n/a	7	0.1	n/a	1,789,393
	0.5%	Green Roof	8	1	n/a	n/a	342,967
Total			**355**	**77**	**0.4**	**449**	**6,546,195**
1150	5.0%	Bioswales	n/a	n/a	n/a	n/a	-
	5.0%	Bioretention	563	134	0.5	785	3,336,064
	5.0%	Retention Pond	720	113	0.6	825	667,213
	0.5%	Filterra	59	12	0.1	n/a	4,170,080
	0.5%	Bacterra	n/a	n/a	n/a	128	4,170,080
	2.0%	Porous Pavement	n/a	26	0.2	n/a	5,004,096
	0.5%	Green Roof	33	4	n/a	n/a	959,118
Total			**1,375**	**289**	**1.4**	**1,738**	**18,306,652**
1200	5.0%	Bioswales	n/a	n/a	n/a	n/a	-
	5.0%	Bioretention	118	26	0.1	164	686,966
	10.0%	Retention Pond	301	45	0.2	345	274,786
	0.0%	Filterra	n/a	n/a	n/a	n/a	-
	0.0%	Bacterra	n/a	n/a	n/a	n/a	-
	0.0%	Porous Pavement	n/a	n/a	n/a	n/a	-
	0.0%	Green Roof	n/a	n/a	n/a	n/a	-
Total			**419**	**71**	**0.3**	**510**	**961,753**
1210	5.0%	Bioswales	n/a	1	0.1	n/a	30,413
	5.0%	Bioretention	139	34	0.1	194	1,043,352
	5.0%	Retention Pond	178	28	0.1	204	208,670

Subwatershed	Subwatershed Treated	BMP	Nitrogen Reduction (lb/yr)	Phosphorus Reduction (lb/yr)	Sediment Reduction (t/yr)	Fecal Reduction (B. Col/yr)	Estimated Cost[1] ($)
	0.5%	Filterra	15	3	n/a	n/a	1,304,191
	0.5%	Bacterra	n/a	n/a	n/a	32	1,304,191
	2.0%	Porous Pavement	n/a	7	0.1	n/a	1,565,029
	0.5%	Green Roof	8	1	n/a	n/a	299,964
Total			340	74	**0.5**	429	5,755,809
	5.0%	Bioswales	n/a	1	0.1	n/a	15,206
	5.0%	Bioretention	730	154	0.7	1,019	4,014,631
	5.0%	Retention Pond	934	130	0.7	1,070	802,926
1220	0.5%	Filterra	76	13	0.1	n/a	5,018,288
	0.5%	Bacterra	n/a	n/a	n/a	166	5,018,288
	2.0%	Porous Pavement	n/a	30	0.3	n/a	6,021,946
	0.5%	Green Roof	42	5	0.1	n/a	1,154,206
Total			**1,783**	**333**	**1.9**	**2,255**	**22,045,492**
	5.0%	Bioswales	1	1	0.2	n/a	32,947
	5.0%	Bioretention	308	76	0.3	430	2,231,361
	5.0%	Retention Pond	394	65	0.3	452	446,272
1230	0.5%	Filterra	32	7	n/a	n/a	2,789,201
	0.5%	Bacterra	n/a	n/a	n/a	70	2,789,201
	2.0%	Porous Pavement	n/a	15	0.1	n/a	3,347,042
	0.5%	Green Roof	18	2	n/a	n/a	641,516
Total			**753**	**166**	**0.9**	**952**	**12,277,541**
	5.0%	Bioswales	2	4	0.6	n/a	106,445
	5.0%	Bioretention	684	162	0.6	954	4,507,032
	5.0%	Retention Pond	874	137	0.7	1,002	901,406
1240	0.5%	Filterra	72	14	0.1	n/a	5,633,790
	0.5%	Bacterra	n/a	n/a	n/a	156	5,633,790
	2.0%	Porous Pavement	n/a	32	0.3	n/a	6,760,548
	0.5%	Green Roof	40	5	0.1	n/a	1,295,772
Total			**1,671**	**354**	**2.3**	**2,111**	**24,838,782**
	5.0%	Bioswales	1	2	0.2	n/a	40,550
	5.0%	Bioretention	818	196	0.7	1,141	5,585,190
	5.0%	Retention Pond	1,046	166	0.8	1,198	1,117,038
1250	0.5%	Filterra	86	17	0.1	n/a	6,981,487
	0.5%	Bacterra	n/a	n/a	n/a	186	6,981,487
	2.0%	Porous Pavement	n/a	39	0.3	n/a	8,377,784
	0.5%	Green Roof	48	6	0.1	n/a	1,605,742
Total			**1,997**	**426**	**2.2**	**2,525**	**30,689,278**
Grand Total			**28,156**	**5,554**	**32**	**35,127**	**280,893,861**

2) BMP costs were derived from cost information derived through various Geosyntec projects and from other sources such as the Milwaukee Metropolitan Sewerage District Regional Green Infrastructure Plan.

n/a = not determined or insufficient data

Appendix D

Summary of Watershed-wide BMP Recommendations

Summary of Watershed-wide Best Management Practice Recommendations

BMP Category	BMP Code*	Quantity	Unit	COST ($)	Nitrogen Load Reduction (lbs/year)	Phosphorus Load Reduction (lbs/year)	Sediment Load Reduction (tons/year)	Fecal Coliform Load Reduction (billion colonies/yr)	Comments
AGRICULTURE	Conservation Tillage(329)		acre						Any ag conservation practices that could be adopted in this watershed have likely already been adopted.**
AGRICULTURE	Filter Strip(393)	50.9	acre	$1,480,000	1,990	553	1	313	Geosyntec's "Buffer Installation (non-urban)."
AGRICULTURE	Grassed Waterway(412)		acre						Any ag conservation practices that could be adopted in this watershed have likely already been adopted.**
AGRICULTURE	Terrace(600)		feet						Any ag conservation practices that could be adopted in this watershed have likely already been adopted.**
AGRICULTURE	Nutrient Management(590)		acre						Any ag conservation practices that could be adopted in this watershed have likely already been adopted.** Further, this is a non-structural BMP; thus, pollutant load reduction would not be modeled.
HYDROLOGIC	Clearing and Snagging(326)		feet						Nonstructural BMP; thus, pollutant load reduction not modeled. Practice should be applied selectively with ecological benefits of woody debris considered.
HYDROLOGIC	Stream Channel Restoration(9)	142,560	feet	$9,970,440					Stream channel restoration means remeandering of channelized stream segments; thus, no pollutant load reduction calculated.

BMP Category	BMP Code*	Quantity	Unit	COST ($)	Nitrogen Load Reduction (lbs/year)	Phosphorus Load Reduction (lbs/year)	Sediment Load Reduction (tons/year)	Fecal Coliform Load Reduction (billion colonies/yr)	Comments
HYDROLOGIC	Stream Channel Stabilization(584)		feet						Stream channel stabilizations means grade control. While this BMP type was mentioned in the 2005 plan as a potential BMP, an estimated pollutant load reduction would require a detailed stream investigation.
HYDROLOGIC	Streambank and Shoreline Protection(580)	7,920	feet	$190,080	989	365	2	516	
HYDROLOGIC	Wetland Restoration(657)	15	acre	$216,076	1,220	455	2	314	
URBAN	Filter Strip(835)	87	acre	$2,530,000	355	61	1	17	Geosyntec's "Buffer Installation (urban)."
URBAN	Grass-lined Channel(840) with Permanent Vegetation(880)	38,966	sq. feet	$935,194	18	41	6	n/a	Geosyntec's "Vegetated Swale (Conveyance) Retrofits "is best categorized as Grass-lined Channel (840) with Permanent Vegetation (880). The term "Bioswales" is also used in the addendum; there currently is no practice standard for "bioswale."
URBAN	Infiltration Planter(40)	11,711	number	$117,117,640	803	152	1	1,747	Geosyntec's Filterra and Bacterra systems.
URBAN	Porous Pavement(890)	54	acre	$70,270,584	n/a	348	3	n/a	Also "Permeable Pavement"
URBAN	Rain Garden(13) (new IUM code #897)	30	acre	$63,193,804	10,315	2,397	8	14,392	Geosyntec's "Bioretention" best placed into the Rain Garden category.
URBAN	Street Sweeping(17)		number						Nonstructural BMP; thus, pollutant load reduction not modeled.
URBAN	Bioretention Facility(800)	46	acre	$15,908,110	16,576	2,562	13	18,988	Geosyntec's "Detention Basin Retrofits" are best placed into this category.
URBAN	Infiltration Trench(847)		number						Included in Bioretention Facility (IUM 800) BMPs.

BMP Category	BMP Code*	Quantity	Unit	COST ($)	Nitrogen Load Reduction (lbs/year)	Phosphorus Load Reduction (lbs/year)	Sediment Load Reduction (tons/year)	Fecal Coliform Load Reduction (billion colonies/yr)	Comments
URBAN	Green Roof(11)	26	acre	$13,468,529	445	54	1	n/a	
OTHER2	Septic system upgrade(34)		number						The 2005 plan stated that few septic systems were present. Much effort would be required to calculate for little overall benefit in pollutant load reduction. It is better to address this via ordinances that require a point of sale inspection (thus education and policy recommendations).
OTHER2	Cistern(12)		number	-	-	-	-	-	No reference to cisterns found in 2005 Plan. Non-structural BMP whereby no pollutant load reduction would be modeled.
OTHER2	Education(1)		number						Nonstructural BMP; thus, pollutant load reduction not modeled.
OTHER2	Monitoring(2)		number						Nonstructural BMP; thus, pollutant load reduction not modeled.
OTHER2	Regulations(15)		number						Nonstructural BMP; thus, pollutant load reduction not modeled.
TOTALS				**$295,280,458**	**32,710**	**6,988**	**37**	**36,287**	

* NRCS Conservation Practice Standard or Illinois Urban Manual Practice Standard

** based on Geosyntec's review of transect surveys and personal communication with Robert Jankowski, NRCS District Conservationist.

Appendix E

Summary of Watershed-wide Pollutant Load Reduction Targets

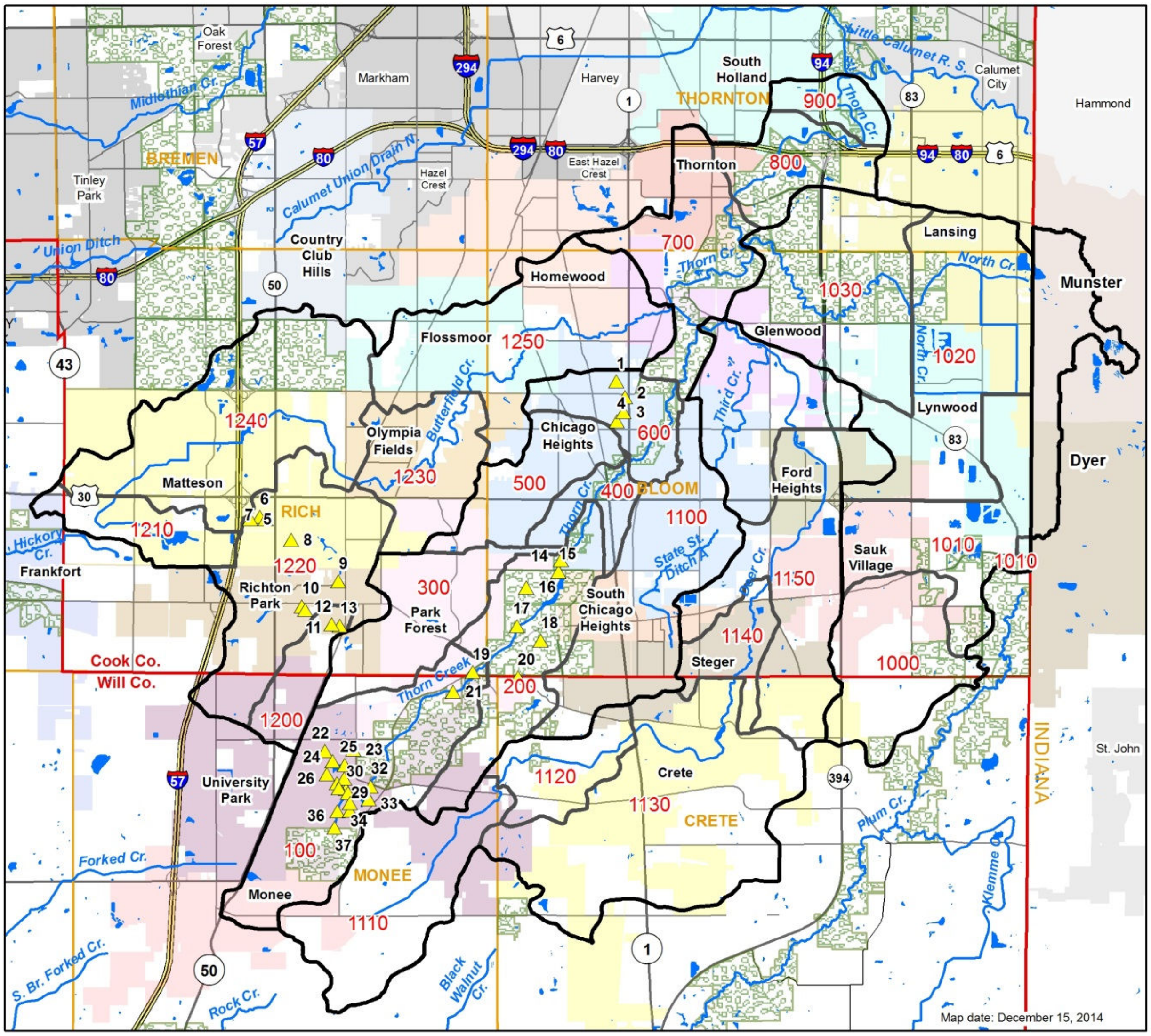
Summary of Watershed-wide Pollutant Load Reduction Targets

Subwatershed	Nitrogen Reduction Target (lb/yr)	Phosphorus Reduction Target (lb/yr)	Sediment Reduction Target (lb/yr)	Fecal Coliform Reduction Target (B. Col/yr)
Scenario-based Stormwater BMPs				
Indiana	998	172	1	1,262
100	1,597	290	1	1,942
200	907	167	1	1,103
300	982	211	1	1,242
400	388	81	1	489
500	936	179	1	1,183
600	619	128	1	782
700	1,148	220	1	1,451
800	592	128	1	747
900	280	61	0	353
1000	815	152	1	990
1010	1,253	233	1	1,521
1020	1,718	367	2	2,171
1030	1,441	261	2	1,750
1100	2,806	573	3	3,546
1110	531	99	0	645
1120	531	99	0	646
1130	1,922	344	2	2,334
1140	355	77	0	449
1150	1,375	289	1	1,738
1200	419	71	0	510
1210	340	74	0	429
1220	1,783	333	2	2,255
1230	753	166	1	952
1240	1,671	354	2	2,111
1250	1,997	426	2	2,525
Subtotal	*28,156*	*5,554*	*32*	*35,127*
Stream Corridor and Farmed Wetland Projects				
Buffer Installation (urban)	355	61	1	17
Buffer Installation (non-urban)	1,990	553	1	313
Stream Stabilization	989	365	1	516
Farmed Wetland Restoration	1,220	455	2	314
Subtotal	*4,554*	*1,434*	*5*	*1,160*
Total	**32,710**	**6,988**	**37**	**36,287**

Appendix F

Stakeholder-identified Site-specific BMPs – Map and Table

Thorn Creek Watershed Based Plan Addendum - Stakeholder-identified Site-specific BMP Locations



Legend

- Thorn Creek Watershed Boundary
- Counties
- Townships
- Lakes/Ponds
- Forest Preserve
- Streams
- BMP project locations

0 2 4 Miles

Chicago Metropolitan Agency for Planning

Data Sources: Watershed Planning Area - CMAP (2004); County & Township Boundaries - CMAP (2014); Municipal Boundaries - Cook Co. (2014) & Will Co. (2014); Major Roads - IDOT (2011); Streams - Illinois EPA (2004); Waterbodies - National Hydrography Dataset (USGS 2007) & CMAP Land Use (2005).

Thorn Creek Watershed Based Plan Addendum: Stakeholder-identified Site-specific BMPs										
Map #	**Subwatshd Code**	**BMP Type**	**Category**	**BMP Code**	**Units**	**Landowner**	**Potential Partners**	**Longitude**	**Latitude**	**Comment**
1	600, 1250	Green infrastructure plan	Other	3	#	Prairie State College		-87.639165	41.530469	
2	600, 1250	Green infrastructure plan implementation	various TBD (Hydrologic, Urban, Other)	various TBD	various TBD	Prairie State College	City of Chicago Heights, Cook Co., MWRDGC	-87.636786	41.527231	
3	600	Streambank Protection, Urban Filter Strip	Hydrologic, Urban	580, 835	feet, acres	Prairie State College	Will-So. Cook SWCD	-87.637087	41.52413	
4	600	Brush Management, Restoration & Mngmnt of Declining Habitats	Urban	314, 643	acres	Prairie State College		-87.638944	41.522246	
5	1220	Brush Management, Restoration & Mngmnt of Declining Habitats	Urban	314, 643	acres	Prairie State College		-87.739062	41.501565	
6	1220	Green infrastructure plan	Other	3	#	Prairie State College		-87.736534	41.502064	satellite campus
7	1220	Green infrastructure plan implementation	various TBD (Hydrologic, Urban, Other)	various TBD	various TBD	Prairie State College		-87.734884	41.501621	satellite campus
8	1220	Wetland Restoration, Urban Filter Strip, Vegetated swales (Bioswale or Grass-Lined Channel w/ Permanent Vegetation), Field Border	Hydrologic, Urban, Ag	657/999, 835, n/a (n/a, 840 w/ 880), 386	acres	Vlg of Matteson, multiple private	Land Conservancy Will Co., GSU	-87.727891	41.497393	
9	1220	Stream Channel Stabilization, Streambank Protection, Culvert resizing, Floodplain reconnection/ Wetland Creation, Urban Filter Strip	Hydrologic, Urban	584, 580, n/a, n/a/997, 835	feet, acres	Vlg of Richton Park	MWRDGC	-87.714798	41.488927	E Br Butterfield Crk
10	300, 1200, 1220	Green infrastructure plan	Other	3	#	Vlg of Richton Park, multiple private		-87.724806	41.483742	

Thorn Creek Watershed Based Plan Addendum: Stakeholder-identified Site-specific BMPs (cont.)										
Map #	**Subwatshd Code**	**BMP Type**	**Category**	**BMP Code**	**Units**	**Landowner**	**Potential Partners**	**Longitude**	**Latitude**	**Comment**
11	300, 1200, 1220	Green infrastructure plan implementation	various TBD (Hydrologic, Urban, Other)	various TBD	various TBD	Vlg of Richton Park, multiple private		-87.72382	41.483058	
12	1200	Stream Channel Stabilization, Streambank Protection, Culvert resizing, Floodplain reconnection/Wetland Creation, Urban Filter Strip	Hydrologic, Urban	584, 580, n/a, n/a/997, 835	feet, acres	Vlg of Richton Park	MWRDGC	-87.71653	41.480039	E Br Butterfield Crk
13	1200	Brush Management, Restoration & Mngmnt of Declining Habitats	Urban	314, 643	acres	Vlg of Richton Park, others	Land Conservancy Will Co., GSU	-87.714341	41.479785	"Richton Park Prairie"
14	200	Stream Channel Stabilization, Streambank Protection	Hyrdologic	584, 580	feet	FPD Cook Co.	USACE	-87.653971	41.493691	
15	200	Dam Removal	Hydrologic	16	#	FPD Cook Co.	USACE	-87.654578	41.49122	Sauk Lake
16	200	Brush Management, Restoration & Mngmnt of Declining Habitats	Urban	314, 643	acres	FPD Cook Co.	USACE	-87.663447	41.48798	Sauk Trail Woods
17	200	Stream Channel Restoration, Stream Channel Stabilization, Streambank Protection	Hydrologic	9, 584, 580	#, feet	FPD Cook Co.	USACE	-87.665799	41.480006	
18	200	Brush Management, Restoration & Mngmnt of Declining Habitats	Urban	314, 643	acres	FPD Cook Co.	USACE	-87.659349	41.477074	Schubert's Woods, King's Grove
19	100	Stream Channel Stabilization, Streambank Protection, Rain Garden	Hydrologic, Urban	584, 580, 897	feet, #	Land Conservancy of Will Co., private	Vlg of Park Forest, FPD Will Co.	-87.677929	41.470496	
20	200	Vegetated swale (Bioswale or Grass-Lined Channel w/ Permanent Vegetation), Wetland Restoration	Urban, Hydrologic	n/a (n/a, 840 w/ 880), 657	acres	Land Conservancy of Will Co.	Crete Twp., local landowners	-87.665518	41.469441	

Thorn Creek Watershed Based Plan Addendum: Stakeholder-identified Site-specific BMPs (cont.)										
Map #	**Subwatshd Code**	**BMP Type**	**Category**	**BMP Code**	**Units**	**Landowner**	**Potential Partners**	**Longitude**	**Latitude**	**Comment**
21	100	Stream Channel Stabilization, Streambank Protection, Urban Filter Strip	Hydrologic, Urban	n/a, 584, 580, 835	feet, acres	Land Conservancy of Will Co.	Vlg of Park Forest	-87.683192	41.466433	
22	100	Bioretention Facility, Vegetated swale (Bioswale or Grass-Lined Channel w/ Permanent Vegetation)	Urban	800, n/a (n/a, 840 w/ 880)	acres	Governors State Univ.		-87.718121	41.453965	
23	100	Bioretention Facility, Vegetated swale (Bioswale or Grass-Lined Channel w/ Permanent Vegetation), Wetland Restoration	Urban, Hydrologic	800, n/a (n/a, 840 w/ 880), 657	acres	Governors State Univ.	Nathan Manilow Sculpture Park	-87.710322	41.454324	
24	100	Wet detention basin retrofit: Constructed Wetland (wetland shelf), Shoreline Protection, Dredging	Hydrologic	656, 580, 7	acres, feet, #	Governors State Univ.	Nathan Manilow Sculpture Park	-87.715965	41.451923	
25	100	Wet detention basin retrofit: Constructed Wetland (wetland shelf), Vegetated swales retrofit (Bioswale or Grass-Lined Channel w/ Permanent Vegetation)	Hydrologic, Urban	656, n/a (n/a, 840 w/ 880)	acres	Governors State Univ.	Nathan Manilow Sculpture Park	-87.71399	41.450595	
26	100	Green infrastructure plan implementation	various TBD (Hydrologic, Urban, Other)	various TBD	various TBD	Governors State Univ.	Nathan Manilow Sculpture Park	-87.717521	41.44924	GI plan in 2015
27	100	Parking lot retrofits: Porous Pavement, Vegetated swales (Bioswale or Grass-Lined Channel w/ Permanent Vegetation)	Urban	890, n/a (n/a, 840 w/ 880)	acres, feet	Governors State Univ.		-87.712858	41.448375	East Lot 3

Thorn Creek Watershed Based Plan Addendum: Stakeholder-identified Site-specific BMPs (cont.)										
Map #	**Subwatshd Code**	**BMP Type**	**Category**	**BMP Code**	**Units**	**Landowner**	**Potential Partners**	**Longitude**	**Latitude**	**Comment**
28	100	Parking lot retrofits: Porous Pavement, Vegetated swales (Bioswale or Grass-Lined Channel w/ Permanent Vegetation)	Urban	890, n/a (n/a, 840 w/ 880)	acres, feet	Governors State Univ.		-87.714848	41.447414	East Lot 2
29	100	Wet detention basin retrofit: Constructed Wetland (wetland shelf), Shoreline Protection, Dredging	Hydrologic	656, 580, 7	acres, feet, #	Governors State Univ.		-87.714261	41.446382	
30	100	Wet detention basin retrofit: Constructed Wetland; Vegetated swales retrofit (Bioswale or Grass-Lined Channel w/ Permanent Vegetation)	Urban	656; n/a (n/a, 840 w/ 880)	acres	Governors State Univ.		-87.712244	41.446214	
31	100	Stream Channel Stabilization, Streambank Protecction	Hydrologic	584, 580	feet	Governors State Univ.		-87.711759	41.445421	
32	100	Stream Channel Restoration, Stream Channel Stabilization, Streambank Protection, storm sewer infrastructure retrofit, lift station retrofit	Hydrologic	9, 584, 580, n/a, n/a	#, feet	Governors State Univ.	Vlg of University Park, Aqua Illinois	-87.7055	41.446765	
33	100	Pond retrofit: Constructed Wetland (wetland shelf), Shoreline Protection, Urban Filter Strip; Vegetated swale (Bioswale or Grass-Lined Channel w/ Permanent Vegetation); Channel Stabilization	Urban	656, 580, 835; n/a (n/a, 840 w/ 880); 584	acres, feet	Governors State Univ.		-87.706112	41.444125	Pine Lake

Thorn Creek Watershed Based Plan Addendum: Stakeholder-identified Site-specific BMPs (cont.)										
Map #	**Subwatshd Code**	**BMP Type**	**Category**	**BMP Code**	**Units**	**Landowner**	**Potential Partners**	**Longitude**	**Latitude**	**Comment**
34	100	Stream Channel Stabilization, Streambank Protection	Hydrologic	584, 580	feet	Governors State Univ.		-87.711121	41.443367	GSU Environmental Field Station
35	100	Pond retrofit: Wetland Restoration, Dredging; Vegetated swale (Bioswale or Grass-Lined Channel w/ Permanent Vegetation)	Hydrologic, Urban	657/999, 7; n/a (n/a, 840 w/ 880)	acres, #, feet	Governors State Univ.		-87.711116	41.441789	
36	100	Stream Channel Restoration, Stream Channel Stabilization, Streambank Protection	Hydrologic	9, 584, 580	#, feet	Governors State Univ.	Vlg of University Park, USACE	-87.714566	41.441599	
37	100	Culvert retrofit, Vegetated swale (Bioswale or Grass-Lined Channel w/ Permanent Vegetation), Stream Channel Stabilization, Streambank Protection	Hydrologic, Urban	n/a, n/a (n/a, 840 w/ 880), 584, 580	#, feet, acre	Governors State Univ.	Vlg of University Park	-87.71528	41.438285	

Acronym Key:

FPD	Forest Preserve District
GSU	Governors State University
IEPA	Illinois Environmental Protection Agency
IUM	Natural Resources Conservation Service - Illinois Urban Manual Practice Standard
NRCS	Natural Resources Conservation Service - Conservation Practice Standard
MWRDGC	Metropolitan Water Reclamation District of Greater Chicago
SWCD	Soil and Water Conservation District
USACE	United States Army Corps of Engineers
n/a	not available






Thorn Creek Watershed Based Plan

December 2005

northeastern illinois planning commission
Environment and Natural Resources Group

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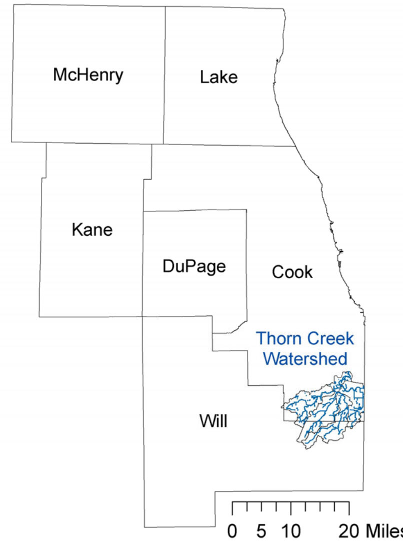
ACKNOWLEDGMENTS

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

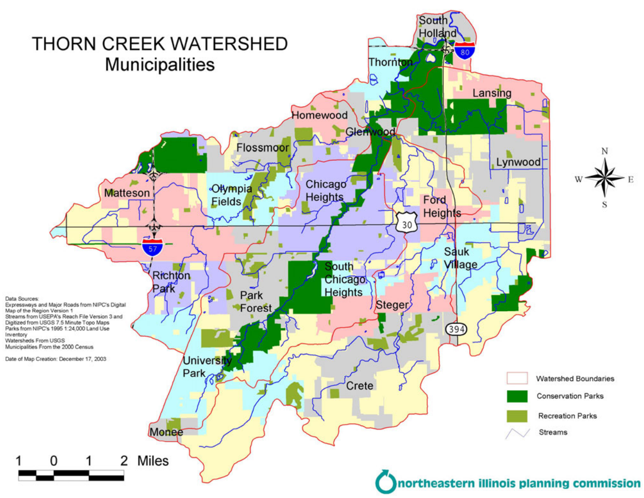
Partners in the development of the *Thorn Creek Watershed Based Plan* included the Thorn Creek Ecosystem Partnership and the Thorn Creek Restoration Coalition. Numerous individuals helped shape this Watershed Based Plan through their service on the Steering and Technical Advisory Committees for the Thorn Creek Watershed Planning process. They are listed in Section 1.3. The Northeastern Illinois Planning Commission (NIPC) provided staff support and drafted the Watershed Based Plan document. NIPC staff members who worked on the plan include Laura Barghusen, Michael Carter, Dennis Dreher, Jesse Elam, Jessica Higgins, Holly Hudson, Jason Navota, Sarah Nerenberg, Suzanne Thorsen, Jennifer Welch, and Jeff Wickenkamp.

EXECUTIVE SUMMARY



Location and Conditions

Thorn Creek flows northward about 20 miles from its origin in eastern Will County to its confluence with the Little Calumet River in southern Cook County, running along the way through the municipalities of University Park, Park Forest, South Chicago Heights, Chicago Heights, Glenwood, Thornton, and South Holland. Thorn Creek and its tributaries—Deer Creek, Butterfield Creek, and North Creek—form a 107 square mile watershed (about 104 square miles of which are in Illinois). The *Thorn Creek Watershed Based Plan* focuses on a smaller area than this, the main stem Thorn Creek subwatershed, which is 32.2 square miles or 20,614 acres in size.



Urbanized land, at 48 percent, makes up a plurality of the entire Thorn Creek watershed, with another 48 percent comprised of forested cover (primarily along the major drainageways), grassland, and cropland (mainly in the southwest two thirds of the watershed). The subwatershed has a dual character in other ways as well. For instance, the northeastern third extends into the Chicago Lake Plain, a flat expanse formed by the same glacier that created Lake Michigan, while the origin of the stream in the southwest lies in a rolling landscape of glacial moraines, the hills created by sediments deposited during glacial retreat. Thorn Creek flows from an area of hills and ravines with farms and forest cover into a much flatter, more urbanized landscape.

Water quality has been declining in Thorn Creek for the past several decades, largely due to the effects of land conversion. With conversion to cropland and urban cover, prairie has declined from an estimated 70 percent in pre-settlement times to less than 12 percent within the grassland areas. As a result, increased stormwater runoff has carried a significant pollutant burden into the stream. Aquatic communities have suffered as well, although conditions vary along the stream course. Studies at certain locations have shown poor fish diversity and a preponderance of pollution tolerant organisms. With its array of different habitat types, however, the Thorn Creek watershed still supports a large number of species for its size, made possible in large part by the conservation of natural areas in forest preserve lands along the stream. The fraction of pre-settlement forest remaining in the Thorn Creek watershed (about 83 percent) is much higher than in Illinois overall (about 30 percent). Several rare and threatened species make their home in the watershed, and there is a great diversity of birds and plants despite the degradation of the aquatic community.

Background and Goals

With funding from the Illinois Environmental Protection Agency obtained in 2003, the Northeastern Illinois Planning Commission sought to employ its Model Watershed Planning Strategy in a threatened watershed in the region while also piloting new federal guidelines for Watershed Based Plans. The U.S. Environmental Protection Agency now calls for more thorough quantification of water quality problems and establishment of rigorous measures of success to help assure the effectiveness of federal assistance. For a variety of reasons, the Thorn Creek watershed stood out as a candidate, not least because of the capacity of the Thorn Creek Ecosystem Partnership and the Thorn Creek Restoration Coalition as collaborating organizations.

The most pressing watershed issues emerged from early meetings with stakeholders. This list was combined with additional information to develop a set of goals and objectives for the watershed that were categorized as either resource-based goals, such as habitat restoration, or watershed coordination goals, such as improved education and outreach. The *Thorn Creek Watershed Based Plan* focuses closely on the goal of protecting and enhancing surface water quality to support uses designated for Thorn Creek by the Illinois Environmental Protection Agency. This is so because improving water quality is the intent of the funding behind the plan, yet the plan also provides a doorway for considering the other important goals identified by watershed stakeholders. In order of priority, these include the resource-based goals of protecting and restoring aquatic and terrestrial habitat, protecting and enhancing groundwater quality and quantity, reducing flooding and flood damages. The watershed coordination goals include improving cooperation among actors in the watershed, such as businesses, universities, and governments, and educating stakeholders about their role in protecting the watershed.

Findings of Water Quality Assessment

Water quality sampling data from several sources were analyzed to determine the extent of impairment by various contaminants. A land use pollutant loading model also was employed to relate water quality problems back to the mix of land uses and the amount of impervious surface in the watershed. Watershed stakeholders reviewed the results and concluded that the water quality constituents most in need of attention include the presence of pathogenic organisms (as indicated by fecal coliforms), low dissolved oxygen, hydrologic modification, dumping and debris, and road salt runoff.

Recommendations and Evaluation

A set of Watershed Management Recommendations (WMRs) was developed to address the goals stakeholders identified as most important to them. From there, a smaller subset of WMRs directed at surface water quality was selected for further elaboration, with estimates of their effectiveness and cost to implement. Stakeholders then prioritized these water quality related WMRs. Several steps to take most immediately were:

- Enact and enforce ordinances to protect floodplains, riparian buffer areas, flood prone areas, natural depressional storage areas, and other natural retention and drainage features. Acquire and protect floodplains for flood prevention, open space, and environmental enhancement along the mainstem and tributaries.
- Utilize natural drainage and infiltration measures to reduce runoff volumes, filter pollutants from runoff water, and improve stormwater infiltration into the ground. Implement lot level BMPs to

capture stormwater. Maintain, restore, and enhance natural drainage and storage systems that can serve multiple objectives such as stormwater conveyance, storage, and habitat.

- Conduct stream cleanups to improve aesthetics, remove trash and debris, and maintain channel flow. Leave some natural elements as habitat features.
- Improve road maintenance practices to remove potential pollutants, such as through regular street sweeping, and reduce the use of road salt in winter.
- Adopt and enforce ordinances, programs, and practices that protect natural areas and sensitive features from new development and human activities and that minimize unavoidable disturbances of high quality natural areas.
- Collect current baseline scientific data for the watershed, including information on the location, capacity, and impact of retention/detention within the watershed. Develop detailed short and long term watershed monitoring strategies and a standard list of indicators.
- Eliminate illicit sanitary/industrial/commercial connections to storm sewers.
- Develop comprehensive plans for watershed management, stormwater management, land use, and flood hazard mitigation for Thorn Creek and all significant tributaries and incorporate into local plans and policies.

In turn, these general WMRs were rendered into a Short Term Action Plan that included phasing implementation, estimating costs, and identifying responsible parties.

1. INTRODUCTION

1.1. Overview

Thorn Creek flows north from its origin near Monee in eastern Will County to its confluence with the Little Calumet River in South Holland in Cook County (Figure 1-1, Appendix A). Thorn Creek and its tributaries — Deer Creek, Butterfield Creek, Third Creek, and North Creek — form a 107 square mile subwatershed of the Little Calumet watershed. Thorn Creek itself runs through the municipalities of University Park, Park Forest, South Chicago Heights, Chicago Heights, Glenwood, Thornton, and South Holland.

Although the watershed is largely urban, it supports a diversity of terrestrial and aquatic wildlife, and the substantial portion located in the Cook County Forest Preserve is somewhat protected from many of the negative effects of urbanized land use found within other parts of the watershed. Even so, water quality has declined over the past few decades. The natural hydrology of the stream has been altered, and concentrations of several pollutants substantially exceed Illinois standards.

Using funding from the Illinois Environmental Protection Agency, the Northeastern Illinois Planning Commission (NIPC) set out in 2003 to develop a pilot Watershed Based Plan in the region. The dedication, track record, and organizational capacity of the Thorn Creek Ecosystem Partnership and the Thorn Creek Restoration Coalition made them excellent partners for this pilot project.

This Watershed Based Plan focuses on nonpoint source pollution, particularly in the 26 square mile watershed of the Thorn Creek mainstem. While the Watershed Resource Inventory in Section 2 of this document delves into a broad range of issues — for example, recreation, habitat restoration, etc. — the recommendations of this Watershed Based Plan concentrate on water quality.

1.1.1. PLAN ORGANIZATION

This organization of this document follows the organization of the planning process, which is described further under Model Watershed Planning Strategy (Section 1.2) below. The sections of this plan are as follows:

Section 1 — Introduction. This section outlines the Model Watershed Planning Strategy the Northeastern Illinois Planning Commission employs and relates it to the U.S. Environmental Protection Agency's specifications for watershed plans. A self-assessment of the *Thorn Creek Watershed Based Plan* relative to the USEPA guidelines is also presented. Goals and objectives for the Thorn Creek watershed from stakeholder input are documented.

Section 2 — Watershed Resource Inventory. This section summarizes general physical conditions in the watershed, such as climate and soil type, and reviews available hydrological and water quality data. Causes and sources of water quality impairment are discussed. The Inventory presents the results of a predictive analysis associating land use and surface imperviousness with water quality, as well as an empirical analysis of water quality data. These results are interpreted further in Section 3, where specific conclusions are drawn from them. Information on natural areas, land cover, runoff management, and projects affecting the watershed, among other things, is also presented in the Inventory.

Section 3 — Water Quality Assessment Conclusions and Recommendations. This section concentrates on a set of key water quality constituents identified as watershed priorities by stakeholder committees. Pollutant loading reductions needed to meet water quality standards are presented for priority constituents, followed by recommended next steps.

Section 4 — Thorn Creek Watershed Improvement Plan. This section draws from the data in the Inventory and the water quality assessment of Section 3 to derive recommendations and implementation steps to improve water quality in Thorn Creek. First this section relates general watershed management practices, and then selects those that best meet the identified water quality objectives of watershed stakeholders (described in Section 1). These Watershed Management Recommendations (WMRs) are then described in more detail, with a discussion of cost and expected pollutant reductions. Supporting evidence for the effectiveness of certain WMRs is also presented. An action plan is presented in which groups of potential partners in the watershed and how they could contribute to implementation are identified, strategies for enacting the WMRs are provided, and potential funding sources are outlined. Finally, the framework of an informational outreach and education program is also presented.

Section 5 — Plan Implementation Evaluation. This section describes monitoring needs for tracking the success of WMR implementation.

Maps and other figures are divided between the text and an appendix. The Watershed Resource Inventory has several maps in line with the text for easier reference.

1.2. Model Watershed Planning Strategy

Watershed planning is performed in numerous ways in varying contexts throughout Illinois. The approach used in any particular watershed should reflect the issues, interest groups, technical complexity, resources, and size of the watershed. While flexibility is important, there also are some basic elements that should be included in any watershed planning process. Historically, most successful watershed plans have included the following seven steps:

1. Identify stakeholders
2. Establish goals
3. Inventory watershed resources and conditions
4. Assess waterbody/watershed problems
5. Recommend management practices for prevention and remediation
6. Develop an effective action plan (who, what, when)
7. Implement plan and monitor success

This basic approach was employed in the development of the Thorn Creek Watershed Based Plan. It is consistent with the watershed assessment approach described in the Illinois Environmental Protection Agency's (IEPA) biennial *Illinois Water Quality Report* (also known as the "305(b) Report"). It has also been recommended by the IEPA for the development of watershed plans, and is the foundation for a watershed based planning manual currently under development for the State of Illinois by the Northeastern Illinois Planning Commission.

New directives for Watershed Based Plans from the U.S. Environmental Protection Agency (USEPA) call for thorough quantification of identified problems, measures of success, and documentation of the manner in which plan implementation will be monitored. In essence, the agency is requiring more assurance that federal grant dollars invested in watershed projects will result in measurable improvements in water quality and waterbody uses. The new guidelines can be found in "Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories in FY 2003".[1] This guidance was developed specifically for watershed entities interested in Section 319 funding to help implement their plans. USEPA's objective is to ensure that federally funded projects make effective progress towards restoring waters impaired by nonpoint source pollution.

Plans that result from this process will be called Watershed Based Plans. The new plans, while broadly following the seven-step approach described above, must include nine elements. Table 1-1 shows how the seven-step and nine-element approaches relate to one another and where the nine elements are addressed in this plan. The following section presents the recommended seven-step watershed planning process in more detail and indicates how it incorporates the nine EPA-required elements (indicated by the use of the notation **(Element #)** in boldface). Section 1.2.2 below presents an evaluation of this plan's conformance to the nine USEPA elements of a Watershed Based Plan.

[1] See http://www.epa.gov/owow/nps/Section319/319guide03.html; also *Federal Register*, October 23, 2003, Vol. 68, No. 205, p. 60659. Section 319 is part of the federal Clean Water Act.

Table 1-1. Relation between Seven-Step Watershed Planning and USEPA Nine Minimum Elements

Watershed Planning Approach	USEPA Minimum Elements	Section of This Plan in Which Addressed
1. Identify Stakeholders		1.3
2. Goals and Objectives		1.4 1.5
3. Inventory Watershed Resources and Conditions	1. Identify causes and sources that will need to be controlled to achieve load reductions estimated within the plan	2. 3. 4.1.5.
4. Assess Waterbody/ Watershed problems		
5. Recommend Management Practices	2. Estimate load reductions expected for proposed nonpoint source pollution management measures	4.2. 4.3.
	3. Describe the NPS management measures that need to be implemented in order to achieve the load reductions estimated in step 2; and identify critical areas	4.2. 4.3. 4.5.
6. Develop Action Plan	4. Estimate technical and financial assistance needed, costs, and the sources and authorities (e.g., ordinances) that will be relied upon to implement the plan	4.4. 4.6. 4.7. 4.9.
	5. Information and public education component; and early and continued encouragement of public involvement in the design and implementation of the plan	4.8. 5.4.
	6. Implementation schedule	4.9.
	7. Interim, measurable milestones	5.2.
	8. Criteria to measure success and, if necessary, reevaluate the plan	5.3.
7. Implement Plan and Monitor	9. Monitoring component	5.3.

1.2.1. METHODOLOGY

1.2.1.1. Identify and Assemble Stakeholders

One of the most important considerations in a successful watershed planning process is the level of involvement and commitment of key individuals, or stakeholders, that reside or work in the watershed. Ideally, local stakeholders will drive the planning process and will utilize outside resource agencies for technical support, coordination, and funding. With the early and ongoing involvement of local community members and local government officials, such "bottom-up" plans are more likely to be implemented than "top-down" plans that are driven primarily by outside agencies and organizations.

Another key element of stakeholder involvement is strong leadership, particularly at the community level. In many cases, leadership comes down to one or two key individuals who can convey their enthusiasm and knowledge to potential stakeholders and outside agencies. Continuity in leadership is also critical, as planning and implementation can take many years to complete. With consistent internal support, momentum and enthusiasm are maintained. Without it, the planning process can wither and die.

Typical Steps:
- Assemble stakeholders in an initial meeting.
- Discuss known watershed characteristics and problems.
- Identify a preliminary list of watershed issues and concerns.
- Identify an initial planning structure to engage stakeholders and resource experts in future meetings (e.g., setting up policy and technical advisory committees).

1.2.1.2. Establish Goals

Before any detailed analysis of the watershed is conducted, it is important that the watershed stakeholders identify a preliminary set of goals. These goals should reflect the concerns and desired outcomes of people living and working in the watershed. While the initial goals may change over time as more information becomes available, they provide the basic direction for the planning steps that follow.

While the focus of this watershed planning guidance is on water quality and waterbody uses, it is also desirable at this stage of the planning process to identify related concerns and goals. For example, flooding problems are often associated with water quality problems and should be identified if they are significant concerns in the watershed.

As a note of caution, there is often a tendency to rush to identify detailed problems and solutions in the early meetings of the stakeholders. While some discussion along these lines may be inevitable, participants should be directed to identify goals that reflect desired outcomes for the watershed. For example, improved water quality, improved fishing, and enhanced recreational access all are appropriate goal categories. In contrast, better stormwater management, improved education, and stream restoration are potential solutions, but are not goals.

Typical Steps:
- Identify impartial facilitator.
- Identify a range of potential watershed goals.
- Discuss and prioritize key goals.

1.2.1.3. Inventory Watershed Resources and Conditions

Watershed inventories are needed to document existing conditions and problems in the watershed. The inventories should be directed specifically at factors related to the previously identified goals. Inventories are sometimes done on an iterative basis — the quality and thoroughness of readily available information will determine whether more in-depth data collection may be necessary.

Typical Steps:
- Assemble any readily available data from reports, particularly the Illinois Water Quality Report.

- Map any available spatial information (e.g., land use, wetlands, and other natural resources).
- Visually evaluate key waterbodies and natural resources (particularly the stream corridor), documenting simple physical characteristics and problems.

1.2.1.4 Assess Existing Watershed and Waterbody Problems and Threats

An effective watershed planning process requires a logical, understandable procedure to process potentially large quantities of information about watershed problems. The Illinois EPA has documented such a process in its biennial *Illinois Water Quality Report*. The logic of this process starts with a consideration of desired waterbody uses and their impairments and proceeds to an analysis of causes of impairment and sources of pollution. The assessment approach should consider not only existing problems, but also those problems that can be predicted to arise if watershed conditions (e.g., land use) change.

The assessment should utilize appropriate analytic tools such as geographic information systems (GIS) and pollutant load spreadsheets. Depending on the complexity of issues in the watershed, water quality models also may be appropriate.

Typical Steps:

- Identify potential uses and use impairments from 305(b) Report.
- Utilizing local resource experts, update the IEPA assessment to the level of detail necessary to understand the watershed.
- Identify and quantify the causes and sources or groups of similar sources that will need to be controlled to achieve estimated pollutant load reductions **(Element 1)**.
- Identify critical areas for protection and/or remediation.

1.2.1.5. Recommend Management Practices for Prevention and Remediation

Based on the previously identified causes of use impairment and the specific sources that are contributing, appropriate control objectives and best management practices (BMPs) should be identified. While there is sometimes a tendency to simply borrow lists of BMPs from published guides or other watershed plans, it is important that recommended practices be tailored to the specific conditions, needs, and priorities of the watershed.

Typical Steps:

- Identify specific objectives necessary to address the causes and sources of impairment (e.g., phosphorus reduction, flow rate control, streambank stabilization).
- Estimate of the pollutant load (or flow) reductions expected to achieve the objectives **(Element 2)**.
- Describe the nonpoint and point source management measures that will need to be implemented to achieve the load reductions estimated above and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan **(Element 3)**.
- In addition to BMPs necessary to reduce existing impairments, identify practices needed to prevent or minimize future problems (e.g., those associated with new development) as well as measures needed to maintain existing high quality conditions (e.g., ongoing stewardship and management of natural areas).

1.2.1.6. Develop an Effective Action Plan

An action plan is needed to translate the quantitative recommendation of various BMPs into specific, implementable actions and programs. Some of the critical considerations of an action plan are what specifically needs to be done, who will do it, and when it should be accomplished. It is essential to have broad stakeholder involvement in developing the action plan. In particular, both the resource experts who have identified recommended actions and the recommended implementers (e.g., local government officials and major landowners) must be involved. In a successful planning process, there will be considerable interaction and feedback during this part of the process, resulting in mutual education of the participants and an action plan that is both implementable and effective.

Typical Steps:

- Identify specific recommendations for BMPs and implementation programs.
- Where appropriate, compare these to ongoing practices and programs (e.g., watershed development ordinances) already in place in the watershed.
- Identify responsible parties to undertake recommended actions.
- Identify the amount of technical and financial assistance needed, the associated costs, and/or the funding sources and authorities that will be relied upon to implement the plan **(Element 4)**.
- Develop an information/education component, particularly targeting local residents, landowners, and local government officials **(Element 5)**.
- Develop an implementation schedule for the various action plan recommendations **(Element 6)**.
- Describe interim, measurable milestones for determining whether recommendations are being implemented **(Element 7)**.
- Develop a set of criteria that can be used to determine whether pollutant loading reductions and related plan objectives are being achieved over time **(Element 8)**.
- Develop a monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria referenced above **(Element 9)**.

1.2.1.7. Implement Plan and Monitor Success

If the preceding steps have been rigorously pursued, there should be a strong likelihood of implementation success. Nonetheless, the planning process needs to continue well after the action plan has been completed. In particular, a mechanism needs to be in place to report back to stakeholders and implementers about implementation progress.

Typical Steps:

- Identify an entity from the stakeholder group to track plan implementation.
- Following the criteria and milestones referenced above, track plan implementation activities on a regular basis (e.g., annually).
- Contact stakeholders and implementers if progress is lacking.
- Inventory and monitor changes (i.e., improvements) in resource conditions with respect to criteria identified above (e.g., chemical, physical, and biological conditions.
- Periodically compare implementation success to plan goals, recommendations, and criteria to determine whether new actions need to be added to the plan, or whether the plan's goals and objectives need to be revised.
- Revise plan accordingly.

1.2.2. EVALUATION OF PLAN CONFORMITY TO THE NINE MINIMUM ELEMENTS

This section assesses the performance of the *Thorn Creek Watershed Based Plan* (*TCWBP*) with respect to the USEPA nine minimum elements. On the whole, this plan follows the guidelines, although there are areas that would benefit from an upgrade in the future. The best assembled and most time intensive part of the *TCWBP* probably is the Watershed Resource Inventory (Section 2), which assesses water and habitat quality with considerable thoroughness and addresses **Element 1**. The most significant shortcoming in the *TCWBP* relates to **Element 3** because of the plan's lack of specificity about BMP installation sites, overall costs and pollutant load reductions, and responsible parties.

The identification of causes and sources of impairments called for in **Element 1** of the guidelines can also be found in summary form in Section 4.1.5. This table is comprehensive and integrates the major areas of the plan by looking back to the goals and objectives of the stakeholders and forward to the application of the Watershed Management Recommendations (WMRs). While the Watershed Resource Inventory in Section 2 describes the impairments and causes quantitatively and in detail, so that this portion of the plan is on solid footing, the Water Quality Assessment in Section 3 is not as conclusive with regard to the sources. Further study is needed to isolate the sources of several impairments, and Section 3 specifies the types of study required and watershed locations to target.

The WMRs in this plan are a generalized list of nonpoint source pollution management measures, as required in **Element 3**. Those most appropriate for the watershed were selected in consultation with stakeholders, after which priority (geographic) areas, estimated costs, and expected pollutant load reductions were then developed for each WMR. For the most part, however, the recommendations remain general. Critical areas are no more specific than the subbasin level, whereas — for structural BMPs at least — specific sites should be selected. Estimated costs are on a per-unit basis, and expected pollutant load reductions (**Element 2**) are given on a percentage basis for particular pollutant sources (Section 4.3. and 4.4.). The exception to this generality is the Short Term Action Plan, presented in Section 4.5., which outlines a set of WMRs to implement over the next three years. These activities are mostly presented in numerical terms, so that the total cost and, to an extent, the pollutant load reduction can be estimated. However, the *TCWBP* does not evaluate the relative pollutant contribution of, for example, outdated dry bottom detention basins, then quantify the benefit of retrofitting a specified number of them. Not only does the plan provide too little information to select the most cost-effective WMRs, it does not attempt to determine estimated pollutant reductions on an absolute or mass-balance basis. Again, however, it is difficult to reach this level of specificity when the sources of impairment and their relative contributions to water quality problems are not known with great certainty. The *TCWBP* is an evolving document written in the absence of this certainty, and so it takes the approach of establishing a framework for more detailed planning. The Short Term Action Plan provides an example of how to specify the work to be performed, although it does not provide specific BMP installation sites.

Identification of the responsible parties and financial assistance required to implement watershed projects is required by **Element 4**. Various implementation partners are associated with the WMRs in a matrix given in Section 4.9 (Action Plan Summary for Water Quality Improvement). Financial assistance, in turn, is covered in Section 4.7 with an up-to-date list of potential funding sources that concentrates mainly on project grants as opposed to planning grants. While the territory within **Element 4** has been covered, not all the connections have been made. Places, projects, people, and funding have not been connected together at a level of detail beyond the Short Term Action Plan.

Element 5, the information and education component, was approached in an integrative way, as a microcosm of the entire plan. Goals and objectives for the education campaign were developed through stakeholder input, general methods of outreach were described and evaluated, and a specific strategy that identified target audiences and messages was developed with assignment of priorities and responsible parties (Section 4.8). An evaluation mechanism was also developed for the education strategy (Section 5.4).

Element 6 requires an implementation schedule for nonpoint source control measures, the water quality-related WMRs in this plan. This was done on both a short- and longer-term basis. In Section 4.9, the Action Plan Summary for Water Quality Improvement, the general priority of each of the WMRs was ranked by timeframe for implementation, which in turn suggested the most important or highest priority WMRs to feed into the Short Term Action Plan (implementation over three years). Milestones to measure interim progress were developed to guide and monitor activities to be undertaken from three to 15 years hence (Section 5.2, Watershed Management Recommendation Implementation Monitoring Strategy), as required by **Element 7**. These are oriented toward tracking the implementation of the WMRs. Achievement of water quality objectives (i.e., outcomes) is dealt with in matrix form in Section 5.3. This table addresses **Elements 8** and **9** by establishing indicators and milestones for reaching water quality objectives.

1.3. Thorn Creek Watershed Stakeholders

The following 107 individuals volunteered or were invited to participate in the Thorn Creek Watershed Planning process. Several also participated in the Technical Advisory Committee (TAC) or Steering Committee (SC).

Name	Organization	TAC	SC
Ders Anderson	Openlands Project		
Katie Armstrong	Former Village Trustee, Village of Park Forest		
Marcus Arnold	Transportation Planner, South Suburban Mayors & Managers Association		
Steve Aultz			
Cindy Bakkom	Superintendent of Public Programs and Education, Forest Preserve District of Will County		●
Diane Banta	National Park Service		
Janet Basek			
James Bilotta	Board Member, Will County		
Lynn Boerman	C2000 Ecosystem Administrator, Illinois Department of Natural Resources Region 2		●
Tim Bradford	Assistant to Supervisor, Rich Township		
Scott Bullard	Forest Preserve District of Cook County	●	
Margaret Burns-Westmeyer	Beautification Committee, Chicago Heights		●
Steven M. Bylina Jr.	General Superintendent, Forest Preserve District of Cook County		
Roland Carlson	Village of Thornton		●
Mary Carrington	Governors State University		
Joseph Christofanelli	Manager, Village of Glenwood		
Karen D'Arcy	Governors State University	●	●
James Daugherty	District Manager, Thorn Creek Basin Sanitary District	●	●
Don De Graff	President, Village of South Holland		
Kristi DeLaurentiis	South Suburban Coordinator, Metropolitan Planning Council		●
Anthony DeLuca	Mayor, City of Chicago Heights		
Marcy DeMauro	Forest Preserve District of Will County		
Donna Dettbarn	Supervisor, Monee Township		
Rose Marie DeWitt	Will/South Cook Soil & Water Conservation District		●
Charles Dieringer			
Judy Dolan-Mendelson			
Kerry Durkin	Village of Glenwood		
Stuart Fagan	President Governors State University		
Stina Fish	URS Corporation		
Bud Fleming	Cook County Department of Planning & Development		
Mark Franz	Manager, Village of Homewood		
Mary Ann Gearhart	Will County Board		

Deutsch			
Carl Glassford	Open Space Alliance/Sauk Calumet Sierra Club		●
Timothy Good	Forest Preserve District of Will County		
Jeffrey D. Greenspan			
Chuck Gruberman	Village of Homewood		
Michael Grubermann	Administrator, Village of Monee	●	
Rob Gunther	Village of Park Forest		
David Guritz	Irons Oaks Environmental Learning Center		
State Senator Debbie Halvorson			
Andy Hawkins	J. F. New & Associates, Inc.	●	
Andre Haynes	Cook County Highway Department		
Hall Healy			
Jennifer Hindel	Thorn Creek Basin Sanitary District	●	
Richard Hofeld	President, Village of Homewood		
Jean Hurrle			
Robert Jankowski	District Conservationist, US Department of Agriculture/Natural Resource Conservation Service		
John Joyce	Village of Park Forest		
Karen Kaempf	Thorn Creek Audubon		
Nancy Kaszak	Executive Director, CorLands		
Anne Kawaters			
Bill Keonig	Forest Preserve District of Cook County		
Mary Kilday	Cook County Highway Department		
Dave Kircher	Forest Preserve District of Cook County	●	
Kenneth W. Kramer	Trustee, Village of Park Forest	●	●
Jeanne Maggio	Mayor, Village of Glenwood		
Al Marconi			
Chris Marinovich	Superintendent of Conservation, Forest Preserve District of Cook County		
Dave Mauger	Forest Preserve District of Will County	●	●
Larry McClellan			
Sally McConkey	Professional Scientist, Illinois Department of Natural Resources / Illinois State Water Survey		
Alvin McCowan	President, Village of University Park		
Jon Mendelson	Governors State University	●	
Jeff Mengler	Botanist/Wetland Ecologist, U.S. Fish and Wildlife Service		
Greg Meyer	Director, Homewood-Flossmoor Park District		
Peter Miller	HDR Engineering		
Jim Morley	Supervisor, Rich Township		
Janet Muchnik	Former Village Manager, Village of Park Forest		
Joan Murphy	Commissioner, Cook County Building		

Jason Navota	Northeastern Illinois Planning Commission, Project Manager		
David Niemeyer			
Leon Norwood	South Suburban COPE		
Timothy O'Donnell	President, Village of Monee		
Mary Orlick	City of Chicago Heights		●
John Ostenburg	President,Village of Park Forest		
David Owen	President, Village of South Chicago Heights		
Edward Paesel	Executive Director, South Suburban Mayors & Managers Association		
Michael Pasteris	Executive Director, Forest Preserve District of Will County		
Paul Peterson	Administrator, Village of South Chicago Heights	●	
James Phillips	Forest Preserve District of Cook County		
Scott Ristau	Illinois Environmental Protection Agency		
Steve Rodgers			
Richard Rosenthal	President, The Land Group	●	
Max Salmon	Village of Thornton	●	●
Bill Saylor	Illinois State Water Survey		
John Schaefer	Director of Public Works, Village of Homewood		
Jean Sellar	US Army Corps of Engineers		
Connor B. Shaw	Possibility Place Nursery		
Elbert Shaw	Village Manager, Village of University Park		
Deborah Simms	Commissioner, Cook County Building		
Thomas Somer	Supervisor, Bloom Township		
John Spomar	Norco Cleaners, Inc.	●	
Jack Swan	President, Village of Thornton		
Glenn Sweeny			
Renee Thakali	Midewin National Tall Grass Prairie		
Paul Vicari	Project Manager, J. F. New & Associates Inc.		
Amy Walkenbach	Illinois Environmental Protection Agency		
Tyson Warner	Planning Division, Will County Land Use Department		
Tammy Watson	Division of Ecosystems, Illinois Department of Natural Resources		
Bill White	Peoria Field Office, Illinois State Water Survey		
Jeff Wickenkamp	Northeastern Illinois Planning Commission	●	
Valencia Williams	Director of Planning, City of Chicago Heights		
Nancy Williamson	Illinois Department of Natural Resources, Region 2		
Dr. Mary V Woodland	Storm Water Resource Committee		
John Yunger			
Richard Zimmerman	Village Administrator, Village of South Holland		
Frank Zuccarelli	Supervisor, Thornton Township		

1.4. Initial Concerns and Goals for the Thorn Creek Watershed

1.4.1. LIST OF ISSUES AND CONCERNS FROM MEETING DECEMBER 8, 2003

1. Lack of recognition for good actions — businesses who comply on their own
2. Negative images — self-perpetuating
3. Lack of stormwater management
4. All parties should be represented
5. Habitat fragmentation
6. Development pressure on the habitat
7. Degraded streambanks of public and privately-owned land
8. The need for "real" outreach programs
9. Implementation-making sure things happen in areas that need action.
10. Enforcement of state laws
11. Intra-governmental conflicts
12. Loss of aquatic biodiversity
13. Decaying infrastructure — locating and repairing
14. Protection of Thorn Creek headwaters
15. Maintenance of high-quality natural habitats
16. Acquisition of open space — low cost of land in south suburbs
17. Exotic species
18. Being satisfied with progress in small steps: acceptance of restoration management practices
19. Public buy-in: proving that environmental improvements will provide an economic benefit and represent progress
20. Degraded streambanks
21. Lack of water in the upstream portion of the creek
22. Past BMP performance/local applicability
23. Ordinance adoption in line with watershed goals
24. Ineffectual planning that is not implemented
25. Lack of citizen involvement
26. Competition for funding (Butterfield and Thorn Creeks) — coordination
27. Public education
28. Lack of bike trails
29. Aquifer protection
30. Wellhead protection
31. Public education about the aquifer
32. Conservation of sensitive natural areas
33. Educating decision-makers about watershed conservation
34. Educating the private sector (e.g. builders)
35. Involving all watershed communities in protection efforts

36. Access to the creek at appropriate locations
37. Inter-governmental competition may impede cooperation on watershed protection
38. Water quality
39. Debris in the stream
40. Incorporating infrastructure into the plan (e.g.26th Street Dam)
41. Mitigation planning and stormwater management — should be used together
42. Greenways
43. Infrastructure projects — should consider watershed impacts
44. Stormwater detention — removal or rehabilitation of dysfunctional or poorly engineered facilities
45. Errors on watershed maps
46. Inability of organisms to migrate in the stream
47. Monitoring of point sources (e.g. Thorn Creek Basin Sanitary District)
48. Inclusion of the private sector
49. NPDES Phase II regulation — should be incorporated into the process
50. Wetland restoration process as related to stormwater
51. Inability of native species to re-colonize
52. Ubiquitous application of herbicides and pesticides
53. "Not my problem" — ownership of stormwater infrastructure repairs and maintenance
54. Conflicts among environmental organizations
55. Streambank stabilization
56. Flooding

1.4.2. GOALS AND OBJECTIVES FOR THE THORN CREEK ECOSYSTEM PARTNERSHIP AS NOTED IN A *WATERSHED PLAN FOR THORN CREEK*

Goals

- To ensure the preservation, protection, and restoration of natural landscapes and to enhance eco-system processes.
- To integrate the watershed's natural resources into the life and future of the community.
- To foster and facilitate increased intergovernmental, interagency and private sector cooperation within the Thorn Creek watershed.
- To foster and facilitate increased citizen involvement within the Thorn Creek watershed.

Objectives

- To protect critical open space remaining in the watershed.
- To restore, enhance, and maintain open spaces and natural areas.
- To improve water quality, hydrology and hydraulics in watershed streams, lakes, and wetlands.
- To improve environmental education, public outreach, and scientific research.
- To improve conservation / environmental practices related to sustainable development.

- To encourage the use of natural resources to create an (socio) economic benefit to local communities.

1.5. Thorn Creek Goals and Objectives

The following set of goals and objectives was developed using the information collected and identified in Section 1.4.

1.5.1. OVERALL GOAL

Preserve open space and habitat that serve multiple functions such as flood damage reduction, water quality improvement, habitat, and recreation, especially permeable soils, depressional storage, wetlands, and hydric soils. Create a culture in which water (wetlands, waterways, lakes, ponds) is treated as a resource rather than a waste product.

1.5.2. RESOURCE BASED GOALS

1.5.2.1. Habitat and Natural Resources

Issues and Concerns

- Habitat fragmentation and degradation
- Loss of aquatic biodiversity
- Open space protection
- Exotic species
- Aquatic migration
- Degraded streambanks
- Lack of water flow in the upstream portion of the creek
- Unprotected headwaters
- Wetlands as stormwater facilities
- In-stream debris

Goal (Priority 1)

Protect and restore terrestrial and aquatic habitat quality and quantity within the watershed.

Objective

1. Protect, manage, and restore important habitat areas, biological diversity, buffers, green corridors, and "stepping stones" between habitat areas.

1.5.2.2. Water Quality

Issues and Concerns

- Aquifer and wellhead protection (groundwater)
- Lack of point sources monitoring
- Overapplication of herbicides and pesticides
- Lack of good stormwater management and detention
- Joint mitigation planning and stormwater management

Goal (Priority 2)
Protect and enhance surface water quality to support uses designated for Thorn Creek by the Illinois Environmental Protection Agency.

Objectives
1. Reduce contamination (bacteria, fecal coliform, pathogens) from urban runoff, sanitary sewer overflows or aging infrastructure (leakage, and/or failure of connections, lift stations, etc.), illicit connections of sanitary sewers or other waste discharge pipes to storm sewers, and animal waste including pets, horses, and urban wildlife (geese, other birds, raccoons, deer).
2. Reduce organic enrichment / low dissolved oxygen problems from urban runoff; sanitary sewer overflows or aging infrastructure (leakage, and/or failure of connections, lift stations, etc.); illicit connections of sanitary sewers or other waste discharge pipes to storm sewers; and animal waste including pets, horses, and urban wildlife (geese, other birds, raccoons, deer).
3. Reduce nutrient loads (phosphorous and nitrogen) and algal growth from urban runoff; point source discharges / illicit stormsewer connections; and agricultural activity.
4. Reduce aquatic life toxicity (primarily total dissolved solids, chlorides, and sulfates) from urban runoff, road salt and storage / highway maintenance and runoff, and point discharges / illicit stormsewer connections.
5. Reduce fly dumping and debris loads in the stream.
6. Reduce hydrologic disturbance / flow alterations from hydrologic modification and urban development.

1.5.2.3. Water Supply

Issues and Concerns
- Aquifer and wellhead protection (groundwater)

Goal (Priority 3)
Protect and enhance ground water quality and quantity.

Objective
1. Identify and protect important groundwater recharge areas, infiltration areas, and areas of high aquifer sensitivity / susceptibility to pollution, including wellhead protection areas.

1.5.2.4. Recreation and Access

Issues and Concerns
- Greenways
- Lack of sufficient bike trails
- Access to the creek at appropriate locations

Goal (Priority 4)

Increase, improve, and promote recreational resources, opportunities, and access throughout the watershed for social and economic benefits.

Objectives

1. Identify and prioritize areas for recreational enhancement including trails, trail access, and alternative transportation networks.
2. Promote the creek and increase demand for natural resource-based recreation activities.

1.5.2.5. Flooding[2]

Issues and Concerns

- Flooding

Goal (Priority 5)

Reduce flooding and flood damages.

Objectives

1. Reduce flow rates and volumes from existing developed areas.
2. Minimize increases in runoff rates and volumes associated with new development.
3. Manage drainage ways to preserve stormwater conveyance.

1.5.3. WATERSHED COORDINATION GOALS

1.5.3.1. Communication, Coordination, and Governance

Issues and Concerns

- Lack of ordinances and enforcement
- Intra- and inter-governmental and organizational conflicts and competition
- NPDES Phase II regulation
- Infrastructure maintenance and construction
- Inaccurate maps
- Ineffectual plans

Goal (Priority 1)

Increase coordination, cooperation, research, and informed decision-making among governments, agencies, non-profits, and the private sector.

Objectives

1. Create public/private partnerships to implement the Watershed Based Plan and pursue funding opportunities.
2. Improve decision-making by encouraging watershed communities to share accurate information and pursue technical assistance from appropriate agencies.

[2] Additional stormwater-related goals and objectives are included under Water Quality, Section 1.5.2.2.

3. Provide technical assistance to those seeking guidance in the design and/or implementation of best management practices.
4. Coordinate recreational, flood control, habitat, and water quality objectives.

Goal (Priority 4)
Improve procedures and ordinances so that they are up to date, aligned with watershed protection goals, aligned with adopted plans, and enforced/enforceable.

Objectives
1. Strengthen and enforce existing regulations, especially those regulations related to non-point source pollution.
2. Cooperate watershed-wide to coordinate and achieve regulatory goals such as NPDES requirements.
3. Coordinate / incorporate watershed management plans and strategies into local plans and policies.

1.5.3.2. Education and Stewardship

Issues and Concerns
- Negative perceptions of creek / public buy-in
- Inadequate outreach and public education
- Lack of citizen involvement
- Lack of understanding / acceptance of restoration management practices
- Lack of involvement of all watershed communities and private sector
- Recognition for good actions

Goal (Priority 2 — tie)
Educate the public, public officials, community leaders, businesses, and developers about the watershed and their impact and role in protecting watershed resources.

Objectives
1. Develop and disseminate watershed planning and protection information to the public and community leaders and decision-makers.
2. Develop public relations and media strategies to educate, involve, and invigorate the public and community leaders and decision-makers.

Goal (Priority 2 — tie)
Increase involvement in watershed leadership, stewardship, monitoring, and volunteer activities.

Objectives
1. Encourage stewardship, coordination, cooperation, and best management practice implementation with key corporate and political entities.

2. Create and implement short and long-term maintenance, management and monitoring plans for all protected open space including uplands, wetlands, waterways, stormwater conveyance and detention/retention facilities and lakes.

2. THORN CREEK WATERSHED RESOURCE INVENTORY

2.1. Climate

The climate of the Thorn Creek watershed is continental, with wide temperature fluctuations during the course of each year. Summer maximum temperatures are generally in the eighties and low nineties (Fahrenheit degrees) with lows in the fifties and sixties, while high temperatures in winter are generally in the twenties to thirties with lows in the teens and twenties. Precipitation is usually heaviest in the growing season and lightest in midwinter, with the greatest amounts of snowfall coming in December through March and rarely exceeding 12 inches in depth.

The most in-depth climate history data near the Thorn Creek watershed is from Midway Airport (Tables 2-1 and 2-2). Average and extreme temperatures and precipitation levels should be fairly consistent throughout the area.

Table 2-1. 1971-2000 Temperature Normals for Chicago Midway Airport (degrees F)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
High	30.7	36.1	47.4	59.2	71.3	80.8	84.7	82.3	75.1	63.2	48	35.6	59.5
Low	16.2	21.3	30.6	40.2	50.9	60.7	66.3	65	56.7	44.9	33.6	22.2	42.4
Mean	23.5	28.7	39	49.7	61.1	70.8	75.5	73.7	65.9	54.1	40.8	28.9	51
Days >90	0	0	0	0.1	1.3	4.6	8.4	5	1.9	0.1	0	0	21.4
Days <32	16.3	10.7	3.4	0.1	0	0	0	0	0	0	1.9	10	42.6

Table 2-2. 1971-2000 Mean Precipitation Normals for Chicago Midway Airport (inches)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Precipitation	1.95	1.78	2.83	3.82	3.86	4.16	3.82	3.91	3.45	2.79	3.22	2.76	38.3
Snowfall	12.9	10.3	6	1.4	0	0	0	0	0	0.1	2.3	10.1	43.1
Days with >0.1	5	4.6	6.6	7.2	7.1	6.4	6.1	6.3	5.5	5.6	6.7	5.3	72.5

Source: Illinois State Climatologist's Office, a part of the Illinois State Water Survey, www.sws.uiuc.edu/atmos/ statecli.

2.2. Geology and Physiography

2.2.1. BEDROCK AND GLACIAL GEOLOGY

The bedrock of the Thorn Creek watershed is primarily comprised of Silurian dolomite and Ordovician Maquoketa shale. Outcrops of Silurian dolomite of the Thornton Reef formation are generally restricted to artificial exposures like Thornton Quarry, but a few bedrock outcrops are found near Glenwood Road in Glenwood and Margaret Street in Thornton. The features of the bedrock surface topography generally include coarse grained sediments such as sands and gravels that form important productive aquifers. On top of the bedrock lies a mantle of glacial material. The surface geology of the Thorn Creek watershed, like that of the Great Lakes area as a whole, was formed largely by glacial action.

The land surface of the Thorn Creek watershed is made up of two distinct physiographic regions. The northeastern third of the watershed occupies the Chicago Lake Plain, marking the furthest advance of the Wisconsin Glacier, which formed Lake Michigan. The land here is very level, interrupted only by a pair of beach ridges, the Glenwood and the Calumet. This area is composed of lacustrine deposits, fine grained sediments which were once the base of temporary lakes that often formed along the margin of the glacier. Lacustrine sediments are usually poorly drained and may cause water problems for construction projects.

The southwestern two-thirds of the watershed lies on a broad upland composed of the Tinley Moraine, the Westmont Moraine, which is the innermost moraine of the Valparaiso system in the area, and associated ground moraine. The topography is rolling, but in many places, particularly forested areas near Thorn Creek, deep ravines have developed. This area is composed primarily of till, a compact mix of clay, silt, and sand particles that form a matrix around larger particles.

Moraines are formed when a glacial margin advances and melts back several times, depositing till at the glacier's base or allowing sediment to flow off the melting edge of the mass of ice. The hills left after each advance are called end moraines, and a number of notable examples of this geographic feature are located in the watershed. The Westmont and Clarendon moraines on the southern border of the watershed form the divide between the Great Lakes/North Atlantic watershed and the Mississippi River/Gulf of Mexico watershed. Here also is the divide between the Thorn Creek Watershed, with its north flowing streams, and Black Walnut Creek flowing south to the Kankakee, the Illinois, and eventually the Mississippi River. The Tinley moraine forms the hills of Chicago Heights.

Across the landscape, on top of these glacial deposits, lies a layer of windblown silt called loess. Loess is the parent material of the region's rich soils. It is derived from sediments that flowed into major meltwater valleys and were blown from the floodplain. In the Thorn Creek watershed, loess tends to be less than two feet thick over the coarser outwash, tills, and lacustrine sediments.

2.2.2. TOPOGRAPHY AND STREAM GRADIENT

The fairly narrow watershed of the main stem of Thorn Creek follows a general orientation from southwest to northeast. Significant areas of floodplains occur generally above Sauk Trail Lake and in the lower reaches of the main stem (approximately the lower half of the watershed).

Thorn Creek itself begins in the Valparaiso moraine near Crete-Monee Road, runs along the western margin of glacial period Lake Steger, crosses the Tinley moraine at a low point in Chicago Heights, and enters the Little Calumet River after traversing about 6 miles of the Lake Chicago plain. In the moraine, some of the valley bluffs are 35 and 40 feet high, while on the lake plain the average is only 15 feet. Figure 2-1 (Appendix A) provides a color-classified map of elevations, as well as floodplains, within the watershed. The elevation change from the headwaters, at 790 feet above sea level, to the mouth, at 585 feet, is a little more than 200 feet along a horizontal distance of about 20 miles, an average gradient of 10 feet per mile. The general shape of the profile (Figure 2-2, Appendix A) illustrates the substantial differences in stream gradient between the upper morainal portion of the watershed, where the gradient is over 17 feet per mile, and that of the Lake Chicago Plain to the north, where it is less than 3 feet per mile.[1]

2.2.3. SOILS

There are two soil associations in the upper (southern) morainal portion of the Thorn Creek watershed, one formed in silty clay loam till, the other in heavier till of silty clay texture (Figure 2-3, Appendix A). A common soil of the latter association is Bryce silty clay (235), a hydric soil of small depressions and drainageways, formed under wet prairie or marsh vegetation. Another common soil of this association is Frankfort silty clay loam (320A–C soil type), an upland soil of level or gently rolling terrain. Frankfort probably supported prairie and/or savanna vegetation. Two other soils, Napanee silt loam (228B-C) and Chatsworth silty clay (241D–F) are found along the wooded slopes of the upper Thorn Creek Valley.

Soils of the silty clay loam association are widely distributed in this part of the watershed. The common hydric soil is Ashkum silty clay loam (232), found in small drainageways and wet spots throughout. Two soils, Blount silt loam (23) and Morley silt loam (194C–F), are characteristic of the extensive woodlands of this area. Blount is found on level uplands, while Morley is the soil of slopes. Two other widely distributed soils, Beecher silt loam (298) and Markham silt loam (531), are also located on uplands, but probably originated under prairie and/or savanna vegetation. They are the loamy analogues of Frankfort.

The major soil of the Thorn Creek floodplain is Sawmill silty clay loam (107). It occurs both in the upper, morainal reaches of the creek and in the floodplain of Thorn Creek as it traverses the Chicago Lake Plain. Within the watershed, the boundary between the Tinley ground moraine and Chicago Lake Plain runs in an arc from just south of Route 30 at the Indiana state line in the southeast to the intersection of 183rd Street and Chicago Road in the northwest.

Two groups of soils are characteristic of the Chicago Lake Plain: soils of the lake plain proper, and those of the two beach ridges associated with lake plain. Additionally, soils developed on bedrock outcrops may be found in several places, most notably in the vicinity of the Thornton Quarry.

Major soils of the lake plain itself are Milford silty clay loam (69), Martinton silt loam (189), and Del Rey silt loam (192). Milford is a poorly drained soil of flats, shallow depressions and drainageways. Martinton and Del Rey occur at slightly higher elevations, and are somewhat better drained. Martinton developed under prairie vegetation; Del Rey may have originally supported savanna or open woodland. Morley, a principal forest soil of the moraines, also occurs on lake plain, in narrow strips along the wooded slopes of the Thorn Creek valley. Conversely, Milford, Martinton and Del Rey are found in the morainal region, occupying the basin of Glacial Lake Steger, an ice-front lake, whose basin lies between the Tinley moraine and Valparaiso ground moraine.

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[1] *Sources: Thorn Creek: An Inventory of the Region's Resources*, 2000. Illinois Department of Natural Resources, Critical Trends Assessment Program. Bretz, J. Harlan. 1955. *Geology of the Chicago Region. Part II – The Pleistocene.* Illinois State Geological Survey Bulletin 65.

Oakville fine sand (741) and Wesley fine loamy sand (141) are the principal soils of the Glenwood Beach, the outermost of the Chicago Lake Plain beach ridges. Oakville is found on the ridge tops, while Wesley occupies the flanks of the ridge. Watseka loamy fine sand (49) is the major soil of the Calumet Beach. Gilford fine sandy loam (201) is found on flats either within or adjacent to the beach ridge. Rockton loam (503B) is the main soil overlying the dolomite outcrops. It is found primarily in the vicinity of the Thornton Quarry.[2]

2.2.4. AQUIFER SENSITIVITY

The groundwater in the Thorn Creek watershed is ample and of good quality, and 1,543 private wells and 26 public water supply wells make use of this resource.[3] Anecdotal evidence suggests that a previously discovered cone of groundwater depression in Chicago Heights disappeared when the village switched from groundwater to Lake Michigan water in 2003. Ford Heights switched to lake water in the same year as well.

The watershed's groundwater is drawn from relatively shallow bedrock fissures that are covered by thick surface soils. These thick overlying soils help protect the groundwater from contamination by pollutants that might leech through the surface into the groundwater supply.[4]

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[2] *Sources: Soil Survey of DuPage and Part of Cook Counties, Illinois*, USDA, Soil Conservation Service. Soils *of DuPage and parts of Cook County*, Illinois. 1979. Illinois Agricultural Experiment Station Report No.108. Wascher, H.L., J. D. Alexander, B. W. Ray, A. H. Beavers, and R. T. Odell. 1960. *Characteristics of soils associated with glacial tills in northeastern Illinois*. University of Illinois College of Agriculture Bulletin 665. *Will County Soils*, advance sheets. 1980. Willman, H. B. and J. Lineback. 1970. Surficial *Geology of the Chicago Region*, map in Willman, H. B. 1971. *Summary of the Geology of the Chicago Region*. Illinois State Geological Survey, Circular 460.

[3] USGS figures from 1990 indicate that 36.33 million gallons per day of groundwater were withdrawn out of 293.4 mgd (12.4%) of total water use for the Thorn Creek basin.

[4] *Sources*: *Thorn Creek: An Inventory of the Region's Resources*, 2000. Illinois Department of Natural Resources, Critical Trends Assessment Program. Private well information from the Illinois State Water Survey private well database; public well information from Illinois Water Inventory Program.

2.3. Hydrology and Waterbodies

2.3.1. STREAMS

The main stem of Thorn Creek runs approximately 20 miles from its origin to its confluence. Three major tributaries join the Creek during its course (Figure 2-4, Appendix A). Deer Creek flows into Thorn Creek about 7.84 miles upstream from its confluence with the Little Calumet. Butterfield and North Creeks flow into Thorn Creek further to the north, at miles 7.32 and 4.97 respectively.

Two sites on Thorn Creek have been regularly monitored for streamflow by the United States Geological Survey (USGS): Glenwood (station #05536215) and Thornton (station #05532675). The Glenwood site is approximately one mile upstream from the Deer Creek confluence and one half mile below the Thorn Creek Basin Sanitary District outfall. The Glenwood station records Thorn Creek streamflow above the confluence with Butterfield, Deer, and North Creeks, and includes effluent flow from the Thorn Creek Basin Sanitary District (TCBSD) wastewater treatment plant. The Thornton site is approximately one half mile below the confluence with North Creek and two miles above the confluence with the Little Calumet River. The Thornton site records streamflow of Thorn Creek mainstem, Butterfield, Deer, and North Creeks, and effluent flow from the TCBSD and the wastewater treatment plant on Deer Creek. The graphs in Figures 2-5 through 2-10 present mean annual flow, ten year averages of mean annual flow, and mean monthly flow for all years on record, illustrating the general temporal and seasonal trends for Thorn Creek streamflow.

It is interesting to view the change in mean annual streamflow over the period of record from 1950 to 2002. At Glenwood, the trend lines for total flow and baseflow (here meaning total flow minus effluent from the wastewater treatment plant) indicate a fairly constant baseflow of approximately 22 CFS and an increase in total flow from 30 CFS to approximately 50 CFS, owing primarily to flow from the wastewater treatment plant. Ten year averages show a similar trend. Monthly streamflow shows a seasonal variation from the highest flow in April to the lowest flow in October. Data for Thornton show similar patterns except that the baseflow trendline shows a slight increase over the period of record and total flow is two to three times that at Glenwood, due to the Butterfield, Deer, and North Creek tributaries.

Fairly constant baseflows at Glenwood may indicate that urban development of the main stem Thorn Creek watershed over the period of record has not resulted in an overall increase in baseflow volume, as might be expected due to increased amounts of impervious surface and reduced infiltration of stormwater. Several factors may contribute to this result. Significant portions of the watershed were developed prior to 1949. Secondly, some of the increased flow due to impervious areas is being delivered to the sanitary plant because of wet weather inflow and infiltration. A slight increase in base flow at Thornton may be indicative of increasing urbanization and runoff in tributary watersheds, or possibly to increasing wastewater contributions from plants located on these tributaries, but it is difficult to conclude with certainty.

What is not captured by these data is the increasing flashiness or rapid variability in streamflows due to storm events that are perhaps a more damaging impairment than an increase in overall volume. Without comparing hydrographs for identical storm events at similar locations over time, it is difficult to prove that the creeks are more "flashy" due to urbanization. As a partial substitute for analyzing hydrographs, existing streamflow data can be broken into wet weather and dry weather flows to demonstrate that flow during wet weather increased substantially over the past 50 years while dry weather flows went up relatively moderately (Figure 2-11). Flows were analyzed for the Glenwood stream gauge by grouping historical daily flows from 1953 through 2002 into five decades. Wet weather flows were approximated as the top 25 percent of flows in each decade and dry weather flows as the bottom 75 percent.

Increased dry weather flow is largely due to increased baseline plant discharge. However, the highest flows show an increase that exceeds that which is attributable to *baseline* plant discharge. Over the 50-year period, the volume of water delivered to Thorn Creek in wet weather or high flow events has increased by over 55 percent. While baseline plant discharge has increased over the 50-year time period, this accounts for less than half of the flow increase during high flow events. During the same time periods, average precipitation increased by only 16 percent. Some of the stormwater during rain events is delivered to the plant, and from there to Thorn Creek. No matter the source, however, the conclusion remains that much more water enters the stream during a rain event now as compared to 50 years ago, suggesting increased flashiness. Much of the increase in high flows is attributable to the increased urbanization in the watershed, where expanding infrastructure such as impervious surfaces, storm sewers, and sanitary sewers all work to increase the rate and volume of runoff from the land surface. These changes have modified the natural hydrology of the creek.

The Illinois Environmental Protection Agency's *Illinois Water Quality Report, 2004* (IEPA, 2004) identifies "other flow alterations" as a cause of impairment in the upper reaches of Thorn Creek due to hydomodification (upstream impoundment, flow regulation/modification). In the lower reaches of Thorn Creek, "physical–habitat alteration" is cited as a cause of impairment due to hydromodification (channelization) and habitat modification (streambank modification/destabilization) (see Table 2-6). These causes and sources can be at least partially attributed to the changes in streamflow during storm events due to urbanization. It appears, therefore, that altered hydrology resulting in streamflow changes is a source of impairment needing attention and remediation.

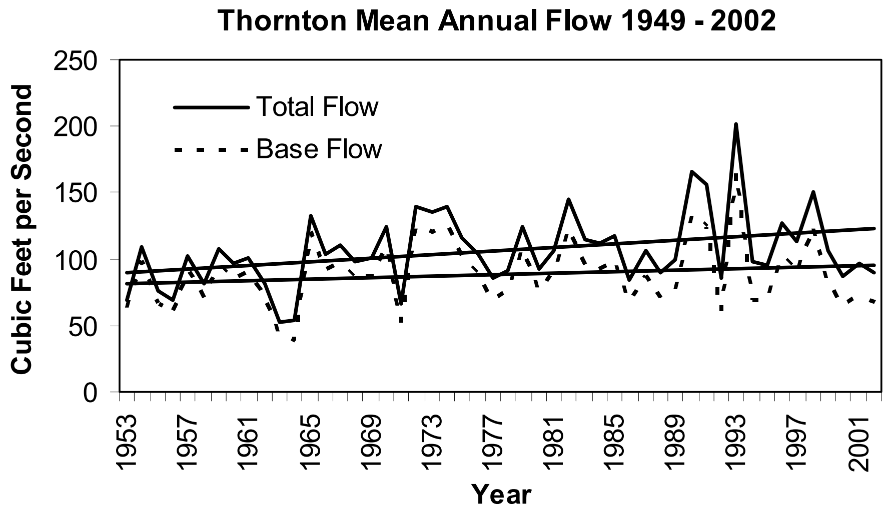

Figure 2-5. *Note:* Here "Base flow" means Total Flow less flow from the TCBSD plant.

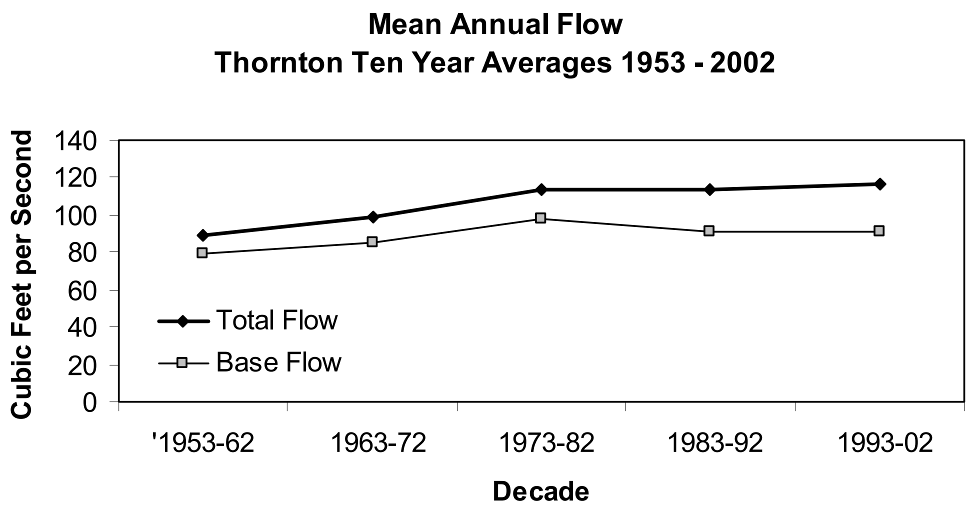

Figure 2-6. *Note:* Here "Base flow" means Total Flow less flow from the TCBSD plant.

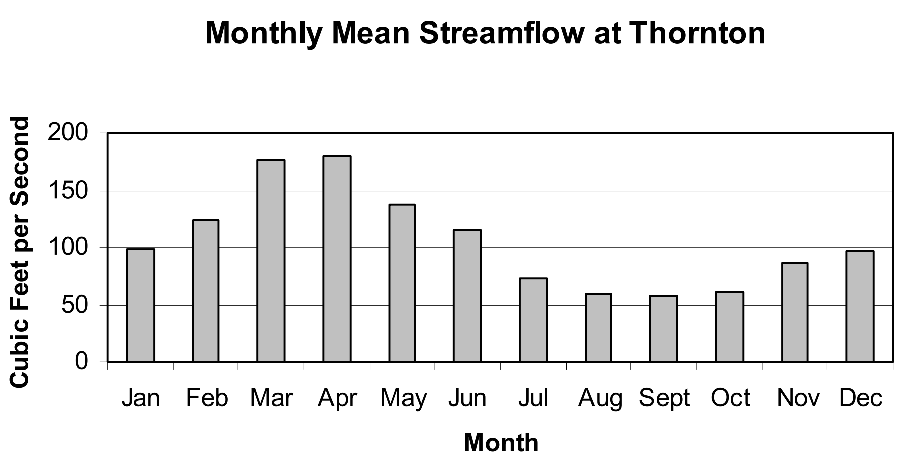

Figure 2-7.

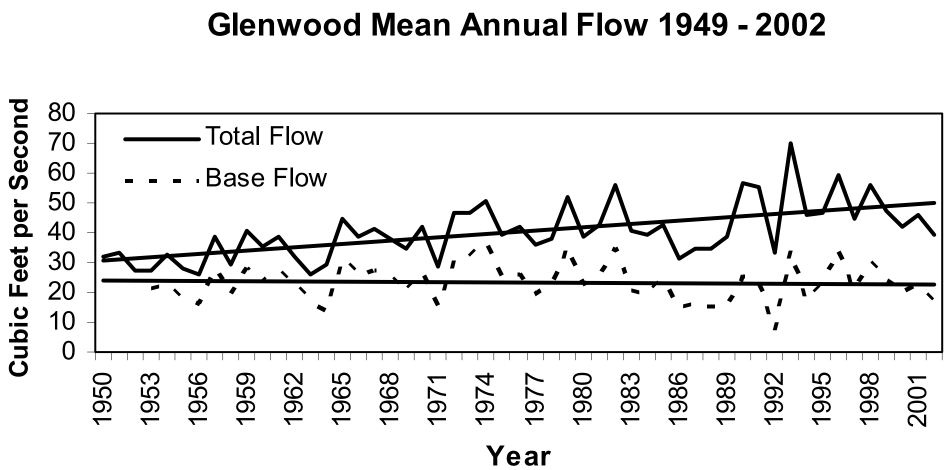

Figure 2-8. *Note:* Here “Base flow” means Total Flow less flow from the TCBSD plant.

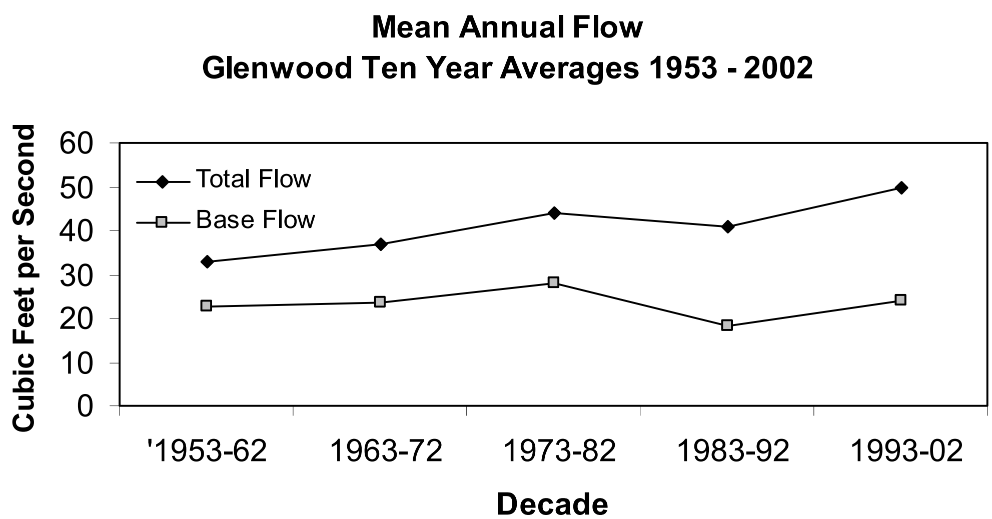

Figure 2-9. *Note:* Here “Base flow” means Total Flow less flow from the TCBSD plant.

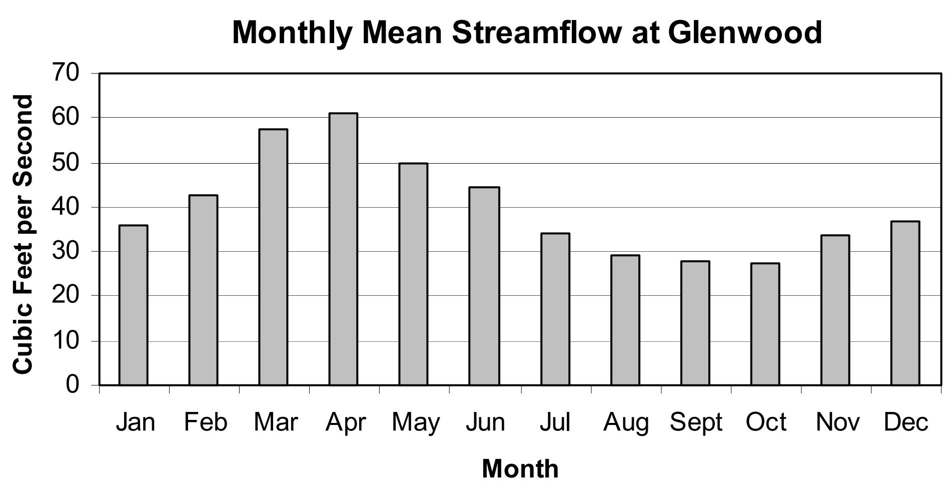

Figure 2-10.

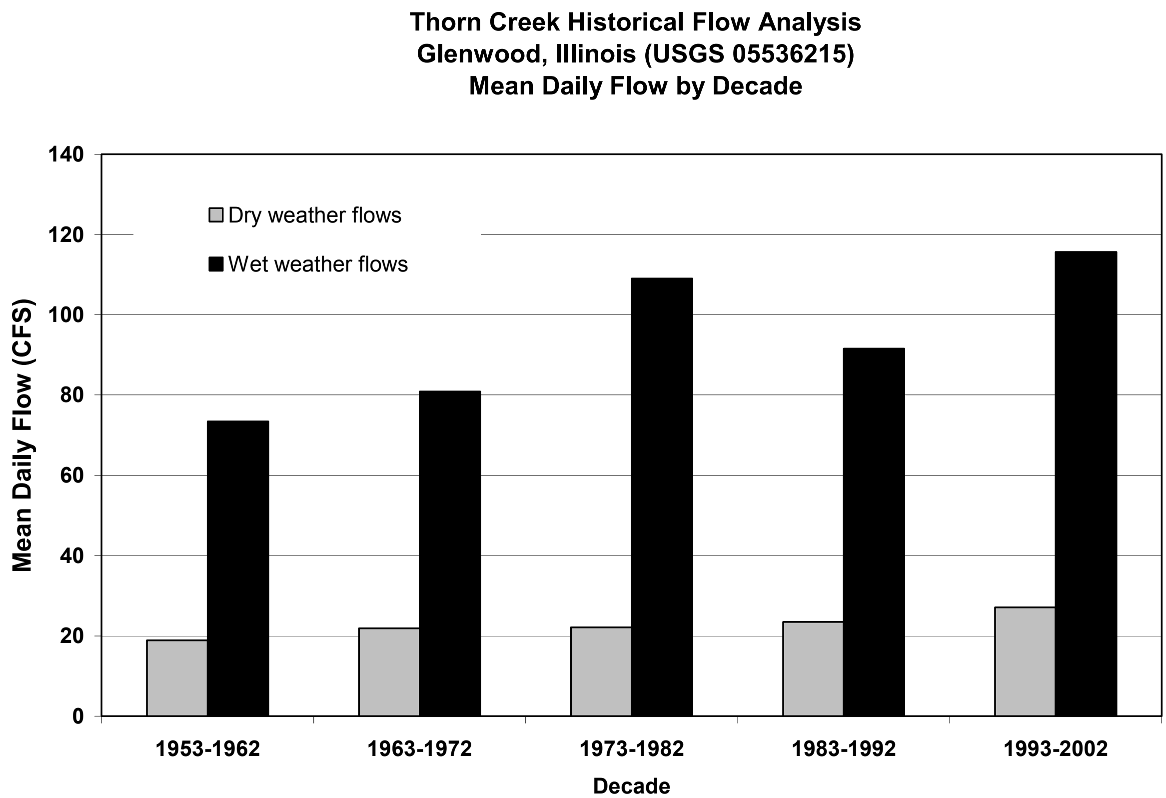

Figure 2-11.

Source: U.S. Geological Survey, Illinois Water Resources Data, Water Year 2002. http://waterdata.usgs.gov/IL/nwis/

Note: Wet weather flows are approximated as those that made up the top 25 percent of observed mean daily flows in each decade. Dry weather flows were approximated as the lower 75 percent of observed mean daily flows.

2.3.2 LAKES

While there are no large lakes within the Thorn Creek watershed, there are nine lakes between 20 and 50 acres in size, primarily created via sand and gravel mining. In addition to these, there are more than 100 small lakes and ponds in the area, most of which are less than two acres in size.[5] Four Illinois EPA 305(b)[6] assessed lakes fall within the Thorn Creek watershed and all are located in Cook County: Lake George, Lake Lynwood, Sauk Trail Lake, and Wampum Lake. Sauk Trail and Wampum Lakes are within Forest Preserve District of Cook County (FPDCC) preserves and are considered to be significant publicly-owned water bodies by the Illinois EPA. See Section 2.4.1.1 for water quality information for these lakes.

Created in 1930 when 26th Street was extended to Western Avenue, Sauk Trail Lake is a 28.8-acre online lake located in South Chicago Heights. A dam and spillway were built across Thorn Creek as a part of this extension. In 1953, the lake was drained and, along with pools on Thorn Creek, treated with rote-none to remove the carp and bullhead that had over-populated the lake. In 1954 and 1959—the year a natural gas pipeline was installed across the lakebed—the lake was stocked with largemouth bass. How-ever, due to turbidity and a history of winterkills, attempts to establish a sport fishery have been unsuc-

[5] *Source:* IDNR, 1999: *Thorn Creek Area Assessment, Volume 2: Water Resources*

[6] Section 305(b) of the Clean Water Act provides for a *National Water Quality Inventory Report to Congress* to be developed by U.S. EPA in conjunction with the states. The reports are available at http://www.epa.gov/305b/.

cessful. The FPDCC has no immediate plans to establish a healthy fishery in the lake. In 1966, when the Illinois State Water Survey examined Sauk Trail Lake, the water volume of the lake was 120 acre-feet, the sediment volume was 13 acre-feet, and the maximum and average depths were 6.4 and 4.0 feet, respectively.[7]

Wampum Lake, created as a borrow pit in 1953-54 for the construction of the Calumet Expressway, is 35 acres in size and lies within the Thorn Creek Preserve just north of Thornton-Lansing Road and east of Thorn Creek. Following creation of the lake, it filled slowly and reached its full water level in 1959—a water level four to five feet higher than originally planned. The lake now has a maximum depth of 13 feet and an average depth of 10.8 feet. It exhibits some shoreline erosion problems for which a shoreline restoration plan recently has been developed. In 1956, Wampum Lake was initially stocked with approximately 25 smallmouth bass which successfully reproduced. However, the lake became dominated by goldfish and black bullhead and was subsequently treated with rotenone in 1972 . Largemouth bass, smallmouth bass, and bluegill were restocked, and fishing remains a popular pastime.[8]

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[7] *Sources:* Jim Phillips, Forest Preserve District of Cook County, 2004 personal communication

[8] *Sources:* Jim Phillips, Forest Preserve District of Cook County, 2004 personal communication. Illinois EPA Water Quality Report, 2000. See http://www.epa.gov/305b/. Vidal, P.J. and H.L. Wight. 1975. *Cook County Surface Water Resources*. Illinois Dept. of Conservation, Div. of Fisheries. Springfield, IL.

2.4. Water Quality Assessment

As a major part of the development of the Watershed Based Plan for Thorn Creek, NIPC and the stakeholders group collected water quality assessment information from a variety of sources, primarily the Illinois Environmental Protection Agency (EPA), the Thorn Creek Basin Sanitary District wastewater treatment plant, and the Chicago Metropolitan Water Reclamation District. The ecological health of a water body can be evaluated in part by examining a variety of chemical parameters that contribute to overall water quality. Evaluations are made relative to the "General Use" standards defined by the Illinois Pollution Control Board, which are designed to protect waters for aquatic life, wildlife, agricultural uses, primary contact, secondary contact, and most industrial purposes. Fish and biotic indicators and habitat assessments also provide important information regarding the health of a stream system and potential for restoration. Those topics are covered in Section 2.5.

2.4.1. ILLINOIS EPA WATER QUALITY ASSESSMENTS

The biennial *Illinois Water Quality Report* prepared by the Illinois EPA describes water quality conditions in terms of the degree to which waters attain their applicable designated uses. Streams and lakes are assessed for the designated uses of aquatic life, fish consumption, primary contact (swimming), indigenous aquatic life, and public water supply. Lakes are also assessed for secondary contact (recreation) and "overall" uses. The degree to which the designated uses are attained (supported) in a waterbody is determined by an analysis of all available information, including biological, physical/chemical, habitat, and toxicity data. Illinois EPA assesses Thorn Creek for aquatic life and primary contact uses. The Thorn Creek tributaries Deer, Butterfield, and North Creeks are assessed for aquatic life use. Aquatic life use assessments are based on biotic and abiotic data, including fish and macroinvertebrate indices, water chemistry, and instream physical habitat. Primary contact (swimming) use impairments are based on fecal coliform levels and the concentration of total suspended solids. The degree to which waters attain their applicable designated uses are defined as follows:

- **Full Support:** Water quality meets the needs of all designated uses protected by applicable water standards.
- **Full Threatened:** Water quality is presently adequate to maintain designated uses, but if a declining trend continues, only partial support may be attained in the future.
- **Partial Support/Minor Impairment:** Water Quality has been impaired, but only to a minor degree. These may be minor exceedences in applicable water quality standards or criteria for addressing the designated use attainment.
- **Partial Support/Moderate Impairment**: Water quality conditions are impaired to a greater degree inhibiting the waterbody from meeting all the needs for designated use.
- **Nonsupport:** Water Quality is severely impaired and not capable of supporting the designated use to any degree.

For a waterbody assessed as having less then full overall support, causes and sources of the impairment are identified at the following magnitudes:

- **Slight (S):** A cause/source that is one of multiple causes/sources for non- or partial support and is judged to contribute relatively little to this non-attainment.
- **Moderate (M):** A cause/source that is the only one responsible for partial support, predominates over other causes/sources of partial support, or is one of multiple causes/sources of nonsupport that have a significant impact on designated use attainment.

- **High (H):** A cause/source that is the only one responsible for nonsupport or predominates over other causes/sources.

All of the following water quality assessments are from the Illinois Environmental Protection Agency's biennial *Illinois Water Quality Report* (also known as the "305(b) Report").

2.4.1.1. Lakes

Both Sauk Trail Lake and Wampum Lake were assessed by the Illinois EPA using 1997 data for publication in the *Illinois Water Quality Report 2000*. At that time, Sauk Trail Lake was rated as partial support for aquatic life and nonsupport for recreational, swimming, and overall use. The causes to which these impairments were attributed were PCBs, nutrients (specifically phosphorus and ammonia), siltation, organic enrichment, and low dissolved oxygen[9], suspended solids, and excessive algal growth. The sources of these causes were identified as agriculture (in the form of non-irrigated crop production), construction and land development, urban runoff/storm sewers, flow regulation and modification, and contaminated sediments from forests, grasslands, and parklands. In the *Illinois Water Quality Report 2002* and *2004*, Sauk Trail Lake received exactly the same ratings. Due to these findings, in 2002 Sauk Trail Lake became listed as a 303(d) medium priority water body by the Illinois EPA.

In both *the Illinois Water Quality Report 2000* and *2002*, Wampum Lake was assessed as full support for all uses. In the *Illinois Water Quality Report 2004*, the lake was assessed as full support for overall, aquatic life, and primary contract (swimming), but partial support for secondary contact (recreation). Potential causes for recreation impairment were attributed to habitat assessment. The potential sources of impairment were urban runoff/storm sewers and forest/grassland/parkland. Hence, Wampum Lake was placed on the medium priority 303(d) list in 2004.

Previous 305(b) reports provide some additional information about the condition of these two lakes. In older reports, each lake was assigned a mean Trophic State Index (TSI), and aquatic life and recreational use impairments were attributed to either sediments or macrophytes. The TSI is a measure of the eutrophication of a body of water, the process by which lakes are enriched with nutrients, increasing the production of rooted aquatic plants and algae. The extent to which this process has occurred is reflected in a lake's trophic classification or state (Table 2-3). The mean Trophic State Index is determined using a combination of measures of water transparency/turbidity[10] (using Secchi disk depth recordings), chlorophyll *a* concentrations, and total phosphorus levels. TSI values range from 20 to 110. A very high TSI value, which indicates excessive nutrients and low transparency, can contribute to use impairments. A TSI of less than 50 usually indicates little or no impairment, while a TSI greater than 70 is a sign of significant impairment.

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[9] Dissolved oxygen is a primary factor in determining a water body's ability to support life and can be affected by photosynthetic activity, wind and wave action, decomposition of organic matter, water flow and temperature.

[10] Turbidity is a measure of suspended materials (e.g., algae, silt) in the water that impact transparency. Low transparency results in less sunlight available to aquatic organisms, inability for aquatic plants to conduct photosynthesis, and a general reduction in plant and animal diversity.

Table 2-3. Description of Trophic State Index

Trophic State	TSI	Characteristics
Oligotrophic	< 40	Nutrient poor, maximum transparency, minimum chlorophyll *a*, minimum phosphorus
Mesotrophic	40 – 50	Moderately productive
Eutrophic	50 – 70	Very productive and fertile
Hypereutrophic	> 70	Excessive nutrient concentrations, minimum transparency, maximum chlorophyll *a*, maximum phosphorus

Aquatic life and recreation use impairments for the older 305(b) reports are based on the TSI in combination with the concentration of nonvolatile suspended solids (sediments) and the percent of the lake surface area covered by macrophytes. These parameters were reported in the *Illinois Water Quality Report 1998* for Sauk Trail and Wampum Lakes. Sauk Trail Lake was hypereutrophic with a TSI of 70. The lake's aquatic life and recreational use impairments were attributed to high levels of sediment and slight macrophyte impairment. These measurements were taken in 1997 when Sauk Trail Lake received partial/moderate support ratings for overall and swimming uses, nonsupport for recreational use, and full support for aquatic life use. Wampum Lake was examined in 1992 and was mesotrophic with a TSI of 47. There were no sediment or macrophyte problems detected, and Wampum received full support ratings for every use.

2.4.1.2. Streams

Thorn Creek has been assessed by Illinois EPA at three locations along its main stem: HBD 04, HBD05, and HBD 06. While data from all three locations were used for NIPC's water quality assessment, described in Section 2.4.2, only HBD 04 and HBD 05 were reported in the Illinois EPA Water Quality Assessment. Both of the assessed stretches are listed by the Illinois EPA as medium priority water bodies in the *Illinois 2002 Section 303(d) List*. A summary of the data provided on these stretches is given in Tables 2-4 and 2-5.

The 7.84 mile HBD 04 reach starting at the confluence with the Little Calumet River and running upstream was examined by Illinois EPA in 1997 and 1998. The stream was rated as partial/minor support for overall use, partial/minor support for aquatic life, and nonsupport for swimming. A second stretch of the stream (HBD 05) was analyzed in 1997 as well. This 10.15 mile section at about the middle of the run of Thorn Creek was rated as partial/moderate support for both overall use and aquatic life use and as nonsupport for swimming use. The causes and degree of impairments of the designated uses of the stream are shown in Tables 2-4 and 2-5.

Results of Illinois EPA's most recent assessments (from the *Illinois Water Quality Report 2004*) of Thorn Creek and three of its tributaries (Deer, Butterfield, and North Creeks) are provided in Tables 2.6 and 2.7, respectively.

Table 2-4. Water Quality Impairments in Reach HBD 04 of Thorn Creek

Cause of Impairment	**Degree of Impairment**
Habitat alterations	Moderate
Metals (specifically copper)	Slight
Nutrients (phosphorus, ammonia, nitrates)	High
pH	Slight
Salinity	Slight
Pathogens	High
Suspended solids	None reported
Priority organics	None reported
PCBs	None reported
Cyanide	None reported
Source of Impairment	**Degree of Source of Impairment**
Municipal	Moderate
Construction	Slight
Land development	Slight
Urban runoff and storm sewers	Moderate
Hydromodification	Slight
Channelization	Slight
Bank modification and destabilization	Slight

Source: Illinois Water Quality Report, *2004 (Illinois EPA, 2004)*

Table 2-5. Water Quality Impairments in Reach HBD 05 of Thorn Creek

Cause of Impairment	**Degree of Impairment**
Metals	Slight
Nutrients (ammonia)	Slight
Organic enrichment/low dissolved oxygen	Slight
Habitat and flow alterations	Moderate
Oil and grease	Slight
Siltation	Moderate
Source of Impairment	**Degree of Source of Impairment**
Construction	Moderate
Land development	Moderate
Urban runoff and storm sewers	Slight
Hydromodification	Slight
Channelization	Slight
Upstream impoundment	None reported
Flow regulation and modification	None reported
Streambank modification and destabilization	Slight

Source: Illinois Water Quality Report, *2004 (Illinois EPA, 2004)*

Table 2-6. Illinois EPA Use Assessment and Potential Causes and Sources of Impairment for Thorn Creek

Segment ID	Designated Use	Use Support	Causes	Sources
Thorn Creek				
HBD 03	Aquatic Life	Not Assessed	(not assessed)	(not assessed)
HBD 05	Aquatic Life	Partial	Total Dissolved Solids	Urban Runoff/Storm Sewers
			Other Flow Alterations	Hydromodification, Upstream Impoundment, Flow Regulation/ Modification
HBD 06	Aquatic Life	Partial	Silver, Total Nitrogen as N, Total Phosphorus	Municipal Point Sources, Major Municipal Point Sources
			Dissolved Oxygen	(none listed)
			Aldrin, Dieldrin, Hexachlorobenzene	Contaminated Sediments
	Primary Contact	Partial	Total Fecal Coliform Bacteria	Municipal Point Sources, Major Municipal Point Sources, Urban Runoff/Storm Sewers
HBD 02	Aquatic Life	Partial	Zinc, Silver, Dissolved Oxygen	Municipal Point Sources, Major Municipal Point Sources, Urban Runoff/Storm Sewers
			Fluoride	(none listed)
			Total Nitrogen as N, Total Phosphorus	Municipal Point Sources, Major Municipal Point Sources
			Physical-Habitat Alterations	(none listed)
			Total Suspended Solids	Urban Runoff/Storm Sewers
			Aldrin, Chlordane, DDT, Dieldrin, Endrin, Hexachlorobenzene, PCBs	Contaminated Sediments
	Primary Contact	Nonsupport	Total Fecal Coliform Bacteria	Urban Runoff/Storm Sewers
HBD 04	Aquatic Life, Primary Contact	Partial (for Aquatic Life), Nonsupport (for Primary Contact)	Zinc, Silver, Fluoride, Total Nitrogen as N, Dissolved Oxygen, Physical Habitat Alterations, Total Fecal Coliform Bacteria, Total Suspended Solids, Aldrin, Chlordane, DDT, Dieldrin, Endrin, Hexachlorobenzene, PCBs, Total Phosphorus	Municipal Point Sources, Urban Runoff/Storm Sewers, Hydromodification, Channelization, Habitat Modification, Bank Modification/Destabilization, Contaminated Sediments, Source Unknown

Segment IDs are arranged from the creek's headwaters (segment HBD 03) and proceed downstream. Segment HBD 05 lies downstream of Sauk Trail Lake and upstream of the Thorn Creek Basin Sanitary District. Segments HBD 06–HBD 04 are downstream of the TCBSD.)

Source: Illinois Water Quality Report, *2004 (Illinois EPA, 2004)*

Table 2-7. Illinois EPA Use Assessment and Potential Causes and Sources of Impairment for Deer, Butterfield, and North Creeks

Segment ID	Designated Use	Use Support	Causes	Sources
Deer Creek				
HBDC	Aquatic Life	Partial	Unspecified Nutrients, Nitrate Nitrogen, Physical-Habitat Alterations, Total Phosphorus	Municpal Point Sources, Urban Runoff/Storm Sewers, Hydromodification, Channelization
HBDC02	Aquatic Life	Partial	Sedimentation/Siltation	Urban Runoff/Storm Sewers
			Other Flow Alterations	Hydromodification, Flow Regulation/ Modification
			Total Phosphorus	Municipal Point Sources
Butterfield Creek				
HBDB03	Aquatic Life	Partial	Dissolved Oxygen	Urban Runoff/Storm Sewers
			Other Flow Alterations	Hydromodification, Flow Regulation/ Modification
			DDT	Contaminated Sediments
North Creek				
HBDA01	Aquatic Life	Partial	Sedimentation/Siltation, Dissolved Oxygen, Non-Native Animals, Aldrin, Hexachlorobenzene	Urban Runoff/Storm Sewers, Hydromodification, Flow Regulation/ Modification, Contaminated Sediments, Forest/Grassland/Parkland

Source: Illinois Water Quality Report, *2004 (Illinois EPA, 2004)*

2.4.2. NIPC WATER QUALITY ASSESSMENTS

2.4.2.1. NIPC Water Quality Empirical Analysis

NIPC gathered water quality data from the Illinois EPA, Thorn Creek Basin Sanitary District (TCBSD), and the Metropolitan Water Reclamation District of Greater Cook County (MWRD) to assess the water quality of Thorn Creek. TCBSD and MWRD data, which were more extensive and more consistent than Illinois EPA data, were used for the majority of the analysis. The analysis examined the percentage of instances in which Illinois Pollution Control Board (IPCB) standards of sampled constituents were exceeded at each sampling location (Table B-1, Appendix B). For constituents lacking an IPCB standard, a generally accepted guideline was used to screen data. For those constituents and locations with excursions (exceedences) of greater than 5 percent of the samples, the data were graphed to screen for temporal patterns such as seasonal or long term trends. In addition to excursion frequency, we examined average concentrations from the headwaters of the Thorn Creek mainstem to the outfall at the Little Calumet River (Table B-2, Appendix B). Correlating the data with sampling points and subbasin boundaries allowed us to assess which subbasins may contain causes and sources of impairment.

The following fifteen water quality constituents were assessed at twelve sampling sites along the main stem of Thorn Creek:

- Total Suspended Solids (TSS)
- Total Phosphorus (TP)
- Ammonia Nitrogen (NH_3)
- Biological Oxygen Demand (BOD)
- Dissolved Oxygen (DO)
- Copper (Cu)

- Zinc (Zn)
- Arsenic (As)
- Silver (Ag)
- Iron (Fe)
- Total Dissolved Solids (TDS)
- Fecal Coliform (FC)
- Sulfate (SO_4)
- Chlorophyll *a* (Chl A)
- pH

The sampling points and major flow contributors are listed in Table 2-8 from upstream to downstream. Figure 2-12 shows the location of sampling and reference points along Thorn Creek. Locations of sampling points for biotic data are given in Section 2.5.1.

Table 2-8. Sampling Locations and Data Sources for NIPC Water Quality Empirical Analysis

Subbasin	Sampling Point / *Reference Point*	Location	Data Source
SB100	**Stuenkel**	Stuenkel Road	TCBSD
	Western	Western Avenue	TCBSD
SB200+300	**HBD 05**	Route 30 bridge	IEPA
SB400+500	**Above**	East of Halsted Street	TCBSD
SB600	*Wastewater Treatment Plant*		
	Loc54/Orr Rd	Joe Orr Road	MWRD
	Below	Joe Orr Road	TCBSD
	Glenwood	USGS station #05536215	TCBSD
SB700	**HBD 06**	195th Street	IEPA
	Deer and Butterfield Creek Confluence		
	Glenwood School	Main Street	TCBSD
	North Creek Confluence		
	Thornton	USGS station #05536275	TCBSD
	HBD 04	Thornton (Thornton Lansing Rd)	IEPA
SB800+900	**Loc97/170th St.**	170th Street	MWRD

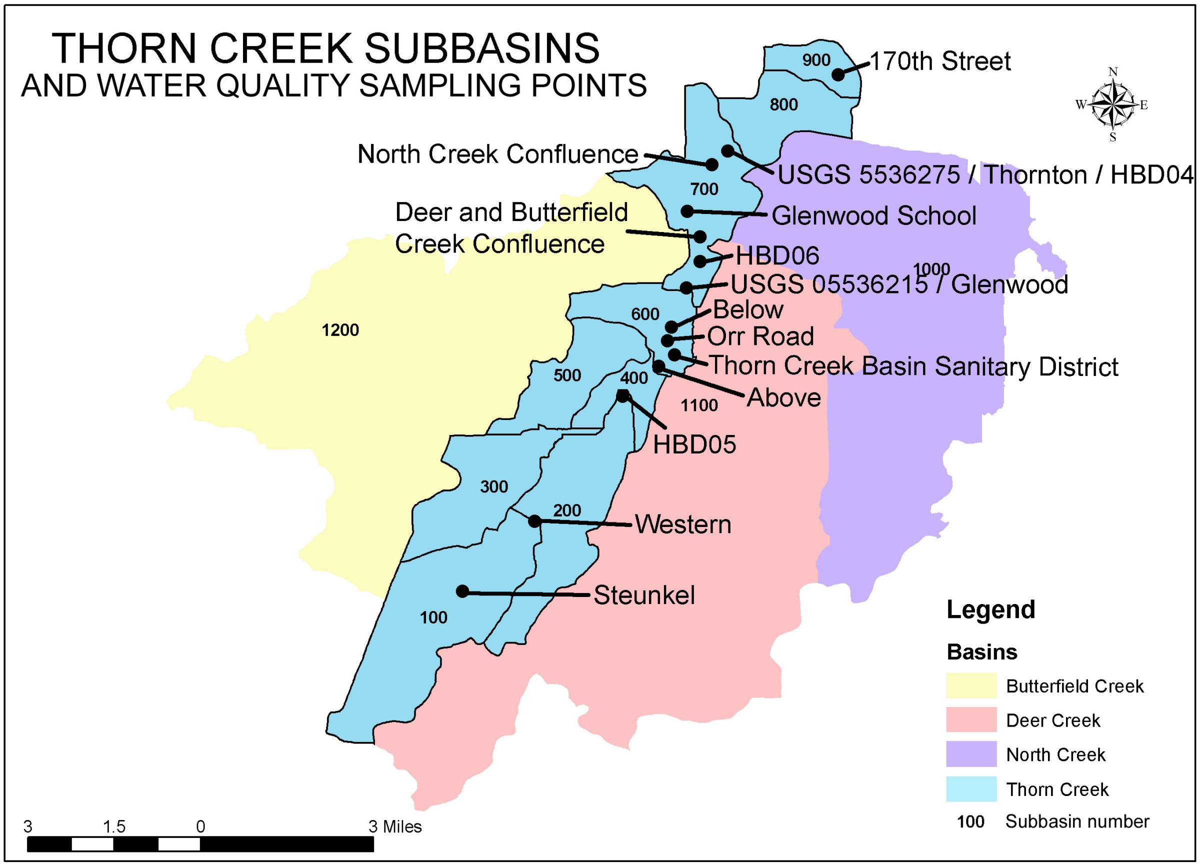

Figure 2-12. Subbasins and Water Quality Sampling Locations in the Thorn Creek Watershed

Sampling frequency and the number of years of sampling data varies by constituent. In general this assessment used monthly sampling data from 1997 to 2004. Assessment of the data was made using IPCB standards for water quality. However, following the establishment of a wastewater discharge connection from the Rhodia silica plant in 1995, the IPCB granted the Thorn Creek Basin Sanitary District treatment plant relief from both the total dissolved solids and sulfate standards for portions of Thorn Creek downstream from the plant to **Thornton** (water quality sampling points are indicated by **boldface** notation in the main text). The revised standards for these reaches are given in Table 2-9. Although Illinois EPA may be examining other standards for revision—including total dissolved solids, sulfate, dissolved oxygen, and phosphorus—the existing standards were used for this assessment.

Table 2-9. Standards for Total Dissolved Solids and Sulfate for Select Reaches of Thorn Creek

Reach	TDS (mg/L)		SO_4 (mg/L)	
	Old	*New*	*Old*	*New*
Joe Orr Road to Deer Creek confluence	1,000	2,650	500	1,350
Deer Creek to Thornton (USGS 055362775)	1,000	2,620	500	1,340
Thornton to Little Calumet River	1,000	2,360	500	1,160

2.4.2.2. NIPC Land Use Pollutant Loading Analysis

NIPC also examined land use in the Thorn Creek subbasins to assess whether water quality impairments might be attributable to prevalent land use types. Different land uses have specific pollutant loading characteristics due to differences in imperviousness and the types of activities associated with those land uses (see Table B-2, Appendix B, for pollutant export coefficients by land use). NIPC assessed whether particular subbasins may be more responsible for specific pollutants than others, potentially making it possible to recommend different suites of best management practices for each subbasin. While the land use assessment can point to possible source areas of pollutants, it does not account for point sources, natural pollutant sinks, or other variations attributable to variability in the landscape and urban fabric. As such, the model has limitations as a predictor of pollutant loading and should not be relied upon as a single source for assessing water quality except where no empirical data exist, and the model should still be used with caution in any case. Empirical data should be relied upon when possible.

Watershed imperviousness is an important indicator of expected watershed and water quality impairment. High quality resources are generally supportable in watersheds with up to approximately 10 percent impervious area. As imperviousness increases beyond 10 percent, watershed quality decreases significantly. The Center for Watershed Protection has developed a general guide, reproduced in Table 2-10, for assessing watershed resource quality based on imperviousness.[11] This characterization is important for watershed restoration and management. Watershed conditions can reasonably be expected to improve from one classification to the next higher classification if maximum effort is applied. However, it is highly unlikely that watershed conditions can be improved to pristine conditions, let alone an improvement to more than one classification higher than current conditions.

In order to assess land use impacts, the mainstem watershed of Thorn Creek was divided into nine subbasins based on USGS Hydrologic Unit Codes. These subbasins are numbered from 100 to 900 from upstream to downstream (Figure 2-12). The imperviousness of Thorn Creek subbasins ranges from approximately 14 percent upstream to approximately 40 percent in the middle subbasins, falling to approximately 27 percent downstream (Figure 2-13). Seven of twelve subbasins are between 25 percent and 40 percent impervious, characterized as non-supporting. In general, subbasins 400 through 700 would be expected to contribute pollutants out of proportion to the area they comprise. This conclusion is reasonable because these subwatersheds are the most urbanized and contain the greatest amount of impervious surface. Several subwatersheds, however, are good candidates for moving up a watershed classification level. Subbasins 300 and 800, for instance, might be restorable to an impacted condition. The two mainstem subbasins furthest upstream in relatively undeveloped portions of the watershed (subbasins 100 and 200) as well as the three tributary subbasins fall into the impacted characterization and may be restorable to sensitive conditions.

[11] *Urban Subwatershed Restoration Manual Series, Manual 4: Urban Stream Repair Practices*, Center for Watershed Protection, November 2004.

Table 2-10. Relation between Watershed Quality and Impervious Land Cover

Imperviousness	Category	Characterization
0 – 10%	Sensitive	Subwatershed typically has impervious cover of zero to 10 percent. Streams are of high quality, and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects. Since impervious cover is so low, they do not experience frequent flooding and other hydrological changes that accompany urbanization. These streams typically do not require restoration and are very rarely found in urbanized watersheds.
10 – 25%	Impacted	Subwatershed typically has impervious cover ranging from 11 to 25%, and shows clear signs of degradation due to watershed urbanization. Greater storm flows begin to alter the stream geometry. Both erosion and channel widening are evident in alluvial streams. Stream banks become unstable, and physical habitat in the stream declines noticeably. Stream water quality shifts into the fair/good category during both storms and dry weather periods. Stream biodiversity declines to fair levels, with the most sensitive fish and aquatic insects disappearing from the stream. These watersheds exhibit the greatest stream repair potential since they experience only moderate degradation, have an intact stream corridor, and usually have enough land available in the subwatershed to install upland restoration practices.
25 – 60%	Non-supporting	Subwatersheds with impervious cover between 25 and 60% no longer support their designated uses, as defined by hydrology, channel stability, habitat, water quality or biological indicators. Subwatersheds with 25 to 40% impervious cover may show promise for partial stream repair, but they are so dominated by hydrologic and water quality stresses that they normally cannot attain pre-development biological conditions. Under some circumstances, streams with greater imperviousness may show potential for partial restoration, but primarily to protect infrastructure, create more natural stream corridors and prevent bank erosion, or achieve other community objectives.
60 – 100%	Urban drainage	Subwatersheds exceeding 60% impervious cover. The stream corridor has been essentially eliminated or physically altered so that the stream functions primarily as a conduit for conveying stormwater flows, and can no longer support a diverse stream community. The stream channel is often highly unstable, and stream reaches can experience severe widening, down-cutting and streambank erosion. Pool and riffle structure needed to sustain fish is diminished or eliminated, and the stream substrate can no longer provide habitat for aquatic insects, or spawning areas for fish. Water quality is consistently rated as fair to poor, and water contact recreation is no longer possible due to the presence of high bacterial levels. The biological quality of non-supporting streams is generally considered poor, and is dominated by pollution tolerant insects and fish. The prospects to improve aquatic diversity within urban drainage are quite poor, although it may be possible to improve water quality conditions in the remaining stream corridor.

Source: Center for Watershed Protection, 2004

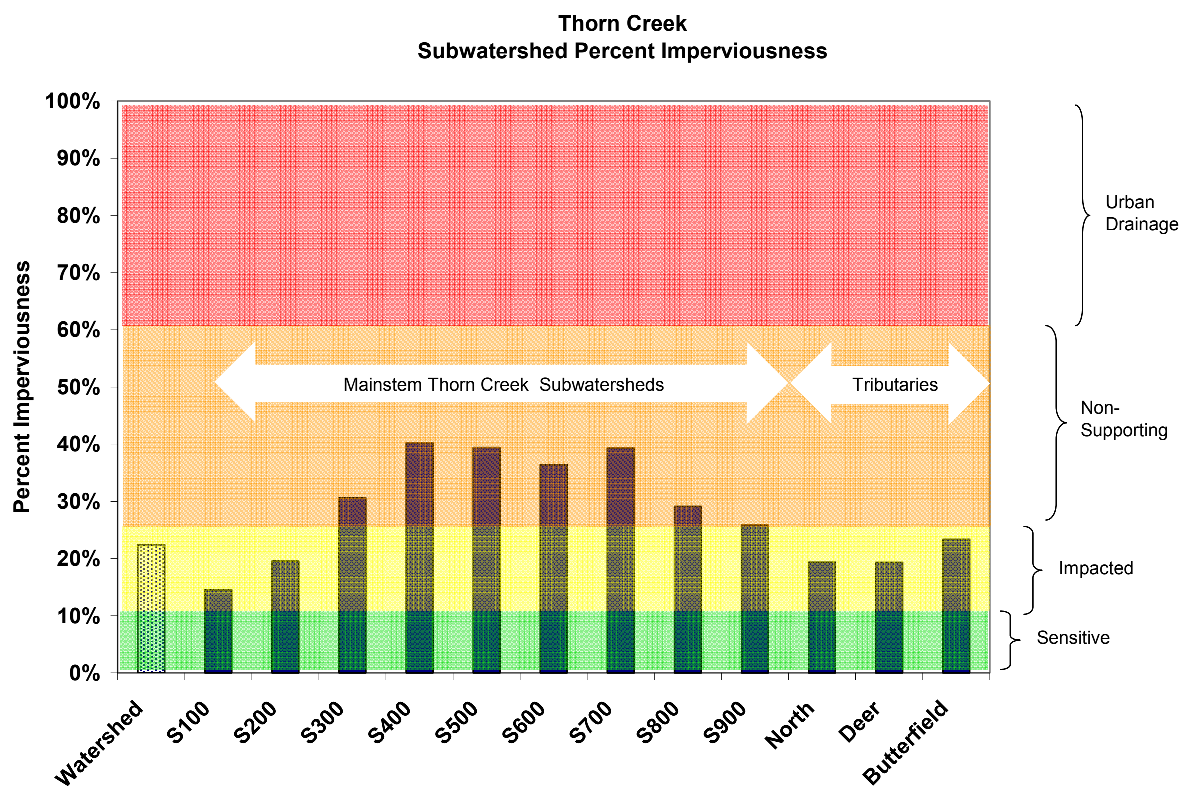

Figure 2-13. Thorn Creek Subwatershed Percent Imperviousness

Under this land use pollutant loading analysis, residential, commercial, and industrial land uses are expected to be primarily responsible for water quality impairments. NIPC's assessment of pollutant loading associated with these land uses examined seven pollutants:

- Total Suspended Solids (TSS)
- Total Phosphorus (TP)
- Total Nitrogen (N)
- Biological Oxygen Demand (BOD)
- Copper (Cu)
- Zinc (Zn)
- Total Dissolved Solids (TDS)

Using water quality sampling data, annual flow volume data from the USGS station at **Glenwood**, and average annual discharge data from the Thorn Creek Basin Sanitary District, NIPC also estimated concentrations of pollutants in the water column that were not attributable to effluent flow from the Thorn Creek Basin Sanitary District discharge. It is an interesting exercise to examine how the land use assessment predicts pollutant concentrations as compared to empirical data. The results, discussed in the next section, point out that the model overestimates TSS, nitrogen, BOD, and metals while underestimating phosphorus and TDS. At the most basic level, this indicates that the model is of limited utility for predicting actual conditions in the Thorn Creek watershed. Natural systems are much more complex than can be accounted for in a simple model such as this.

2.4.3. RESULTS OF NIPC WATER QUALITY ASSESSMENTS

The results of NIPC's empirical water quality analysis and land use pollutant loading analysis are presented and discussed below.

2.4.3.1. Fecal Coliform

Fecal coliform, a class of bacteria found in the digestive tract, is used to indicate the potential presence of pathogenic organisms in water. Fecal coliform levels in Thorn Creek exceeded the Illinois standard of 200 per 100 mL sample[12] more than 70 percent of the time for all nine sampling stations. Adjusting the standard to 400 per 100 mL to account for sampling averaging reduces the frequency of exceedences by an average of 10 percent for each sampling station. Nonetheless, fecal coliform levels exceed the adjusted standard more than 70 percent of the time for all sampling points but **Stuenkel**, the furthest upstream sampling station, which exhibits greater than 50 percent excursions[13] (see Table B-1).

The overall temporal trend in coliform levels over the sampling period is downward, indicating an improvement in water quality over time. The conversion of areas from septic to sanitary sewer service over the time period during which the samples were taken (1997 to 2004) may partially explain the temporal decrease in fecal coliform concentrations. There does not appear to be a consistent upstream to downstream trend in terms of the frequency with which the Illinois standard is exceeded, nor do fecal coliform levels appear to vary with flow conditions. Average concentrations of fecal coliform far exceed the Illinois standards throughout the stream course. Average fecal coliform concentrations do appear to increase from **Stuenkel** downstream to a maximum at **LOC54/Orr Rd** below the wastewater treatment plant outfall and then decrease downstream to **LOC97/170th St**, where there is another increase (Table B-2). Effluent from the treatment plant, which contains an average fecal coliform concentration well below the standard, is helping ameliorate the fecal coliform problems. However, there are significant nonpoint sources of fecal coliform throughout the watershed that are impairing the stream.

The cause of high fecal coliform can possibly be attributed to animal waste and other contaminants on turf grass lawns. Sources may include household pets, but geese and other urban wildlife are more likely sources for the levels detected. Livestock and horses also can be sources of fecal coliform, though few if any of these types of facilities are thought to exist in the watershed. Failing septic systems are another potential source for high coliform levels, yet few septic systems remain in the watershed. No known combined sewer overflows discharge to Thorn Creek. Other possible sources include failing sanitary sewers leaking into storm sewers, a failing sewer lift station, or other aging infrastructure problems. Further investigation is needed to determine the cause.

The Illinois EPA *Water Quality Report* identifies pathogens as a "high" cause of impairment for downstream reaches, but does not list pathogens as a cause of impairment for upstream reaches. NIPC's assessment, while consistent with Illinois EPA's downstream findings, indicates fecal coliform impairment throughout the stream course.

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[12] Fecal coliform is measured by inoculating culture dishes with a defined volume of water quality sample, then counting the number of bacterial colonies that grow. The result is expressed in numbers of colonies that grow per 100 mL of sample water.

[13] Illinois EPA only requires application of a bacterial limit in Thorn Creek during the summer months (May – October). Protection is not required during the winter months since public contact is unlikely. For this reason, the TCBSD is only required to disinfect its effluent in the summer. November through April higher levels of fecal coliform are allowed in Thorn Creek.

2.4.3.2. Dissolved Oxygen

Dissolved oxygen (DO) in water is necessary for aquatic organisms to survive. Dissolved oxygen levels below the Illinois standard of 5.0 mg/L are believed to impair aquatic life; levels above this standard are considered to be desirable. DO levels fell below the Illinois standard greater than 5 percent of the time at four sampling stations along Thorn Creek (Table B-1), indicating a potential problem with low DO levels. An examination of seasonal variations in the data reveals that low DO levels during summer and fall months when the flow is typically lower than during the winter and spring. Oxygen is also less soluble during summer and fall due to higher water temperatures, resulting in lower DO concentrations. Low DO levels, in some cases as low as 2.5 mg/L, appear to be more prevalent in upstream sections of the creek, at the **Stuenkel** and **Western** sampling points in particular, where more than a third of the samples fell below the Illinois minimum standard. This may be due to low flow conditions in upstream sections, or may be related to high fecal coliform levels; further investigation into causes and sources is needed. DO levels do not appear to be a problem below **Western**. Increased DO levels below this point may be due to a stream gradient that aerates the water enough to correct low DO occurring upstream. The wastewater treatment plant discharge, which averages 7.47 mg/L of DO and has a low biological oxygen demand, is improving the oxygenation condition of the stream for aquatic life.

The Illinois EPA 305(b) report identifies low dissolved oxygen as a "slight" cause of impairment for upstream reaches, but not as a cause for downstream reaches. Analysis of Illinois EPA water quality sampling data indicates that exceedences of the dissolved oxygen standard are rare. This is consistent with the present finding that low DO levels may be impairing the stream in upstream reaches but not downstream.[14]

2.4.3.3. Biological Oxygen Demand

Biological oxygen demand (BOD) measures the amount of oxygen consumed by microorganisms in a water sample over a five day period, and is an indicator of the potential for oxygen depletion in the water. There is no Illinois standard for BOD. NIPC's land use analysis predicts 4.65 mg/L of BOD in the stream at **Glenwood**, with contributions—in decreasing order—from residential, commercial, industrial, and institutional land uses (Figure 2-14). Sampling data indicates BOD concentrations averaging approximately 3.0 mg/L throughout the stream course and 2.94 mg/L at **Glenwood** (Table B-2.). The TCBSD discharges approximately 2.57 mg/L of BOD to the stream. The land use model overpredicts BOD for Thorn Creek, but its results are not unreasonable. Nonetheless, it does not appear that BOD is an impairment in Thorn Creek.

[14] It has been suggested that the dissolved oxygen standard for Illinois should be adjusted to account for seasonal fluctuations *(An Assessment of National and Illinois Dissolved Oxygen Water Quality Criteria*, Garvey and Whiles, Southern Illinois University, April 2004). However, the established Illinois standard applies in this assessment.

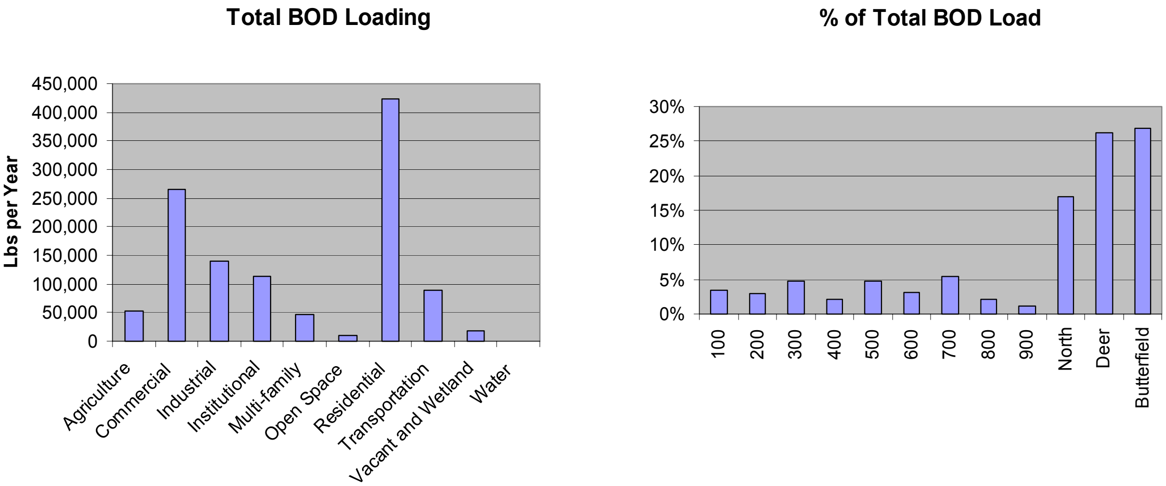


Figure 2-14. Total BOD Loading by Watershed Land Use and Percent of BOD Load by Subbasin

2.4.3.4. Total Dissolved Solids

Total dissolved solids (TDS) is a broad measure that includes many dissolved minerals in the water column, such as chloride, magnesium, and iron. The wide variety of constituents, both harmful and benign, that fall within the TDS category makes it somewhat difficult to gauge the extent of impact on aquatic resources and uses.

TDS levels exceed the Illinois standard of 1,000 mg/L more than 50 percent of the time for seven of the nine sampling stations. However, the standard has been revised for Thorn Creek twice since the Rhodia silica plant began discharging into the Thorn Creek Basin Sanitary District plant in 1995.[15] The revised TDS standard (Table 2-10) for points from **Below** to **LOC97/107th St** significantly lowers the frequency with which the standard is exceeded to 0 percent for all sampling stations within these reaches. The two stations furthest upstream did not exceed the original standard.

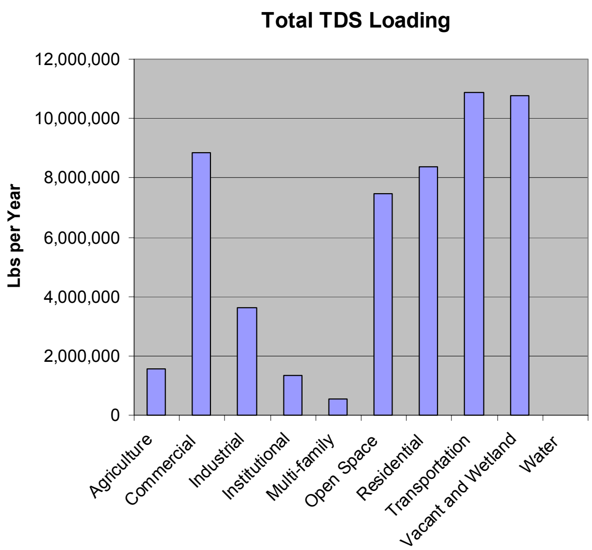
There does not appear to be an upstream–downstream trend in TDS levels, and the frequency of excursion and concentrations of TDS are fairly consistent throughout the stream course, though not all points were sampled consistently. However, there does appear to be an increasing trend of TDS levels over the time period examined(1997-2004), indicating a change in watershed conditions or an increase in TDS levels from one or more point discharges along the stream. Clearly the silica plant that came online in 1995 is a source, but there does not appear to be an increase in the average TDS concentration below the TCBSD plant as compared to sampling stations immediately upstream of the plant. In fact, the average TDS concentrations for the period examined generally range between 1,000 and 1,200 mg/L for sampling stations from **Above** downstream (Table B-2), indicating that the silica discharge is not responsible for the overall increase in TDS levels over time.

While not a strong trend, there does appear to be a seasonal pattern in TDS levels, with slightly higher concentrations in winter months and lower concentrations in summer months. This would support the generally-held supposition that TDS levels increase in winter months due to road salt application for

[15] Rhodia discharges to a public sewer that is tributary to the wastewater treatment plant, which was not designed to treat and remove TDS or sulfates, and these constituents basically pass through the plant and are discharged to the creek. Hence the adjusted creek standard.

snow and ice control. The average TDS concentration in subbasin 100, which has lower development density and fewer roads needing snow and ice control, is approximately half that (at 645 mg/L) of downstream subbasins, indicating that salt application may be a cause of high TDS levels.

The land use analysis predicts 194.2 mg/L of TDS to be present in the water column from the following potential sources, in decreasing order of importance: transportation, vacant and wetland, commercial, residential, and open space (Figure 2-15). Empirical data indicates that TDS averages between about 650 mg/L and 1,300 mg/L throughout the stream course, with an average concentration of 1,196 mg/L at **Glenwood**. The TCBSD does not provide TDS discharge data. The land use model underpredicts TDS for Thorn Creek.



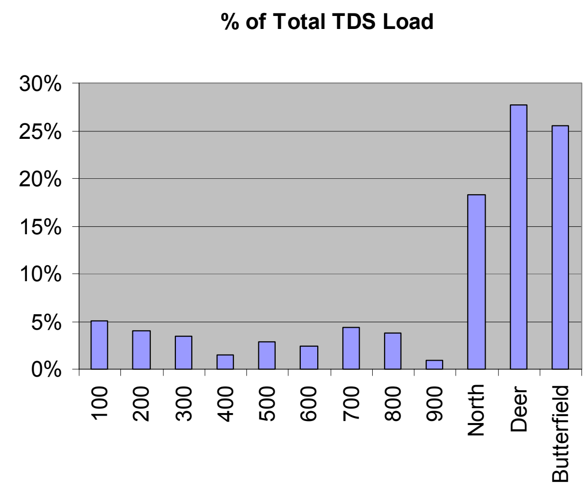


Figure 2-15. Total TDS Loading by Watershed Land Use and Percent of TDS Load by Subbasin

The Illinois EPA 305(b) report identifies salinity as a "slight" cause of impairment for downstream reaches, but not as a cause for upstream reaches. Empirical data indicates elevated TDS levels throughout the majority of the stream course, excepting subbasin 100. Since TDS levels fall within revised standard limits set by the IEPA, it is not an impairment requiring attention at this time. However, more frequent and detailed monitoring for chlorides throughout the year may help determine whether chlorides are primarily responsible for high TDS levels and begin to isolate TDS constituents needing attention.

2.4.3.5. Sulfate

Sulfate (SO_4) is primarily a concern for drinking water supplies, which are not at issue in this watershed, and levels below approximately 2,000 mg/L are assumed to be adequate to protect aquatic life. Sulfate levels exceeded the original Illinois standard of 500 mg/L from **LOC54/Orr Rd** downstream greater than 20 percent of the time. However, the second revised standard for sulfate (Table 2-9) causes the frequency of exceedences to fall to zero over the period assessed (Table B-1). The IPCB and the Illinois EPA found that "granting the adjusted standard for sulfate and TDS would have no measurable adverse effect on aquatic life in Thorn Creek and the Little Calumet River."[16] Still, sulfate concentrations show an increasing trend over time for most sampling points, and may become an issue in the future should this trend

[16] Case AS 2001-09.

continue. The average concentration of sulfate increases significantly from **Stuenkel** to **LOC54/Orr Rd**, just below the wastewater treatment plant outfall, and remains high in downstream reaches (Table B-2). This may indicate a source of sulfate between **Above** and **LOC54/Orr Rd**, most likely the Rhodia silica operation. The Illinois EPA does not identify sulfate as an impairment of Thorn Creek, and an assessment of Illinois EPA water quality sampling data indicates that exceedences of the sulfate standard are rare. Due to the revised standards, we do not consider sulfate an impairment of Thorn Creek, but monitoring of sulfate concentrations should be continued.

2.4.3.6. Total Phosphorus and Chlorophyll *a*

Phosphorus is often the limiting nutrient for controlling vegetative growth in aquatic systems. Too much phosphorus, in the presence of light, can stimulate high growth of algae, which, upon death, can cause dissolved oxygen concentrations to drop as the algae decompose, thereby impairing aquatic life. Illinois does not have a standard for total phosphorus (TP) concentration in streams. However, 0.05 mg/L is commonly used as a screening tool. If this guideline is exceeded, consideration should be given to algal blooms. TP levels exceeded 0.05 mg/L more than 90 percent of the time for five sampling points that are fairly well distributed along the stream course. Possibly because Illinois does not have a state standard, however, the data have not been consistently collected, except for the two MWRD sampling sites **LOC54/Orr Rd** and **LOC97/107th St**, which show a slight decreasing trend since 1997. In fact, for three of the five sampling points showing a high frequency of exceedence, only 15 samples were collected, and only for a period of approximately one year or less. Nonetheless, an examination of average TP concentrations indicates consistently high TP levels of ten to 100 times the recommended guideline in the water column throughout the stream course. An examination of data by month does not indicate a seasonal pattern of exceedence for TP. The data also indicate a spike in TP concentration below the wastewater treatment plant, which discharges an average TP concentration of 3.84 mg/L (Table B-2). One possible explanation for this high effluent concentration could be the Innophos waste water discharge of phosphates to the plant.

An examination of chlorophyll *a* concentrations showed 40 percent exceedences of the USEPA recommended guideline of 7.3 µg/L at **LOC54/Orr Rd**, 5 percent at **Thornton**, and 67 percent at **LOC97/107th St** (Table B-1). It should be noted that a number of the exceedences at these sampling points occur in winter when nuisance algal growth is less likely. All of the summer averages, when algae would be assumed to be a problem, meet the guideline criteria (Table 2-11). It is interesting to note that there are often higher chlorophyll *a* results in the winter. Since the main impact of algal blooms is depression of dissolved oxygen levels, the higher chlorophyll *a* levels in the winter are not likely to be detrimental because winter dissolved oxygen levels are typically high.

Table 2-11. Average Chlorophyll *a* Concentrations in Thorn Creek, 1997-2004

Sampling Location	Year-round (µg/L)	Summer (µg/L)
Above		4.2
LOC54/Orr Rd	9.0	7.3
Glenwood		4.0
Thornton		4.9
LOC97/107th St	11.3	5.3

The high TP concentrations do not appear to be causing problems with low dissolved oxygen, which is only a problem in far upstream reaches or in combination with excessively high chlorophyll *a* concentrations. The presence of filamentous (attached) algae has been reported anecdotally for Thorn Creek, but the impact of such algae, beyond aesthetics, has not been determined. Ecological impacts, such as whether the presence of algae changes the species and populations of macroinvertebrates in the stream, are also undetermined and warrant further study. The forest canopy and shady conditions along the stream course, which prevent sunlight from reaching the stream and helping fuel algal blooms, may be partly responsible for the absence of an algae problem. Presettlement conditions indicate a mostly forested stream corridor, and maintaining this forested condition would be consistent with historic conditions. A shaded corridor would also help to prevent the combination of sunlight and high phosphorus concentrations from causing algal blooms with a potentially greater impact on stream health.

The land use model predicts an average annual TP concentration of 0.157 mg/L in the water column at **Glenwood**, with residential land use by far the primary source, followed by industrial, commercial, and open space land uses (Figure 2-16). Average sampling concentrations of phosphorus range from 0.23 mg/L above the Thorn Creek Basin Sanitary District to 5.8 mg/L below the basin discharge point and 2.48 mg/L at Glenwood (Table B-2), indicating that TP loading is greater than the land use model predicts. This stands to reason for all points below the Thorn Creek Basin Sanitary District, which discharges an average of 3.84 mg/L to the stream, where phosphorus loading is much greater than above the District's discharge.

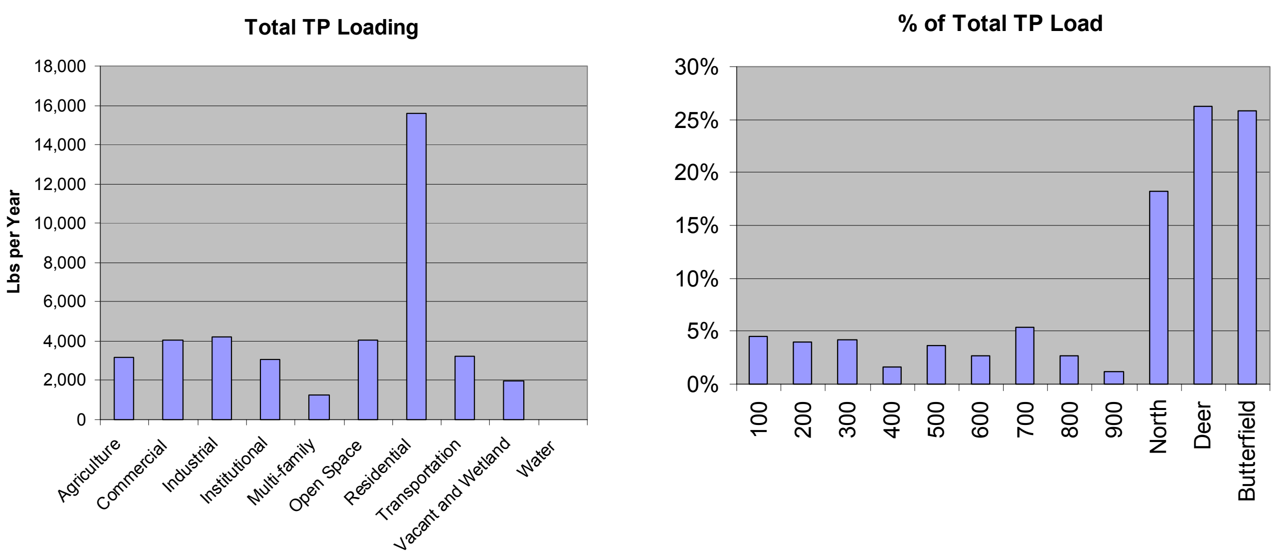


Figure 2-16. Total P Loading by Watershed Land Use and Percent of TP Load by Subbasin

The Illinois EPA 305(b) report identifies nutrients (phosphorus, ammonia, and nitrates) as a "high" cause of impairment for downstream reaches, but only "slight" for upstream reaches. While the high concentrations of phosphorus may present an impairment or the potential for impairment, the severity of this impairment is unclear. It also appears that while there likely are nonpoint sources of phosphorus in the watershed contributing to high phosphorus concentrations, the primary source appears to be the wastewater treatment facility, which is operating without a state-mandated phosphorus limit on its discharge. This raises the question of whether addressing nonpoint sources of phosphorus is a prudent use of limited resources for watershed improvement.

2.4.3.7. Nitrogen

Nitrogen is another essential plant nutrient of concern that is found in three common forms in water: (a) nitrate (NO_3^-), which is converted to ammonia by algae; (b) ionized ammonia (NH_4^+), the form preferred by plants as a nutrient and the form most toxic to fish; and (c) dissolved molecular nitrogen (N_2). Like phosphorus, high concentrations of nitrogen can be a condition for high algae growth. The most consistently sampled form of nitrogen for Thorn Creek was un-ionized ammonia (NH_3), which was assessed using the acute standards for general use of 0.33 mg/L from April to October and 0.14 mg/L from November to March. Un-ionized ammonia levels exceeded Illinois standards greater than 30 percent of the time for upstream reaches (**Stuenkel** and **Western**) and approximately 50 percent of the time from **Above** downstream (Table B-1). Average concentrations of un-ionized ammonia were fairly consistent around 0.3 to 0.4 mg/L from **Above** downstream (Table B-2), suggesting that nonpoint sources of nitrogen exist throughout the watershed. The wastewater treatment plant also discharges ammonia nitrogen to the stream at an average concentration of 0.39 mg/L. At these concentrations, it appears that nitrogen is an impairment to aquatic life with potential for algal growth that should be addressed, especially for downstream reaches.

The land use analysis predicts 1.3 mg/L of total nitrogen (TN) in the water column at **Glenwood**, primarily from residential land use, followed by commercial, agriculture, and industrial land uses (Figure 2-17).

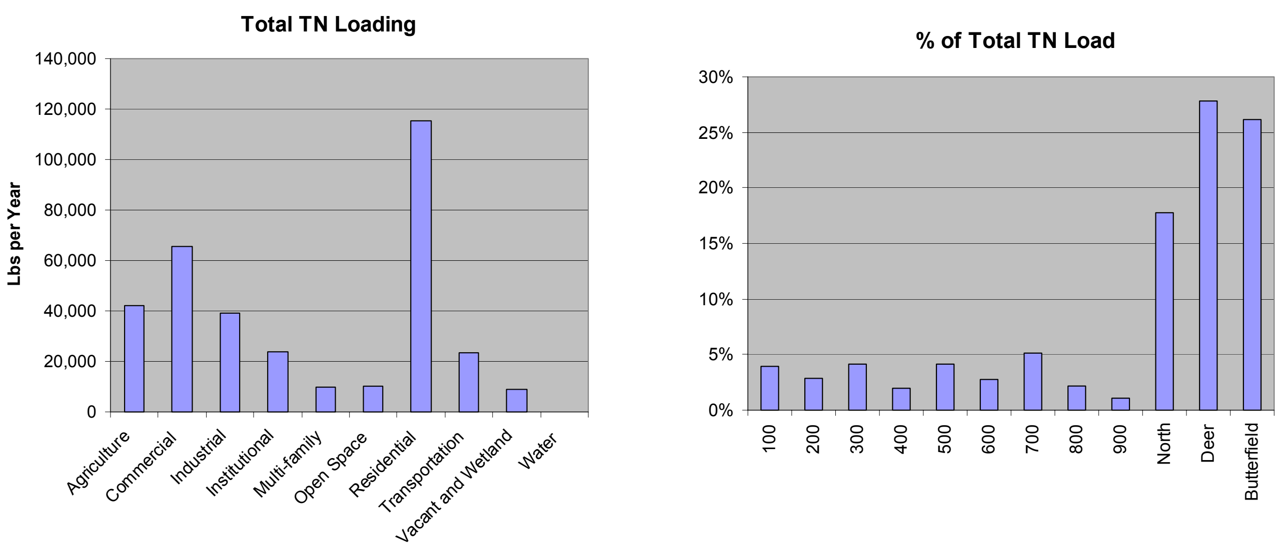


Figure 2-17. Total N Loading by Watershed Land Use and Percent of TN Load by Subbasin

The Illinois EPA 305(b) Report identifies nutrients (phosphorus, ammonia, and nitrates) as a "high" cause of impairment for downstream reaches, but only "slight" for upstream reaches. This is consistent with the present finding that nitrogen is an impairment that should be addressed.

2.4.3.8. pH

The acidity of water is measured by pH. Values greater than 7.0 indicate basic (alkaline) conditions, values less than 7.0 indicate acidic conditions, and a pH of 7.0 is neutral. All life forms are sensitive to pH levels. The vast majority of measured pH levels for Thorn Creek were within the accepted Illinois standard range of 6.5 – 9.0, which supports aquatic life. **LOC54/Orr Rd** reported 7 percent exceedences, with a few samples falling below the range and a few above the range. **LOC97/107th St** reported 3 percent exceedences (Table B-1). These results indicate that pH does not appear to be a problem throughout the creek, but that there are occasional, isolated instances of pH standards violations. The Illinois 305(b) report identifies pH as a "slight" cause of impairment for downstream reaches, but not for upstream reaches, which is consistent with the present analysis. Although pH is not an impairment needing attention at this time, continued monitoring is important.

2.4.3.9. Metals

Due to their potential toxicity, metals can impair water quality for aquatic life, both chronically (long-term exposure) and acutely (short-term exposure). Five metals were examined and compared to the Illinois standards for Thorn Creek, which are based on a water hardness of 400 mg/L:

- **Arsenic:** 360 μg/L acute, 190 μg/L chronic
- **Nickel:** 26.67 μg/L acute, 16.2 μg/L chronic
- **Silver:** 5 μg/L
- **Zinc:** 1,000 μg/L
- **Iron (soluble):** 1 mg/L

Data for these metals, which are inconsistent at some locations, were collected at four sampling stations along Thorn Creek: **Above**, **LOC54/Orr Rd**, **Thornton**, and **LOC97/107th St**. The results indicate no exceedances for arsenic, nickel, or silver and only low exceedences for iron (8 percent of 12 samples at **Above** and 8 percent of 13 samples at **Thornton**), not enough to confirm a problem with metals on Thorn Creek (Table B-1).

Land use analysis predicts concentrations of 0.013 mg/L and 0.129 mg/L of copper and zinc, respectively at **Glenwood**. Copper sources include, in order of contribution in the Thorn Creek watershed, transportation, residential, commercial, and industrial land uses (Figure 2-18). Zinc loading primarily results from residential land uses, but transportation and commercial land uses are also contributors (Figure 2-19). The TCBSD does not report discharge figures for copper or zinc.

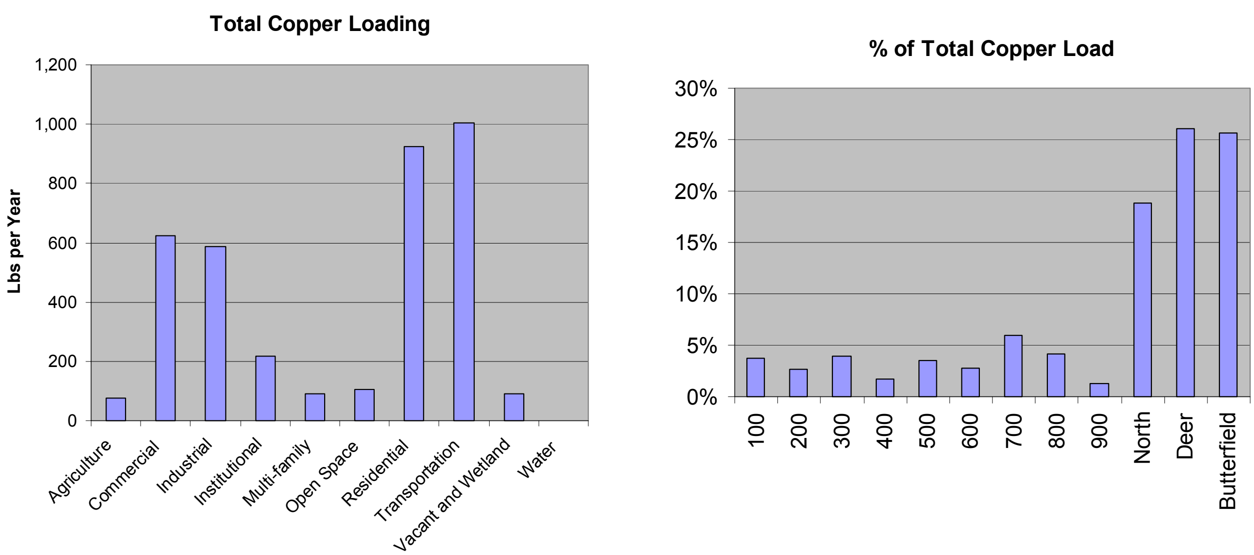


Figure 2-18. Total Copper Loading by Watershed Land Use and Percent of Copper Load by Subbasin

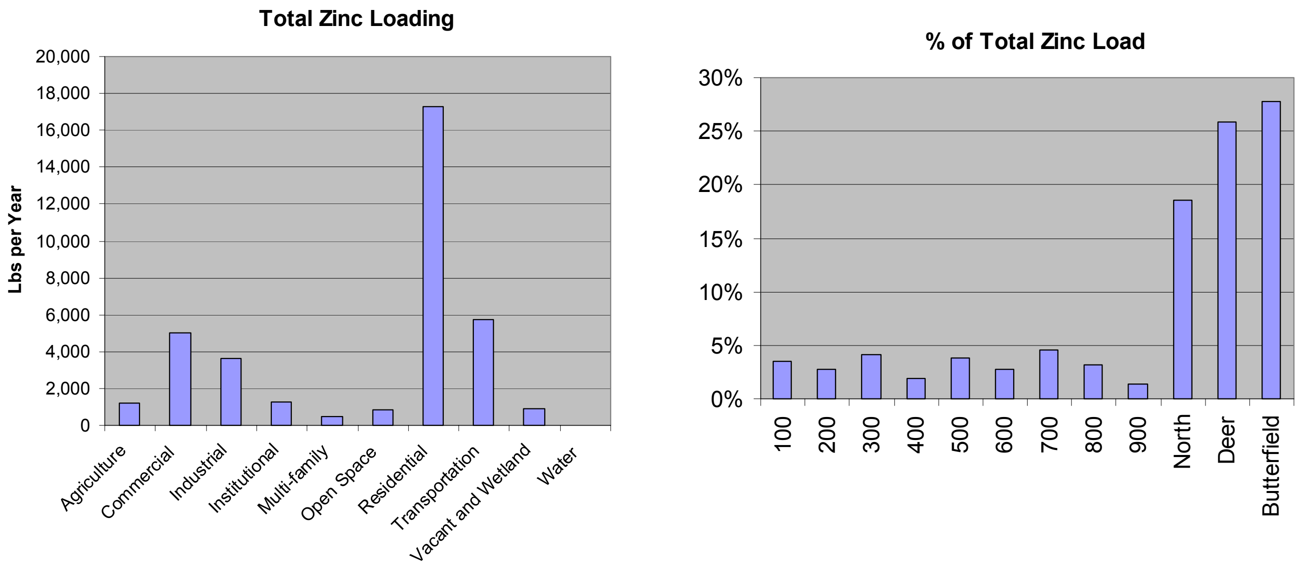


Figure 2-19 . Total Zinc Loading by Watershed Land Use and Percent of Zinc Load by Subbasin

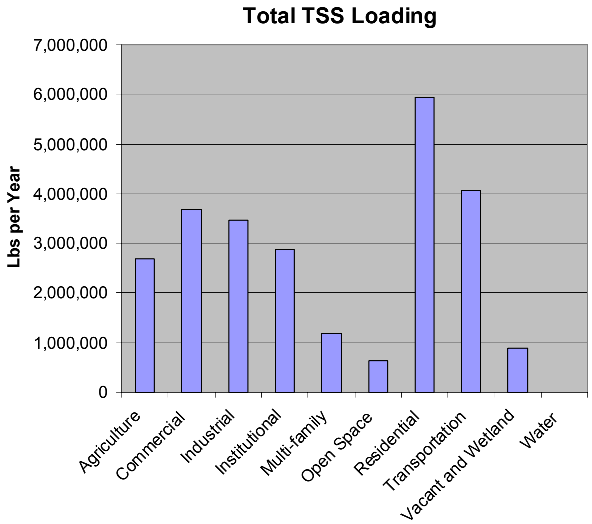
The Illinois EPA 305(b) report identifies metals as a "slight" cause of impairment for upstream and downstream reaches, and an evaluation of its water quality sampling data indicates only rare exceedences of arsenic. The present findings do not support the Illinois EPA statement that metals are a cause of impairment.

2.4.3.10. Total Suspended Solids

Total suspended solids (TSS) measurements quantify all particles suspended in water and is related to turbidity, a measure of water coloration or "murkiness." Most TSS loading is believed to be related to rain events, though data to correlate TSS loading with rain events were not assessed. While there is no Illinois standard for TSS, measurements greater than 80 mg/L have been found to have the potential to harm aquatic life.

Average TSS concentrations at all the sampling stations fell well below the 80 mg/L guideline, and generally ranged between about 20 and 40 mg/L (Table B-2). Just below **Glenwood** at **HBD 06**, average TSS concentration was 20.5 mg/L. Of the approximately 100 samples taken for TSS since 1997 by the MWRD at their two sampling locations, only two samples exceeded 80 mg/L TSS, and these samples were taken following storm events. An estimated 2.73 mg/L average concentration of TSS is discharged to the creek by the TCBSD. It is plausible that the wastewater treatment plant discharge is beneficially diluting some of the existing TSS load in the stream. Anecdotal reports of clean sands and bedrock substrates in the stream indicate a fairly healthy condition regarding TSS and siltation.

The land use model predicts an average annual concentration of 94.4 mg/L of TSS in the water column at **Glenwood**, with residential land use the primary source followed by transportation, commercial, industrial, and institutional uses (Figure 2-20). However, sampling results show that TSS averaged 20.5 mg/L just downstream of **Glenwood** at **HBD 06** (TSS was not analyzed at Glenwood), indicating that the land use model as currently set up is greatly overpredicting instream TSS.



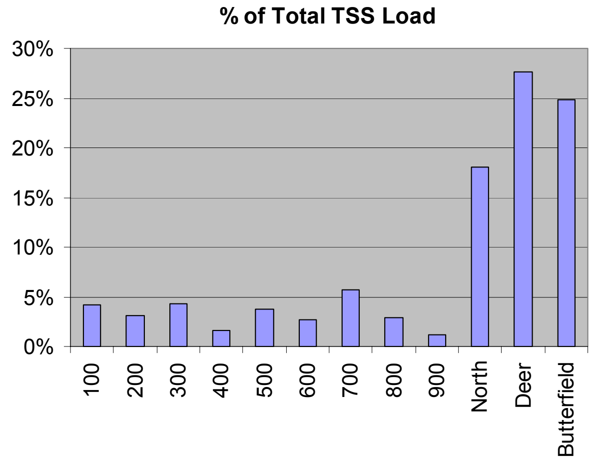


Figure 2-20. TSS Loading by Watershed Land Use and Percent of TSS Load by Subbasin

The Illinois 305(b) report identifies suspended solids as a cause of impairment for downstream reaches, and siltation as a "moderate" cause of impairment for upstream reaches. While the land use analysis indicates that TSS loading might be a problem, the data do not support this statement, and it seems unlikely, given the present findings, that TSS is impairing the stream. Nonetheless, monitoring and reducing any existing loading would likely benefit the stream. Further study of TSS in the tributaries is also warranted.

2.4.4. ADDITIONAL DATA ON WATER QUALITY IN THORN CREEK

2.4.4.1. Thorn Creek Stream Inventory and Opportunity Assessment

An assessment of Thorn Creek was prepared in 2002 by Eubanks & Associates for the South Suburban Mayors and Managers Association. That study examined a 6.45 mile stretch of Thorn Creek located primarily in the Forest Preserve District of Cook County during the spring of 2002. Dissolved oxygen levels throughout the stretch were sufficient to sustain aquatic species throughout the stream course, which aids in unhindered fish movement and habitat development. The levels of total dissolved solids observed were just below the standard for safe general use, and would be expected to decrease as the season progresses and solids (like road salt) flush through the watershed. The pH levels within the stream segment were essentially neutral, and suitable for aquatic life present. Sedimentation within the stream was found to occur mostly in low flow banks where the stream meanders, due to the composition of the stream bottom and the water depth.

2.4.4.2. Illinois EPA-identified Impairments Not Captured in NIPC Assessments

A number of additional causes of impairment for Thorn Creek were identified in the Illinois 305(b) report. These include habitat and flow alterations (discussed elsewhere in this study), priority organics, PCBs, cyanide, and oil and grease. These are consistent with the character of the watershed as moderately to highly urbanized. Aside from flow alterations, however, NIPC was unable to confirm these impairments.

2.5. Fish and Biotic Indicators

In addition to physiochemical indicators of water quality like phosphorus and dissolved oxygen, the diversity and abundance of aquatic organisms also helps paint a picture of watershed health.

2.5.1. SAMPLING LOCATIONS

The sampling locations where biotic indicator data were collected can be found in Figure 2-21. Sites **R0210601**, **R0210602**, and **R0203101** are Illinois Department of Natural Resources (DNR) RiverWatch Program sites**.** Site **R0210601** is located at about the middle of the main stretch of Thorn Creek. Site **R0210602** is located in the Glenwood North Forest Preserve, north of Glenwood School and the confluence of Butterfield Creek and Deer Creek at the old B&O Railroad bridge crossing. Site **R0203101** is located near Thorn Creek's confluence with the Little Calumet River. Illinois DNR also has four fish sampling locations along Thorn Creek: one each within the **Sauk Trail**, **Joe Orr**, and **Thorn Creek Forest Preserves**; and one at **Glenwood Road**. **HBD 05**, **HBD 06**, and **HBD 04** are Illinois EPA monitoring sites. **HBD 05** is located at Route 30 in Chicago Heights, **HBD 06** is south of the ComEd substation at 195th Street, and **HBD 04** is at Thornton-Lansing Road.

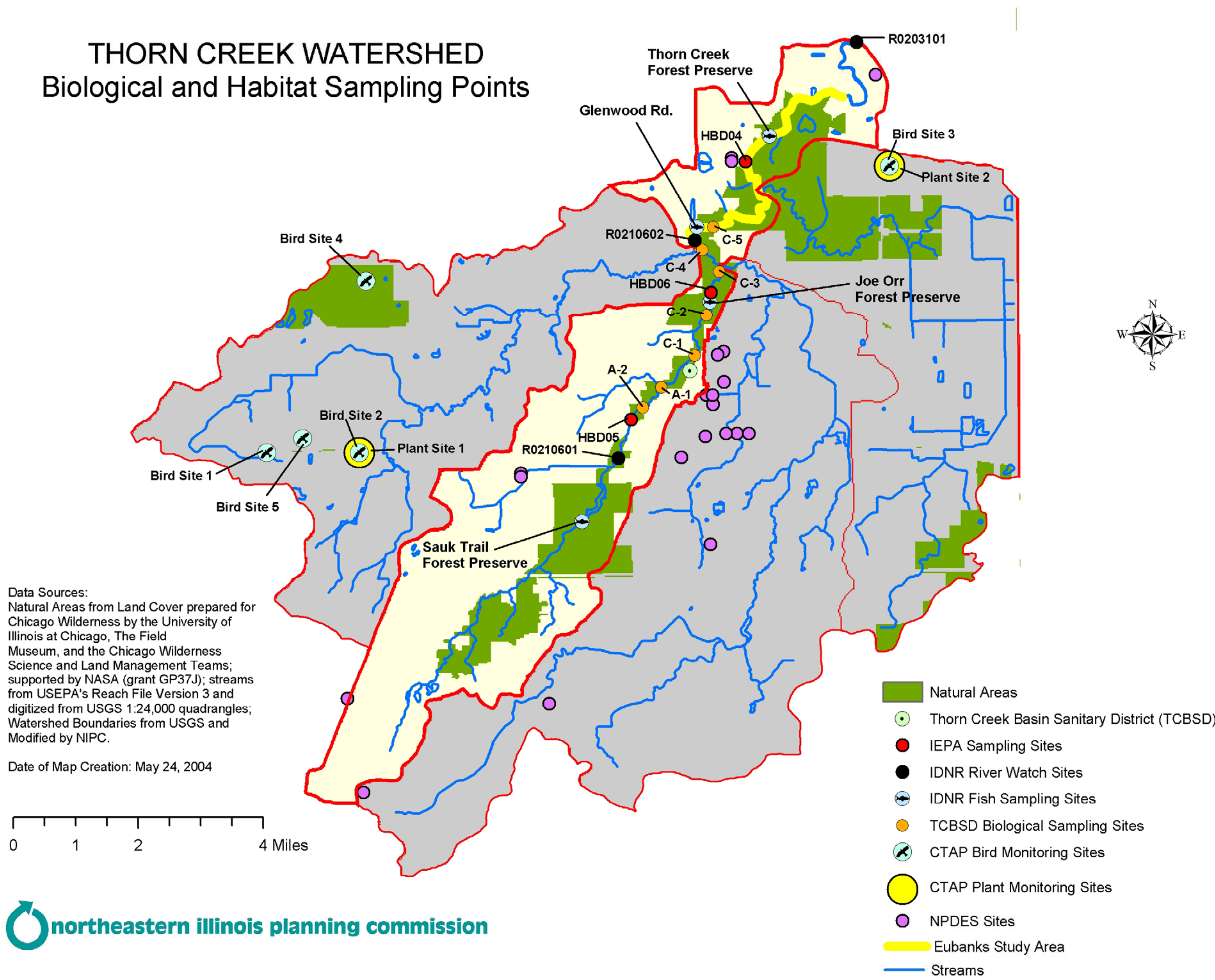


Figure 2-21. Biological and Habitat Sampling Locations

2.5.2. RIVERWATCH PROGRAM MACROINVERTEBRATE DATA

The data summarized in Table 2-12 were gathered by the RiverWatch Program, a program of the Illinois DNR that relies on volunteer monitoring by trained citizens in order to evaluate the health of a stream or river. Data were gathered via biological monitoring and stream habitat surveys and were compiled by Illinois DNR scientists. The paragraphs below explain these measures.

Table 2-12. Illinois DNR RiverWatch Data Summary, Thorn Creek, 1997–2003

	Site R0210601	Site R0210601	Site R0210602	Site R0210602	Site R0210602	Site R0203101	State Average	Basin Average
Year	1997	1998	2001	2002	2003	2001	—	—
% Dom	72.8%	100.0%	92.8%	68.4%	62.6%	92.7%	—	—
MBI	6.42	11	5.92	5.67	5.6	5.93	5.77	6.13
EPT	2	0	1	3	4	1	2.47	1.66
TXR	7	1	7	9	10	7	8.52	8.37
BIO	0.586	0.89	23.8	70.1	83.5	0.21	0.46	0.46
HAB	0.349	0.534	2.0	43.1	67.5	0.09	0.56	0.46

Source: IDNR CTAP website, http://ctap.inhs.uiuc.edu/reports/river_watch_analysis.asp.

The *percentage dominance* (% Dom) of a stream is the percentage of organisms represented by the three most common taxa found at that site. The lower this number, the greater the diversity; waters of higher quality are generally able to support greater diversity. The *Macroinvertebrate Biotic Index* (MBI) rates stream health using organisms tolerant to pollution and sample density. The lower the MBI score, the better the stream quality:

MBI Score	**Water Quality**
Below 6.0	Good
6.1 to 7.5	Fair
7.6 to 8.9	Poor
Above 9.0	Very Poor

The *EPT* score evaluates the number of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). EPT species richness increases with stream water quality. *Total taxa richness* (TXR) is the total number of taxa (out of a total of 37 indicator taxa) identified by the volunteers at each monitoring site. The overall *biological score* (BIO) is a weighted average of the percentile scores for MBI, EPT, total taxa richness, percent dominance, and percent worms. The overall *habitat score* (HAB) is a measure of habitat quality based on the physical characteristics of the stream, including surrounding land uses, channel disturbances, stream substrate, water odor and color, and canopy cover.

2.5.3. IEPA AND THORN CREEK BASIN SANITARY DISTRICT MACROINVERTEBRATE DATA

In 1996, an Illinois EPA study rated Thorn Creek at **HBD 04** (Thornton-Lansing Road) as having an MBI of 5.8. Another macroinvertebrate survey was conducted by Illinois EPA in 2001 at **HBD 05** (Route 30) and **HBD 06** (195th Street). Samples were collected using the hand-picked methodology. Table 2-13 provides the number of each species collected at the two sites and the relative tolerance of each. A higher tolerance indicates an ability to survive despite relative degradation of habitat and water quality. Thorn Creek yielded an MBI of 5.8 at **HBD 05** and 7.9 at **HBD 06**.

Table 2-13. Illinois EPA Macroinvertebrate Data, Thorn Creek, 2001

		Sampling Location	
Organism	**Tolerance**	**HBD 05**	**HBD 06**
Dugesia tigrina	6		1
Oligochaeta	10	30	240
Erpobdella punctata	8	4	
Mooreobdella fervida	8		1
unid. erpobdellid (imm. specimens)	8		1
Helobdella stagnalis	8	4	
Helobdella triserialis	8	7	
Helobdella sp. (imm. specimen)	8	1	
Caecidotea intermedius	6	128	14
Caecidotea (imm, females)	6	108	53
Orconectes virilis	5	2	1
Baetis intercalaris	7	1	1
unid. baetid (inc., EI)	4	1	
Stenacron interpunctatum	4	5	
unid. heptageniid (inc., EI)	3.5	1	
Aeshna umbrosa	4		1
Calopteryx maculate	4	5	6
Argia apicalis	5		1
Cheumatopsyche sp.	6	77	1
Hydropsyche depravata complex	5	207	61
Hydropsyche spp. (EI)	5	17	
hydropsychid (EI)	5.5	8	2
unid. hydroptilid (pupa)	2	1	
Stenelmis crenata	7	1	1
Stenelmis spp. (L)	7	2	
Ablabesmyia mallochi	6	1	
Brillia flavifrons	6	1	
Brillia sp. (EI)	6		3
Chironomus sp.	11	2	3
Conchapelopia sp.	6	4	8
Cricotopus (C.) bicinctus	10	2	35
Cryptochironomus sp.	8	7	8
Polypedilum fallax-gr.	6	1	
Polypedilum illinoense-gr.	5	6	25
Polypedilum scalaenum-gr.	6		25
Polypedilum sp.	6		3
Rheocricotopus robacki	6	3	
Thienemanniella xena	2	4	
unid. tanypodinae (inc. spec., EI)	6	1	
Similium vittatum complex	8	9	3
Tipula sp.	4	3	
Ferrissia sp.	7		1
Fossaria sp.	7	1	
Amnicola limosa	4	3	
Corbicula flumineum	4	4	27
Musclium secures	5		
Musclium transversum	5	12	3
Pisidium compressum	5	1	

		Sampling Location	
Organism	**Tolerance**	**HBD 05**	**HBD 06**
Hydra sp.		1	
Peltodytes duodecimpunctatus		2	

Source: All data received from Howard Essig, Illinois EPA (Des Plaines regional office).

The Thorn Creek Basin Sanitary District has also recorded MBI data for seven locations along Thorn Creek: two upstream of the plant's discharge point (**A-1, A-2**) and five below (**C-1** through **C-5**) (Figure 2-21). The data from these surveys are summarized in Table 2-14. It is worth noting that the Huff and Huff, Inc. report from 2000 was prepared in order to monitor the biological impact of a silica plant wastewater discharge to the wastewater treatment plant starting in 1995. These data show that TDS and sulfate concentrations increased immediately below the wastewater treatment plant, but that stream MBI ratings did not trend significantly up or down, indicating that the increased TDS and sulfate had not significantly affected the MBI ratings through the 1999 study period. However, the 2001 Illinois EPA study **HBD 06**, located between C-2 and C-3, yielded an MBI score of 7.9, thus indicating further study is warranted.

Table 2-14. MBI Values Above and Below Thorn Creek Basin Sanitary District Plant, 1988-1999

	MBI Values by Sampling Site Location						
Sampling Period	**A-2**	**A-1**	**C-1**	**C-2**	**C-3**	**C-4**	**C-5**
July 1988	—	6.9	10.9	7.1	6.2	—	—
November 1992	9.7	6.8	8.0	6.5	7.4	7.0	6.7
August 1994	6.4	6.3	6.3	6.4	6.2	6.5	5.5
Average 1988–1994	8.1	6.7	8.4	6.7	6.6	6.8	6.1
September 1997	7.9	7.6	7.0	7.0	6.3	7.3	6.5
September 1999	10.6	6.9	8.4	6.3	6.9	7.6	5.1
Average 1997–1999	9.2	7.3	7.7	6.7	6.6	7.5	5.8
Parameter							
TDS, mg/L	1359	1315	1729	1547	1533	1501	1466
Sulfate, mg/L	412	372	817	342	788	645	728

Sources: Biological Survey of Thorn Creek (Huff and Huff, Inc., December 1994); Biological Assessment of Thorn Creek Late Summer, 1997 (Huff and Huff, Inc., December 1997); and Environmental Assessment for the proposed Increase in Total Dissolved Solids Discharge from the Thorn Creek Basin Sanitary District (Huff and Huff, Inc., November 2000).

2.5.4. ILLINOIS DNR AND ILLINOIS EPA FISH DATA

The types and abundances of fish in a stream also can function as an indicator of water and habitat quality. For most streams in the Midwest, a sample containing less than fifty individual fish indicates severely disturbed conditions. Additionally, different types of fish vary greatly in their tolerance to environmental disturbances such as poor water quality or habitat degradation. The fish species collected thus offer insight into the condition of the stream.

In 1998, fish were collected at four sites on the Thorn Creek as part of an Illinois DNR biological survey. These data are presented in Table 2-15. An *Index of Biotic Integrity* (IBI) was calculated for each site based on this study. The IBI is a water quality score which is calculated from multiple types of fish data utilized to classify streams. The total number of organisms and the number of different species present are determined. These numbers are then applied to an index, or scale, that lists organisms according to their sensitivity to pollution. An IBI of less than 20 is often indicative of a nonsupport situation, while a score greater than 41 is typical for full support streams. The IBI is then used to determine the **Biological Stream Characterization** (BSC), which ranges from A to E, with A being the highest rating.

Table 2-15. Illinois DNR Fish Community Data, Thorn Creek, 1998

Common Name	**Scientific Name**	**Number of Individuals Caught By Sampling Location**			
		Thorn Creek Forest Preserve	Sauk Trail Forest Preserve	Joe Orr Forest Preserve	Glenwood Road
Grass pickerel	*Esox americanus*	0	0	0	0
Carp	*Cyprinus carpio*	1	0	0	6
Golden shiner	*Notemigonus crysoleucas*	0	0	0	2
Creek chub	*Semotilus atromaculatus*	140	10	88	66
Fathead minnow	*Pimephales promelas*	19	1	15	7
Bluntnose minnow	*Pimephales notatus*	0	0	0	40
Emerald shiner	*Notropis atherinoides*	0	0	0	5
White sucker	*Catostomus commersoni*	4	9	3	6
Black bullhead	*Ameiurus melas*	0	9	0	0
Largemouth bass	*Micropterus salmoides*	1	3	1	5
Green sunfish	*Lepomis cyanellus*	29	40	239	35
Sunfish hybrid	*Lepomis spp.*	1	0	0	0
Bluegill	*Lepomis macrochirus*	1	2	1	0
Johnny darter	*Etheostoma nigrum*	0	0	0	7
	Total	**196**	**74**	**347**	**179**
	Number of Species	**7**	**7**	**6**	**10**
	IBI	**32**	**32**	**30**	**32**
	BSC	**C**	**C**	**D**	**C**

Source: Illinois Department of Natural Resources

Another sampling was conducted in August 2001 by Illinois DNR in cooperation with the Illinois EPA as part of an intensive basin survey. The survey was performed at **HBD 05**, the Route 30 bridge. Overall diversity was low, and despite abundant habitat, only six species were present at the site (Table 2-16). The creek was given an IBI score of 22 and a BSC of D. The accompanying report cited the lack of connection to a good quality large river system, local water quality problems, and a highly urbanized landscape as the causes of the poor fish diversity.

Table 2-16. Illinois DNR and Illinois EPA Fish Community Data, Thorn Creek at HBD 05, 2001

Common Name	Scientific Name	Number
Creek chub	*Semotilus atromaculatus*	116
Fathead minnow	*Pimephales promelas*	3
Bluntnose minnow	*Pimephales notatus*	1
White sucker	*Catostomus commersoni*	35
Largemouth bass	*Micropterus salmoides*	6
Green sunfish	*Lepomis cyanellus*	7
	Total	**168**
	Total Species	**6**
	Total Native Species	**6**
	IBI	**22**
	BSC	**D**

Source: Fish Community Survey of Lake Michigan Basin, Cook County, IL, from Steve Pescitelli, IDNR

The Thorn Creek Basin Sanitary District (TCBSD) also undertook a fish survey at the same locations where its macroinvertebrate sampling was conducted (**A-1, A-2**; **C-1** through **C-5** except **C-2**). The results of this survey are presented in Table 2-17.

Table 2-17. TCBSD Fish Survey Results, Thorn Creek, 1999

Fish Description			**Total Length (cm)**		**Number of Fish Caught by Sampling Location**						
Family and Species	Common Name	Trophic Status	Harvest-able Fish Size	Longest Fish Caught	Upstream		Downsteam (C-2 not sampled)				**Total**
					A-2	**A-1**	**C-1**	**C-3**	**C-4**	**C-5**	
Cyprinidae	**Minnows & Carps**										
Cyprinus carpio	Common Carp	Omnivore	30.5	41.0	0	0	13	2	0	2	**17**
Semolitus atromaculatus	Creek Chub	Insectivo-rous cypriad	n/a	22.0	1	13	0	2	1	5	**21**
Pimephales no-tatus	Bluenose Minnow	Omnivore	n/a	7.5	0	0	1	0	0	2	**3**
Catostomidae	**Suckers**										
Catostomus commersonii	White Sucker	Sucker	30.5	32.0	5	5	0	0	0	0	**13**
Centrarchidae	**Sunfishes And Basses**										
Lepomis cyanel-lus	Green Sunfish	Sunfish	15.2	12.0	41	57	15	0	6	22	**141**
Ictalluridae	**Freshwater Catfishes**										
Ameiurus melas	Black Bullhead	Bullhead	19.1	24.0	2	0	0	0	1	0	**3**
Esocidae	**Pikes**										

Fish Description			Total Length (cm)		Number of Fish Caught by Sampling Location						
Family and Species	Common Name	Trophic Status	Harvest-able Fish Size	Longest Fish Caught	Upstream		Downsteam (C-2 not sampled)				**Total**
					A-2	**A-1**	**C-1**	**C-3**	**C-4**	**C-5**	
Esox americanus americanus	Redfin Pickerel	Piscivore	n/a	13.0	0	0	0	0	0	1	**1**
Total Number of Fish (individuals)					52	75	29	4	8	32	**199**
Total Number of Fish Species					4	3	3	2	3	5	**7**
IBI					**28**	**28**	**22**	**24**	**26**	**28**	**--**

Source: Environmental Assessment for the Proposed Increase in Total Dissolved Solids Discharge from the Thorn Creek Basin Sanitary District (Huff and Huff, Inc., November 2000).

2.6. Channel and Riparian Conditions

While data are unavailable for the entire run of Thorn Creek, detailed observations on channel and surrounding land conditions were made by Eubanks & Associates for the stretch from Thorn Creek's confluence with Butterfield Creek to the Paarlberg Farm (Figure 2-21). This 6.45 mile stretch was examined by Eubanks in order to compile the Thorn Creek Ecosystem Profile commissioned by the South Suburban Mayors and Manager's Association. The survey was conducted in spring 2002. The document offers additional insight on water quality and related issues, and is available for review. Observations and data from this study are summarized below and in Table 2-18.

Channel width was measured at both the top and the bottom of the channel, with average width measurements being 58 and 43 feet, respectively. The maximum water depth ranged from 1.0 to 6.5 feet, with a mean depth of 3.3 feet. Water velocity measurements ranged from 0.2 mph to 2.9 mph with a mean of 1.2 mph. Overall substrate stability of the creek ranged from moderate to high. The composition of the bottom varied depending upon location, ranging from bedrock to 100 percent sand and gravel to 20 percent sand and 80 percent silt and clay.

Table 2-18. Stream Conditions, Thorn Creek from Butterfield Creek Confluence to Paarlberg Farm, 2002

Parameter	Range	Average
Dissolved Oxygen	6.90-8.78 ppm	7.9 ppm
Turbidity	19.0-41.9 ntu	28.4 ntu
Transparency (Secchi disk)	10-28 in	—
Total dissolved solids	833-1107 mg/L	986 mg/L
pH	7.43-7.67	—
Channel width	25-84 ft (top); 21-75 ft (bottom)	58 ft (top); 43 ft (bottom)
Channel depth	1.0-6.5 ft	3.3 ft
Water velocity	0.2-2.9 mph	0.2 mph
Pool/Riffle Development	None-High	—
Substrate stability	Moderate-High	—
Sediment accumulation	None-Low	—

Source: Surveyed 4/17 and 5/23/2002 by Eubanks& Associates for South Suburban Stormwater Strategy: A Plan for Watershed Management; *South Suburban Mayors and Managers Association, 2002.*

The original stream corridor was intact with little evidence of channelization for the examined stretch. At normal water levels, the stream corridor had moderate sinuosity. Pool and riffle development ranged from none to high, with the upper reaches in Cook County Forest Preserve property containing moderate levels. North of Thornton Lansing Road, there was little or no pool/riffle development with occurrences mainly at bridges and road overpasses. Pools and riffles provide habitat and benefit water quality by increasing dissolved oxygen levels.

Erosion was present throughout the examined reach of Thorn Creek. Most sections had moderate amounts, but erosion levels ranged from low to high depending upon the area. There are a few geologic features, such as sandstone bluffs and a predominantly sandy/gravel bottom with areas of bedrock, which, along with a largely undeveloped floodplain, reduced the impact of erosion in the upper reaches of the stream. Over time, erosion occurs in most aquatic systems as water pulls soil away from the shoreline, eventually altering the hydrology of the water body. The increased erosion that accompanies development is one of the greatest factors in the decline of rivers and streams. Natural forces, in combination with point discharges and storm flows carrying debris and sediment, cause additional erosion and contamination of streams and rivers.

Armoring is the placement of some artificial material along a streambank or shoreline in order to reduce erosion. Armoring is often beneficial to one area while increasing erosion in adjacent sections. Armoring was observed in five of the fourteen reaches examined, including one instance on Forest Preserve property and in residential projects just north of Thornton Lansing Road.

In-stream debris load, which includes both natural and manmade debris, made Thorn Creek impassable in five places on the examined stretch. The size of these snags ranged from 25 to 145 feet in length. Seven reaches of the stream contained at least one mid-stream sand bar or island. While such formations may increase habitat availability, they often increase debris accumulation and stream obstruction. Bars or islands are constantly changing features in natural streams and rivers — they move, disappear, and reform over time.

The substrate is comprised predominantly of sand and gravel, with some silt/clay content in upper reaches. Due the bottom substrate and characteristics of the stream corridor, aquatic plant and algae populations were not particularly high. Three genera of filamentous algae were observed — *Spirogyra*, *Cladophora*, and *Pithophora*. Submerged aquatic plants, specifically thin stem pondweed and coontail, were present in two sections of the stream. No invasive aquatic species were observed. The sparseness of aquatic vegetation may have been due in part to the time of year (spring) in which the survey was conducted. Bank vegetation consisted predominantly of trees and celandine, with the percent shade coverage ranging from 20 to 75 percent and expected to increase with warmer weather.

A stream survey was conducted in August 2001 by the Illinois DNR in cooperation with the Illinois EPA as part of an intensive basin survey. The results are shown in Table 2-19. The survey made qualitative habitat observations at **HBD 05**, the Route 30 bridge.

Table 2-19. Habitat Observations, Thorn Creek at HBD05, 2001

Substrate	**Percent**
Silt/Mud	5%
Sand	10%
Gravel	50%
Cobble	35%
Cover	
Cover	30%
Morphology	
Pool	60%
Riffle	30%
Run	10%

Source: Illinois DNR (2001)

Finally, the Thorn Creek Basin Sanitary District conducted an analysis of channel conditions along with its macroinvertebrate and fish surveys. The results are reproduced in Table 2-20. The sites examined (**A-1** and **A-2** upstream of the District's discharge point; **C-1** through **C-5** downstream; plus locations in Deer and Butterfield Creeks) showed a mixture of pools and riffles, with mainly gravel, sand, and cobble substrates. Concrete and tires were noted at several sites.

Table 2-20. Channel Conditions, Thorn Creek, 1999

Site Location	Substrate	Morphology	Average Depth (ft)
Thorn Creek Upstream			
A-1	gravel, cobble, mud and sand	riffles glides	2.5
A-2	sand, gravel and woody debris	shallow pools glides	2 to 4
Thorn Creek Downstream			
C-1	sand, gravel, concrete, and tires	riffles glides	2
C-2	gravel, concrete, and tires	shallow pools glides riffles	2
C-3	sand, gravel and woody debris	shallow & deep pools deep glides	2 to 4
C-4	sand, cobble and concrete	shallow pools glides	3
C-5	sand and cobble	riffles glides	2
Tributaries			
Deer Creek	mud	shallow glides riffles shallow pools	1 to 2
Butterfield Creek	sand, mud and cobble	riffles glides	0.5 to 1

Source: Environmental Assessment for the Proposed Increase in Total Dissolved Solids Discharge from the Thorn Creek Basin Sanitary District (Huff and Huff, Inc., November 2000)

2.7. Natural Resources

The Thorn Creek watershed is rich in natural resources, natural communities, and biodiversity. This section examines these resources.

2.7.1 CURRENT AND PRESETTLEMENT LAND COVER

Today, the Thorn Creek watershed is approximately half urban or built-up (Table 2-21; Figure 2-22, Appendix A). While the watershed remains about 19 percent cropland, the relatively thin layer of loess prevents it from being classified as prime agricultural land. The Thorn Creek watershed has a comparatively high percentage of forest and woodland areas – 19.7 percent versus 11 percent for the state overall.

Table 2-21. Current and Presettlement Land Cover in the Thorn Creek Watershed

Land Cover or	**Current (c. 1995)**		***Presettlement (pre-1820)***
Community Type	**Acres**	**Percent**	***Percent***
Urban/Built-Up	31,749	47.6	
Cropland	12,338	18.5	
Grassland	7,985	12.0	
Prairie	--	--	*~70.0*
Upland Forest	11,648	17.5	
Bottomland Forest	1,482	2.2	
Forest, Woodland & Savanna	--	--	*~23.6*
Nonforested Wetlands	1,151	1.7	
Water	370	0.6	
Wetland	*	*	*~6.4*
Totals	**66,725**	**100.0**	***100.0***

Source: Thorn Creek Area Assessment, Volume 3: Living Resources, Illinois DNR, 1999.
**A separate study (Suloway and Hubbell, 1994) determined that wetlands (classified as bottomland forest, shallow marsh/wet meadow, open water, deep marsh, and shrub-scrub) currently occupy about 2,806 acres (4.2%) of the Thorn Creek watershed.*

Presettlement land cover is classified by natural community type. A natural community describes all the living things in an area. Each community has a high degree of interconnectedness and contains a unique association of plants and animals. Before significant human impact, the Thorn Creek watershed was largely prairie and woodland with some areas of savanna and wetland. Timber stands occurred mainly along the creek corridor. In the lower reaches of the stream, near the confluence of the mainstem of Thorn Creek with Deer, North, and Butterfield Creeks, large areas of wet prairie existed. Pockets of marshland also occurred throughout the watershed. The Illinois DNR estimates that, in the early 1820s, 70 percent of the land in the basin was covered by prairie, most of which was silt-loam prairie, about 24 percent by forest and savanna, and the rest by standing water/wetlands (Figure 2-23, Appendix A).[17]

Eighty-three percent of the presettlement forest cover in the watershed remains today, though much of it is degraded. Only 30 percent of the land that was forested in presettlement times remains forest in the state overall. Fifty-four acres of Thorn Creek's remaining forest survives in undegraded condition. High quality examples of sand prairie, sedge meadow, sand flatwoods, and sand seeps also exist within the watershed. Twenty acres of quality prairie remain in the area.

[17] *Sources*: Chicago Wilderness *Atlas of Biodiversity*; Illinois Department of Natural Resources Critical Trends Assessment Program; and *Pre-Settlement Land Cover for Cook and Will Counties*, prepared by Marlin Bowles and Jenny McBride of Morton Arboretum.

2.7.2. WETLANDS

Twenty-three percent of the land in Illinois was once wetlands. Only 11 percent of those wetlands now remain, and just 0.65 percent of these are considered high quality. Cook County has lost 80–89 percent of its wetlands. As development and agriculture drain these areas, the communities lose a valuable resource and necessary part of the ecosystem. These now rare wetlands are vital habitats for numerous plants and animals, many of which can only survive in specific wetland conditions. Additionally, wetlands function to mitigate the effects of storm flow in streams by retaining rainwater and delaying the delivery of water to the main stream, thus decreasing peak discharges and reducing flooding.

Before 1820, wetlands of all types covered an estimated 47 percent of the Thorn Creek area (Figure 2-23, Appendix A). This high percentage of presettlement wetland cover is typical of the poorly-drained glacial terrain that underlies the Thorn Creek watershed. As of 1996, 3.6 percent of the Thorn Creek watershed remained wetland, or about nine percent of the original wetlands (Figure 2-22, Appendix A). More than half of the watershed's remaining wetlands are bottomland forests, but there are also many shallow marshes and wet meadows. Twenty-six acres of the wetlands in the watershed are ranked as high quality, undegraded natural communities.[18]

2.7.3. NATURAL COMMUNITIES

The Thorn Creek watershed is largely urban and industrial with the majority of natural areas confined to stream corridors and county forest preserves. The fragmentation of natural areas by development is one problem that the watershed faces, as divided habitat often prevents breeding, hibernating, and necessary migration. However, the diversity of the watershed's natural communities, while reduced in size, remains intact. There are twenty-nine types of natural communities in the area, including five types of wetland, three of prairie, and two of savanna, each of which is subdivided into separate communities based on soil moisture.

The Thorn Creek watershed, though relatively small, supports a large number of species because of its wide variety of habitats. Thirty percent of the state's vascular plant species are found in the watershed. There are 772 recorded plant taxa in the area, 645 of which are native. Forty-five species of mammals, including the rare river otter, reside in the watershed. The area is also known for its bird communities. These communities are mostly forest-based, but the existence of wetlands and grasslands allow for a great diversity of species. Of the 308 species of Illinois birds, 260 are found in the watershed. However, it appears that development has begun to take a toll on this resource — for instance, 34 avian species that once bred in the Thorn Creek watershed are no longer seen in the area. Aquatic species have also suffered under the stress of urbanization. Due to poor surface water quality, only thirteen species of fish, three mussels, and four large crustaceans are currently found in the area. However, several species of salamanders and regionally rare frogs exist among the eleven amphibian and sixteen reptile species that make their home in the Thorn Creek area, and the threatened Kirkland's snake and Massasuaga rattlesnake have also been documented.

Beginning in 1997, scientists from the Illinois Natural History Survey conducted surveys at 600 sites from various habitats across the state. Part of the Critical Trends Assessment Program, this examination monitored the condition of forests, wetlands, grasslands, and streams throughout Illinois. The project seeks to assess changes in ecological conditions and to serve as a baseline against which to compare regional and

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[18] *Sources*: *Thorn Creek: An Inventory of the Region's Resources*, 2000. Illinois Department of Natural Resources, Critical Trends Assessment Program.

site-specific patterns throughout Illinois. Seven of these assessments were conducted in the Thorn Creek watershed (Figure 21). Five of the studies focused on bird populations, one on grassland plants, and one on wetland plants.

For the bird species data below (Table 2-22), *species richness* reflects the total number of species present in the area and *habitat dependent species richness* is based on those species that can only be found in that particular habitat.[19]

Table 2-22. CTAP Professional Scientists Monitoring — Bird Species

	Site 1	Site 2	Site 3	Site 4	Site 5	State Average
Assessment Year	1999	1999	1998	1999	1999	
Community Type	Wetland	Wetland	Grassland	Wetland	Wetland	
Species Richness	21	9	20	11	23	18.4
Habitat Dependent Species Richness	7	0	4	1	8	1.5
Threatened or Endangered Species	0	0	1	0	2	

Source: IDNR CTAP website, http://ctap.inhs.uiuc.edu/site/dataFactSheet.asp

The plant data below (Table 2-23) are based on all the plant species sampled in the herbaceous (ground cover), shrub, and tree layers. The *floristic quality index* (FQI) assesses floristic integrity by taking into account both the coefficient of conservativism and the total number of plant taxa sampled. The *coefficient of conservativism* (*C*) is a number assigned to each organism that reflects the plant's tolerance to disturbance and fidelity to a specific type of habitat.[20] The higher the FQI, the higher the ecological value of the site.

Table 2-23. CTAP Professional Scientists Monitoring — Plant Species

	Site 1	Site 2	State Average
Assessment Year	1999	1999	
Community Type	Wetland	Grassland	
Species Richness	10	34	18.5
Native Species Richness	8	26	11.3
Floristic Quality Index	7.9	11	4.36
Mean Coefficient of Conservatism	2.5	1.9	1.01
Introduced Species	2	8	
Threatened or Endangered Species	0	0	
Sensitive Species	1	1	

Source: IDNR CTAP website, http://ctap.inhs.uiuc.edu/site/dataFactSheet.asp

2.7.4. NATURAL AND PROTECTED AREAS

Also as part of the Critical Trends Assessment Program (CTAP), the Illinois DNR has conducted an "Inventory of Resource Rich Areas." This process is part of an effort to restore and protect Illinois' natural resources via an ecosystem approach. The Thorn Creek subbasin was designated as one of these resource

[19] Full lists of the species documented at each site are available at http://ctap.inhs.uiuc.edu/site/dataFactSheet.asp.

[20] FQI = $C\sqrt{N}$, where N is the species richness. FQI is calculated here for overall species richness, not solely native species.

rich areas (RRAs) by the Illinois DNR. The Thorn Creek RRA is in both Cook and Will Counties and is 20,614 acres, or about 32 square miles, in size. The area is mostly forest with some non-forested wetlands and bottomlands. There are thirteen "heritage occurrences" in the area — three natural communities (wetland, forest, and prairie), seven plant species, and three animal species. Five natural areas are also identified within the RRA: Volbrecht Road Woods, Wampum Lake Seepage Area, Thornton-Lansing Road, Thorn Creek Woods, and Monee Railroad Prairie. This designation as an RRA is indicative of the natural resources the area has to offer and highlights the importance of protecting them.

There are eleven CTAP natural areas within the greater Thorn Creek watershed (Table 2-24), which include eight "Catogory I" high quality (essentially undegraded) sites which comprise about 67.4 acres. These high quality natural areas include twelve remnants of natural communities made up of eight different natural community types including dry-mesic upland forest, sand flatwoods, dry-mesic prairie, mesic prairie, mesic sand prairie, shrub prairie, sedge meadow, marsh, and sand seep.

Table 2-24. Natural Areas within the Thorn Creek Watershed

Name	Acreage	County
Volbrecht Road Woods	28.23	Cook
Wampum Lake Seepage Area	58.44	Cook
Jurgensen Woods Nature Preserve	110.24	Cook
Thornton-Lansing Road	494.12	Cook
Glenwood Geological Area	4.23	Cook
Plank Road Trail Prairie-A	1.81	Cook
Plank Road Trail Prairie-B	3.70	Cook
Sauk Village Railroad Prairie	1.30	Cook
Jurgensen Teaberry Site	n/a	Cook
Thorn Creek Woods	759.21	Will
Monee Railroad Prairie	4.00	Will

Source: Thorn Creek Area Assessment, Volume 3: Living Resources, pp. 17-18, Illinois DNR, 1999

In addition to the eleven natural areas, the Thorn Creek watershed houses five nature preserves (Table 2-25). Each nature preserve except Dewey Helmick is associated with a corresponding natural area. Nature preserves can be in public or private ownership and are formally dedicated to protect significant natural features.

Table 2-25. Nature Preserves within the Thorn Creek Watershed

Name	Acreage	County
Jurgensen Woods	125.34	Cook
Thornton-Lansing Road	331.48	Cook
Thorn Creek Woods	519.81	Will
Old Plan Road Prairie	9.66	Cook
Dewey Helmick	3.65	Cook

Source: Thorn Creek Area Assessment, Volume 3: Living Resources, pp. 19-20, Illinois DNR, 1999

The Dewey Helmick Nature Preserve is one of the highest quality railroad prairies in the state and is home to over 200 species of native plants. The Thorn Creek Woods, in which the headwaters of Thorn Creek are located, occupy the southern end of the 5,700 acre Thorn Creek Forest Preserve. The Woods are characterized by narrow ridges, deep ravines, broad uplands, shallow depressions, and stream valleys. The predominant species are red oak, white oak, black maple, sugar maple, shagbark hickory, elm, and basswood. Overall, 330 different plant species grow in the Preserve, including sumac, maple-leafed viburnum, witch hazel, nannyberry, blue beech, false indigo, milkweed, and wild bergamot. Numerous animals also reside in these woods, notable are amphibians such as the spotted and blue-spotted salamanders, central newts, green, bull leopard, chorus and tree frogs, and American toads. Birds such as the American goldfinch, chickadee, white-breasted nuthatch, tufted titmouse, great horned owl, screech owl, turkey vultures, Cooper's hawks, and red-tailed hawks also make the Preserve their home.

In addition to official nature preserves, two of the watershed's seventeen golf courses, Olympia Fields Country Club and Flossmoor Country Club, have been designated as certified Audubon Cooperative Sanctuaries. This means that the two courses have made efforts to become more habitable for natural communities. Out-of-play areas are planted with native trees and plants, invasive non-natives are being removed, and a 1.75 acre savanna plot is being re-established at Olympia Fields. These measures will also help to curb erosion and reduce the flow of fertilizers and other chemicals into area waters.

The Forest Preserve District of Cook County has or soon will acquire a number of parcels near the confluence of Thorn Creek and the Little Calumet River. These parcels add acreage to the Thorn Creek Greenway between the Little Calumet and Wampum Lake Forest Preserve. Other acquisitions and plans for acquisitions by the Cook and Will County Forest Preserve Districts are continuing, and this plan and the included maps may not reflect recent acquisitions.

The Governors State University campus, to the south and west of the Thorn Creek Nature Preserve, also contains a few environmentally friendly features including native landscaping and an organic farm.[21]

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[21] *Sources*: Chicago Wilderness website; IDNR CTAP, *Thorn Creek: an Inventory of the Region's Resources* (2000); Jim Phillips, Forest Preserve District of Cook County, personal communication, 2004.

2.8. Trails and Greenways

In 1997, the Northeastern Illinois Planning Commission and the Openlands Project assembled the *Northeastern Illinois Regional Greenways and Trails Plan* for a coordinated network of greenways and trails across the region. The plan recognizes existing open spaces and trails and makes recommendations for new greenways, trail corridors, and linkages. A number of trail systems already exist within the Thorn Creek watershed. The municipalities of Park Forest and University Park have been actively involved in establishing greenways and bike trail systems, and there are a number of trails in the various natural areas and forest preserves. The Sauk Trail Loop circles Sauk Trail Lake, and the Plum Creek to Illinois Central Trail crosses the creek near its headwaters. There are also about 2.5 miles of trail around Owl Lake in the Thorn Creek Woods.

The *Regional Greenways and Trails Plan* would add significantly to this existing system. The focus of the plan is to acquire holdings in areas in order to create or complete connections between preserves, including those in different counties, and to provide generally better access to greenways and trails for communities with a lack of outdoor recreation opportunities. The potential trail and ecological greenway connections for the Thorn Creek area include:

- Extending the Old Plank Road Trail eastward from Will County across southern Cook County to provide a connection to the Thorn Creek greenway system.
- Completing the Cook County sections of the Thorn Creek greenway to create a continuous connection with the Forest Preserve District of Will County's Thorn Creek Holdings as well as to Old Plank Trail Road, the Plum Creek Preserves, and Indiana greenways. Other possible connections would include Governors State University, Markham Prairie, Sand Ridge Prairie, and Wolf Lake.
- Adding to the Forest Preserve District of Will County's holdings in order to provide a continuous greenway along the length of the Thorn Creek in Will County.
- Completion of the 20 mile trail corridor running along the abandoned Penn Central right-of-way to link the Forest Preserve District of Cook County's Thorn Creek greenway to the trails near Joiliet, forming a southern anchor to the entire regional system.

Figure 2-24 (Appendix A) shows existing and proposed greenways within the Thorn Creek watershed. The code references for the greenways appearing on the map are as follows:

- **C91:** Thorn Creek Corridor
- **C93:** Sauk Trail Woods Loop
- **C94:** Sauk Trail Corridor
- **C84:** Old Plank Road Trail
- **C87:** Vincennes Corridor
- **C90:** Lansing Woods Trail
- **C7:** Paul Douglas Trail
- **W52:** Illinois Central Corridor
- **W53:** Thorn Creek
- **W54:** Plum Creek to Illinois Central Corridor

2.9. Flooding, Water Supply, Stormwater Management, and Drainage

2.9.1. TOPOGRAPHY AND FLOODPLAINS

The geography of the Thorn Creek watershed, like that of the entire region, is fairly flat. As a consequence of this topography, floodplains in the area often cover broad expanses. In the past, wetlands and open spaces could effectively absorb storm water as it fell, but as more and more land was developed, infiltration capacity was reduced. Impervious surfaces such as houses, roads, parking lots, and the like do not absorb stormwater. Runoff volume and velocity then increases, causing erosion, overloading streams, and resulting in floods. Development within the floodplains eventually led to a multi-million dollar flood problem in the region.

In the Little Calumet watershed, of which Thorn Creek is a part, 10,800 acres are subject to flooding (Figure 2-2, Appendix A), and an average of 6,866 residences and 142 businesses are damaged by floods annually. Average annual damages due to flooding in the Little Calumet basin total $5,835,000.[22] The Thorn Creek watershed's flooding problem has been especially severe because of its location on the former Lake Chicago plain. The plain is characterized by a smooth landscape with extremely fine-grained sediments. This lack of elevation differentials, in combination with a sediment type that absorbs relatively little water, results in frequent flooding and generally soggy soils that cause problems for construction, roads, and farming. Drainage ditches, storm sewers, and field drains have been installed to prevent flooding in the area, but even moderate rains continue to cause pulses that damage stream banks.[23]

The National Oceanic and Atmospheric Administration's examination of Thorn Creek at THORNTON determined that flooding begins in low lying areas adjacent to the creek at a water level of about 14.5 feet. NOAA also documented the top five historical crests of the creek at that location:[24]

1. 17.06 feet on June 14, 1981
2. 16.87 feet on November 28, 1990
3. 16.24 feet on July 18, 1996
4. 16.0 feet on July 13, 1957
5. 15.95 feet on December 3, 1982

2.9.2. CENTRAL BASIN TUNNEL AND RESERVOIR PROJECT

A multi-billion dollar project is currently underway to address both flooding and waterway pollution in the Chicago area. The Metropolitan Water Reclamation District's Central Basin Tunnel and Reservoir Project (TARP) and Chicago Underflow Plan (CUP) are intended to prevent backflows to Lake Michigan, eliminate pollution caused by combined sewer overflow, and provide an outlet for floodwaters from combined sewer areas. TARP consists of two phases. Phase I is a system of tunnels which will deal largely with pollution control. The system consists of 109 miles of tunnels designed to intercept combined wastewater from overflow points and pump the collected sewage water to treatment plants where it will be treated prior to discharge into area waterways. The project goal is an 85 percent reduction in pollution potential. Phase II is the CUP portion of the plan and consists of reservoirs to assist in urban

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[22] *Source*: Metropolitan Water Reclamation District of Greater Chicago

[23] *Thorn Creek: An Inventory of the Region's Resources* (2000). Illinois Department of Natural Resources, Critical Trends Assessment Program

[24] *Source:* National Weather Service, Advanced Hydrologic Prediction Service. www.crh.noaa.gov

flood control. Because they are primarily flood control devices, the reservoirs are under the authority of the US Army Corps of Engineers with the MWRDGC being the local sponsor.

The southern end of the TARP tunnel system extends into the Thorn Creek watershed with the southernmost component of the overall project being the Thornton Reservoir. Tunnelers started driving through the Little Calumet Leg in February 2003. This is the last section of TARP's first phase, and was estimated to be 30% complete as of August 2004. Contractors broke ground on the eastbound segment of the tunnel in June 2004 and progress on the westbound section began in late August. Project managers have said that the Little Calumet tunnel system should be completed by December 2005. The Thornton Composite Reservoir will provide storage for both the TARP tunnels and the Thorn Creek watershed. The initial phase is the Thornton Transitional Reservoir, which will store overflows from Thorn Creek with a capacity of 9,600 acre-feet. This project will divert more than 80 percent of the 100 year peak discharge of the Thorn Creek, or about 6200 cubic feet per second, into an existing quarry located south of I-80/I-294 between Halsted Street and Indiana Avenue in Thornton. The diverted water will then enter into a connection tunnel which will convey it to a drop shaft and through a deaeration chamber to a division tunnel along I-80/I-294. It will then pass to the West Lobe of the Thornton Quarry, which will act as a storage reservoir during big flood events. The stored water will then be conveyed via the existing Calumet tunnel to the Calumet Water Reclamation Plant. The Thornton Transitional Reservoir is intended only for the detention of stormwater for the purpose of flood control. This Transitional Reservoir will be decommissioned upon completion of the Composite Reservoir. The new reservoir will store 14,600 acre-feet of flood waters collected by TARP within combined sewer areas served by the Calumet TARP tunnel system in addition to the 9,600 acre-feet of Thorn Creek overflows.[25]

2.9.3. STORMWATER MANAGEMENT EFFORTS

The South Suburban Mayors and Managers Association has addressed the issues of flooding and stormwater management by developing the South Suburban Stormwater Strategy. The plan was adopted and published in January 1999 and is a long-term plan aimed at flood mitigation with emphasis on property protection, floodplain regulation, emergency services to minimize flood impacts, wetland and open space protections, structural projects, and public information. Since the adoption of the strategy, the group has drafted a model stormwater and floodplain management ordinance for south suburban municipalities, produced an educational piece entitled "Telling Folks about Floods," and guided a number of open space demonstration projects in the area. The plan, model ordinance, and public information packet are available for review from http://www.ssmma.org/.

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[25] *Thornton Transitional Reservoir Storm Water Management.* Consoer Townsend Envirodyne Engineers, Inc. and the Metropolitan Water Reclamation District of Greater Chicago

2.10. Municipal and Industrial Discharge and Water Use

The land use in a watershed greatly affect the quality of waterbodies and groundwater in an area. Development often means increased pollution and erosion which can significantly damage streams, and contaminants that are released above ground often leech into ground water. Because of this, potential sources of contamination in the watershed should be noted.

2.10.1. TOXIC RELEASE INVENTORY

There are a number of EPA listed Toxic Release Inventory (TRI) Facilities in the watershed (Table 2-26). TRI sites release compounds from manufacturing to the air, land, or water. Lists of the specific chemicals that are being released by each of these facilities can be found at http://oaspub.epa.gov/enviro.

Table 2-26. Toxic Release Inventory Facilities within the Thorn Creek Watershed

TRI ID	Facility Name	Municipality
60411BCNCN2705S	ABC-NACO Inc.	Chicago Heights
60411STNDR10THW	Ace Hardware Corp. Paint Division	Chicago Heights
60411MDWST475EA	Alliance Midwest Tubular Products	Chicago Heights
60411LLBRT400ST	Alpharma Inc.	Chicago Heights
60411BHRPR270ST	Behr Process Corp.	Chicago Heights
60411CLMTS317E1	Calumet Steel Company	Chicago Heights
60411CRVLL3333E	Caravelle Wood Products Inc.	Chicago Heights
60411RXNRD415EA	Chemrex Inc.	Chicago Heights
60411CHCGH211EM	Chicago Heights Steel	Chicago Heights
60411CTDFL500ST	Coated Film Company	Chicago Heights
60411FRDMT1000E	Ford Motor Company Stamping Plant	Chicago Heights
60411CLMBL400EA	IMCO Recycling of Illinois	Chicago Heights
60411WNSLL12THA	Kimble Glass Inc.	Chicago Heights
60411CRGLL374EJ	McWhorter Technologies Inc.	Chicago Heights
60411BCRLC11THW	Meridian Rail Tracks Products Corp.	Chicago Heights
60411PCCHM400E1	Pico Chemical Corp.	Chicago Heights
60411CMBST333ST	Premier Refractories and Chemicals Inc.	Chicago Heights
60411STFFR11THA	Rhodia Inc.	Chicago Heights
60411RVRDL220EA	Riverdale Chemical Company	Chicago Heights
60411DSTNC300ST	Rohm & Haas Company	Chicago Heights
60411THRLL26THS	Thrall Car Manufacturing Company	Chicago Heights
60411TRLCN900E1	Trialco Inc.	Chicago Heights
60411TRNTY2705S	Trinity Industries Inc. Plant 70	Chicago Heights
60411NTDGL1001S	United Globe Nippon Inc.	Chicago Heights
60466LCLBS2545P	Elco Laboratories Inc.	University Park
60466FDRLS2645F	Federal Signal Corp.	University Park
60466HXCNB1175C	Hexacomb Corp.	University Park
60466HYDRT2545B	Hydrite Chemical Company	University Park
60466MCNTY1000G	McIntyre Group Limited	University Park
60466THNTR2600B	Takasago International Corp.	University Park
60425DBRCH333W1	Dober Chemical Corp.	Glenwood
60425RLLSR19421	Roll Services Inc.	Glenwood
60473CCRTC15530	Accurate Dispersions	South Holland
60473BLLPC300WE	Bell Packaging Corp.	South Holland
60473CRLBD50WTA	Carl Buddig and Company	South Holland
60473JLPRS16750	DeSoto Inc.	South Holland

TRI ID	Facility Name	Municipality
60473MCWHR192W1	Eastman Chemicals	South Holland
60473GBRLT114E1	Gibraltar Chemical Works Inc.	South Holland
60473GRTLR15475	Gurtler Chemical Inc.	South Holland
60473PRSCT27EIG	Prescott Company	South Holland
60473RLLSR17025	Roll Services Inc.	South Holland
60473STHHL15600	South Holland Food Processors	South Holland
60473STHHL143W1	South Holland Metal Finishing	South Holland
60473WRLDG530W1	World Generator Company	South Holland

Source: EPA Envirofacts website, oaspub.epa.gov/enviro.

2.10.2. NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

The National Pollutant Discharge Elimination System (NPDES) is administered by the Illinois EPA under the Federal Clean Water Act. NPDES permits regulate wastewater in order to reduce pollutants released into water bodies. A permit is required for any entity discharging wastewater that is generated from any process and can include solid, liquid, or gaseous wastes that might cause pollution or violation of water quality standards. There have been two phases in the implementation of the program. The U.S. Environmental Protection Agency developed Phase I of the NPDES Storm Water Program in 1990. The Phase I program addressed sources of storm water runoff that had the greatest potential to negatively impact water quality. Under Phase I, NPDES permit coverage was required for storm water discharges from most industrial activity and from municipal storm sewer systems located in incorporated places or counties with populations of 100,000 or more. The Phase II Final Rule, published in the Federal Register on December 8, 1999, requires NPDES permit coverage for storm water discharges from certain regulated small municipal storm sewer systems (MS4s) and from construction activity disturbing between 1 and 5 acres of land. Table 2-27 provides a listing of the sites with NPDES permits that are identified by the EPA as discharging into Thorn Creek. These sites are shown in Figure 2-21.

Table 2-27. NPDES Permits Granted to Facilities within the Thorn Creek watershed

NPDES ID	Facility Name	Municipality	Current NPDES Permit?	Parameters / Notes
ILR102381	Georgia Pacific Triad Facility	University Park	n/a	n/a
IL0024473	Consumers Illinois Water	University Park	Yes	BOD, pH, TSS, Oil & Grease; N; Cn (total); Cl; SO4; F; As; Ba; Cd; Cr (hexavalent & total); Cu; Fe (total & dissolved); Pb; Mn; Ni; Ag; Zn; Phenolics; flow; TDS; Hg; Fecal Coliform; Cyanide, Weak Acid, Dissociable
IL0047562	Park Forest Excess Flow Facility	Park Forest	No	BOD; pH; TSS; Cl; Fecal Coliform; Flow; As in bottom deposits; Se in bottom deposits; Cu, Total Sludge; Cd, Sludge (disposed by other method, incinerated, land applied, disposed, in landfill, transported in state, produced); Mo, Sludge; Zn Sludge; Pb Sludge; Ni Sludge; Hg Sludge
IL0054291	Village of Park Forest	Park Forest	Yes	pH; TSS; Fe; Flow; Cl; TDS
IL0034584	Gallagher Asphalt Corporation	Thornton	No	pH; TSS; Oil & Grease; Flow

NPDES ID	Facility Name	Municipality	Current NPDES Permit?	Parameters / Notes
IL0001937	Material Service Corporation	Thornton	No	pH; TSS; Oil & Grease; Flow
IL0059421	Alliance Midwest Tubular Products	Chicago Heights	Yes	pH; TSS; Oil & Grease; Flow Discharges to Thorn Creek Basin Sanitary District
ILR001145	Bull Moose Tube Company	Chicago Heights	n/a	Discharges to Thorn Creek Basin Sanitary District
ILR000196	Calumet Steel Company	Chicago Heights	n/a	n/a
ILR000191	Chemrex Incorporated	Chicago Heights	n/a	Discharges to Thorn Creek Basin Sanitary District
IL0001678	Chicago Heights Steel	Chicago Heights	No	Temp; BOD; pH; TSS; Fe; Flow
ILG250153	Coated Film Company	Chicago Heights	No	Temp; Flow; Cl Discharges to Thorn Creek Basin Sanitary District
ILR001003	Funk Forging Company	Chicago Heights	n/a	n/a Discharges to Thorn Creek Basin Sanitary District
IL0033987	Kimble Glass Incorporated	Chicago Heights	No	pH; TSS; Oil & Grease; Flow Discharges to Thorn Creek Basin Sanitary District
ILR000129	McWhorter Technologies Inc.	Chicago Heights	n/a	n/a
IL0035220	Rhodia Incorporated	Chicago Heights	No	Temp; BOD ; pH; TSS; N; P; C (organic); F; Cd; Cr; Cu; Fe; Pb; Mn, Ni; Zn; Oil & Grease; Flow; TDS; Hg; Chemical Oxygen Demand
IL0027723	Thorn Creek Sanitary Basin[26]	Chicago Heights	No	BOD; TSS; pH; Ammonia N; Flow; Cl; TDS; Fecal Coliform; As in bottom deposits; Se in bottom deposits; Cu Total Sludge; Cd Total Sludge; Sludge (disposed by other method, incinerated, produced, land applied, disposed in landfill, transported interstate); Mo Sludge.; Zn Sludge; Pb Sludge; Ni Sludge; Hg Sludge; Cr Sludge
ILR001151	United Globe Nippon Incorporated	Chicago Heights	n/a	n/a Discharges to Thorn Creek Basin Sanitary District

Source: EPA Envirofacts website, oaspub.epa.gov/enviro.

2.10.3. WATER USE

Municipalities, companies, and domestic users in the Thorn Creek watershed withdraw a total of 294.3 million gallons of water per day (MGD). While most of this water comes from Lake Michigan, groundwater use is not negligible. About 12.4 percent of the total withdrawals in the watershed are from

[26] Two facility-related surveys were conducted by the IEPA concerning the effect of the Thorn Creek Basin Sanitary District Plant on the creek. Completed in 1983 and 1988, these studies examined macroinvertebrate populations, water quality, and habitat conditions at several locations upstream and downstream from the sewage treatment plant. These documents are available for review.

groundwater and just over 5 percent of the publicly supplied population is served by groundwater. Anecdotal evidence suggests that a previously discovered cone of groundwater depression in Chicago Heights disappeared when the village switched from groundwater to Lake Michigan water in 2003. Power supply, industrial, domestic, and commercial uses account for much of the total water use, with much smaller quantities being used for mining and various agricultural purposes. Table 2-28 summarizes data on 1990 water use in the Thorn Creek watershed (data compiled by the U.S. Geological Survey).

Table 2-28. 1990 Water Use within the Thorn Creek Watershed

	Totals	Unit
Groundwater withdrawals	36.33	MGD
Surface water withdrawals	257.07	MGD
Total withdrawals	293.4	MGD
Reclaimed wastewater	0	MGD
Consumptive use, total	56.53	MGD
Conveyance losses	0	MGD
Public Supply		
Population served by groundwater	128.37	Thousands
Population served by surface water	2406.53	Thousands
Total population served	2534.9	Thousands
Groundwater withdrawals	12.07	MGD
Surface water withdrawals	0	MGD
Total withdrawals	12.07	MGD
Water deliveries, public use and losses	-415.24	MGD
Water deliveries, total	427.31	MGD
Per-capita use	4.76	gal/day
Number of facilities	70	
Commercial		
Groundwater withdrawals	0.26	MGD
Surface water withdrawals	7.3	MGD
Total withdrawals	7.56	MGD
Deliveries from public suppliers	122.99	MGD
Total withdrawals plus deliveries	130.55	MGD
Consumptive use, total	11.04	MGD
Domestic		
Self-supplied population	33.92	Thousands
Self-supplied groundwater withdrawals	2.86	MGD
Self-supplied surface water withdrawals	0	MGD
Total self-supplied withdrawals	2.86	MGD
Per-capita use, self supplied	84.32	gal/day
Public-supplied populations	2534.9	Thousands
Deliveries from public suppliers	234.88	MGD
Per-capita use, public-supplied	92.66	gal/day
Total withdrawals plus deliveries	237.74	MGD
Consumptive use, total	24.43	MGD
Industrial		
Self supplied groundwater withdrawals	18.77	MGD
Self supplied surface water withdrawals	48.14	MGD
Total self-supplied withdrawals	67.91	MGD
Reclaimed wastewater	0	MGD
Deliveries from public suppliers	69.25	MGD

	Totals	Unit
Total withdrawals plus deliveries	137.16	MGD
Consumptive use, total	16.93	MGD
Number of facilities	57	
Total Thermoelectric Power Use[27]		
Groundwater withdrawals	0	MGD
Surfacewater withdrawals	200.34	MGD
Total withdrawals	200.34	MGD
Deliveries from public suppliers	0.19	MGD
Total withdrawals plus deliveries	200.53	MGD
Consumptive use, total	2	MGD
Power generation	398.75	Gwatt hrs/year
Number of facilities	1	
Mining Use		
Groundwater withdrawals	0.03	MGD
Surfacewater withdrawals	0.28	MGD
Total withdrawals	0.31	MGD
Consumptive use, total	0.05	MGD
Livestock Use		
Total withdrawals, groundwater	0.06	MGD
Total withdrawals, surfacewater	0.01	MGD
Total withdrawals	0.07	MGD
Consumptive use, total	0.07	MGD
Irrigation Use		
Groundwater withdrawals	2.28	MGD
Surfacewater withdrawals	0	MGD
Reclaimed wastewater	0	MGD
Irrigated land, sprayed	9.24	thousand acres
Irrigated land, flooded	0	thousand acres
Irrigated land, total	9.24	thousand acres
Conveyance loss	0	MGD
Consumptive use, total	2.01	MGD
Wastewater Treatment		
Number of public wastewater facilities	13	
Number of other facilities	17	
Number of wastewater facilities total	30	
Returns by public wastewater facilities	622.68	MGD
Reclaimed wastewater released by public wastewater facilities	0	MGD

Source: USGS, water.usgs.gov/cgi-bin/wuhuc?huc=07120003

In September 2002, the Northeastern Illinois Planning Commission (NIPC) adopted its *Strategic Plan for Water Resource Management*. The plan addressed a number of issues involving water quality, flooding, and water supply in the region. Their examination of water usage in northeastern Illinois indicated that despite the proximity of one of the largest supplies of freshwater in the world, Lake Michigan, water supply is still a concern for the area. Continued population growth is accompanied by an increase in the demand for water in the region. NIPC conducted a 2020 water demand and availability analysis by township based on projections for population, economic activity, and consumptive use by source. The overall conclusion of the analysis was that there will be a significant increase in water demand between

[27] All thermoelectric power use is from fossil fuels.

now and the year 2020, and that while some areas will continue to have a surplus, there is potential for water shortages in a number of areas. Table 2-29 provides NIPC's projections for non-cooling water demand as well as the adequacy of the supply for the townships in the Thorn Creek watershed in 2020.

Table 2-29. Projected 2020 Non-Cooling Water Demand by Township

Township / County	Projected 2020 Demand (MGD)	Relative Supply Assessment
Orland / Cook	16.06	Expected Surplus
Bremen / Cook	15.80	Expected Surplus
Thornton / Cook	28.11	Adequate
Rich / Cook	13.23	Potential Shortage
Bloom / Cook	16.62	Adequate
Monee / Will	5.70	Expected Surplus
Crete / Will	4.95	Adequate

Source: Strategic Plan for Water Resource Management, Northeastern Illinois Planning Commission, 2002.

2.11. Socio-Economic and Human Resources

Table 2-30 shows the Census Bureau's 2000 populations for each of the municipalities through which Thorn Creek runs, along with the number of households, the number of residents that are employed, and (in parentheses) the percent of the labor force that is employed. Next to these are the Northeastern Illinois Planning Commission's forecasts for population, households, and employment in the year 2030. In addition to the municipalities and townships noted above, the Thorn Creek watershed is also within United States Congressional District 2 and runs through Illinois House Districts 79 and 29.

Table 2-30. Demographic Projections for Municipalities in the Thorn Creek Watershed

	Population		Households		Employment		
Municipality	**2000**	**2030**	**2000**	**2030**	**2000**		**2030**
					Number	Percent employed	Number
University Park	6,662	34,571	2,253	11,459	6,170	93.8%	13,854
Park Forest	23,462	26,246	9,138	10,359	3,806	94.7%	5,939
South Chicago Heights	3,970	4,602	1,570	1,835	2,289	94.3%	3,655
Chicago Heights	32,776	36,282	10,703	12,769	14,636	88.9%	18,504
Glenwood	9,000	11,367	3,373	4,232	3,014	95.8%	9,232
Thornton	2,582	2,466	1,008	1,030	1,895	96.9%	2,670
South Holland	22,147	23,353	7,663	8,405	14,426	94.0%	17,671

2.12. Past, Ongoing, and Proposed Watershed Projects

There are a number of active organizations in the Thorn Creek watershed that are working to improve environmental quality in the basin. Some of the organizations and projects are highlighted below.

- In 2001, the South Suburban Mayors and Managers Association produced the South Suburban Stormwater Strategy, a plan to help reduce the destructive forces of floods by fostering intergovernmental action that leads to coordinated and cooperative watershed management. The plan is a framework for watershed projects that balances economic, environmental and social goals. It provides an overview of the project's mission with objectives and timeframe, watershed geography with maps, and specific stormwater management problems. Six strategies are developed that address the challenges of undertaking stormwater management in a comprehensive way. The stakeholders formed six workgroups that developed 36 major recommendations focusing on the following strategies: preventive measures, natural resource protection, structural projects, property protection, emergency management, and public information. These recommendations cover both short-term and long-term activities that new watershed committees and implementing agencies can work from as a blueprint.
- Classes from school districts 153, 161, 163, and 162 are participating in restoration projects under the guidance of the Irons Oaks Environmental Learning Center in Olympia Fields. This program, which is now two years old, involves both on-site as well as outreach programs in an effort to involve and educate teachers and students about wetlands and watersheds. For details on this program, see www.ironsoaks.com.
- The Central Park Wetland Restoration Project in Park Forest has been underway since early 2000. This forty-five acre wetland site was drained in the in the early 1960s and is now being returned to its natural hydrology. The project has been supported by a variety of funding sources and employs volunteers for maintenance and restoration. Wetland species have begun to return to the area, and continued inventories will monitor the site's progress. For more information on this project, see www.backtowetlands.com.
- The Orland Park Watershed Improvement Project restores between 2,000 and 5,000 feet of shoreline per year. While there have been some problems convincing the public of the benefits of the project, the restoration of the banks has led to decreased erosion, reduced flooding hazards, and enhanced natural communities.
- There are currently two Illinois Environmental Protection Agency Green Community projects in the watershed — one in Chicago Heights/South Chicago Heights and one in Monee. Green Community projects support community visioning for a number of environmental topics, including clean air and water, energy efficiency, waste reduction, natural areas protection and restoration, green space development, renewable energy, compatible growth, and environmental education. The aim of these projects is a set of long-term goals and an action plan for achieving the desired environmental vision.
- The Center for Neighborhood Technology created the Southland Watershed Protection Project under a Conservation 2000 grant in early 2002. The focus of this group has been to evaluate political actors, both state and local, in a number of different categories concerning stewardship in the Deer Creek watershed. The group plans to publish a report card rating these governmental units.
- The Thorn Creek Ecosystem Partnership was formed in 1997 as part of the IDNR's Conservation 2000 program to protect the area's natural resources. The group consists of a number of different member organizations and has overseen the distribution of over half a million dollars in grants

for the improvement of ecosystem conditions. In November 2002, the Technical Committee of the Thorn Creek Ecosystem Partnership established a list of priorities for the watershed. The two initial priorities that were identified were protecting the headwaters of Thorn Creek and the Creek's mid-reaches in the Chicago Heights area. In December 2000, part one of a watershed plan for Thorn Creek was developed by the Thorn Creek Ecosystem Partnership. This publication identifies the major concerns regarding the health of the watershed and a list of goals, objectives, and strategies.

- The mission of the Volunteer based Thorn Creek Restoration Coalition is to provide a viable and accessible multi-use waterway. The Coalition functions through inter-related restoration projects organized with technical support/services of oversight and allied advisory agencies.
- In 2004, the South Suburban Mayors and Managers Association and Openlands Project produced the South Suburban Calumet Area Open Space Initiative.

3. WATER QUALITY ASSESSMENT CONCLUSIONS AND RECOMMENDATIONS

3.1. General Conclusions and Recommendations

The water quality assessment was presented to and discussed with the Water Quality Subcommittee of the Technical Advisory Committee (TAC). Two overall recommendations were made. First, more detailed monitoring, localized sampling, and stream surveys are necessary to establish baseline conditions and monitor stream health. Second, prevention is key to maintaining the integrity of Thorn Creek, especially in protecting undeveloped portions of the watershed, the headwaters and the remaining associated wetland complexes, and the stream corridor itself. Ordinances that manage development practices, protect sensitive soils and natural features, and require the use of best management practices (BMPs) should be adopted and enforced by all entities making development decisions.

3.1.1. KEY WATER QUALITY CONSTITUENTS

The results of the water quality assessments performed by the Northeastern Illinois Planning Commission and the Illinois Environmental Protection Agency that were presented in Section 2.4.3 were also reviewed by the TAC. Based on those findings, the TAC then came to a consensus on the key water quality constituents in the Thorn Creek watershed most in need of attention. Fecal coliform and low dissolved oxygen emerged as the most significant threats to ecosystem health, followed by hydrologic modification, dumping and debris, and finally road salt runoff, which the TAC felt needed more investigation in order to assess its impact. The specific water quality conclusions and recommendations in Section 3.2 below are presented in this order of priority. Finally, each of the key water quality constituents have Watershed Management Recommendations (WMRs) associated with them, practices meant to correct the identified water quality impairments. These WMRs are discussed in more detail in the Watershed Improvement Plan in Section 4.2.

3.1.2. RELATIONSHIP OF WATER QUALITY ASSESSMENT CONCLUSIONS AND RECOMMENDATIONS TO WATERSHED RESOURCE INVENTORY

It is important to note that the water quality assessment conclusions and recommendations in this section deal with issues narrower than those in the Watershed Resource Inventory (Section 2). For example, only the levels of physical–chemical water quality constituents relative to Illinois Pollution Control Board standards are discussed here, as opposed to broader indicators of habitat quality such as species abundance and diversity.

3.2. Specific Water Quality Conclusions and Recommendations

3.2.1. PATHOGENIC CONTAMINATION

Fecal coliform is used to indicate the potential presence of pathogenic organisms in water, which are primarily a concern due to their harmful effects on human health. High fecal coliform concentrations throughout the stream course are causing impairment and should be addressed in all subbasins. Sources may include urban runoff; sanitary sewer overflows or aging infrastructure (leakage, and/or failure of connections, lift stations, etc.); illicit connections of sanitary sewers or other waste discharge pipes to storm sewers; and animal waste including pets, horses, manure application, and urban wildlife (geese, other birds, raccoons, deer). Failing septic systems, horses and livestock operations, and landfills were determined to be absent or unlikely causes of fecal contamination in the Thorn Creek watershed. No known combined sewer overflows discharge to Thorn Creek.

The locations of fecal coliform sources for Thorn Creek are not known with the level of specificity necessary to implicate one or another subbasin or critical area. The fecal coliform contamination problem exists throughout the stream course, indicating that either there are multiple sources of fecal coliform along the stream course or that concentrations are not becoming diluted with movement downstream. Thus, fecal contamination cannot be attributed to certain categories of land use predominant in the different basins. Fecal coliform also may be able to reproduce in the stream, further complicating identification of specific sources and locations.

Additional sampling and monitoring along the stream and tributaries, especially in subbasins 100 and 200 (shown in Figure 2-13 on page 2-16), and at stormsewer outfalls and other point sources (WMR 8) should be prioritized to obtain better, more specific data regarding the location and potential source of fecal coliform contamination. This monitoring step should be initiated by first conducting a detailed screening of the watershed to identify potential significant sources of animal waste that may be the sources of fecal contamination, such as agricultural application of manure fertilizers. Additionally, testing for human pathogens should be conducted to determine whether animal wastes or sanitary sewers are the source of fecal coliform contamination. If no “smoking guns” are identified as contributors, implementing WMRs 1, 2, 4, 8, 11, 13, 14, 15, 16, 17, 18, 20, 28, 29, and 32 watershed-wide can help reduce fecal coliform contamination. However, the total pollutant load reductions expected from implementing all of these recommendations are difficult to estimate.

Table 3-1. Reductions Needed to Meet Fecal Coliform Target

Subbasin	Average FC concentration per 100 mL rounded to nearest 100	Target concentration	Percentage reduction needed to meet target
100	3,100	200	94
200+300	NA	200	NA
400+500	6,600	200	97
600	6,800	200	97
700	3,400	200	94
800+900	3,800	200	95

Reducing fecal coliform levels to the Illinois standard of 200 per 100 mL will help Thorn Creek meet the general use standards. Meeting the designated use requires the percentage reductions shown in Table 3-1. Due to the urban character of the watershed, full support may not be an attainable condition for this stream. Reducing fecal coliform levels by the percentages given in Table 3-1 may not be realistically attainable in this watershed.

3.2.2. ORGANIC ENRICHMENT / LOW DISSOLVED OXYGEN

Dissolved oxygen (DO) in water is necessary for aquatic organisms to survive. Dissolved oxygen levels below the Illinois standard of 5.0 mg/L are believed to impair aquatic life; levels above this standard are considered desirable. Low DO levels are likely impairing upstream reaches (subbasins 100 and 200; see Figure 2-16 for map) and should be addressed. Low DO levels do not appear to be a problem in lower reaches, possibly due to a stream gradient adequate to aerate the water sufficiently to improve low DO levels occurring upstream. The wastewater treatment plant discharge, which averages 7.47 mg/L of DO and has a low biological oxygen demand (BOD), is improving the oxygenation condition of the stream for aquatic life in lower reaches.

The sources of low DO for Thorn Creek are difficult to identify with certainty, but the condition is related to the summer and autumn months, when low flow, high temperature, and the presence of fecal coliform are all observed. The water quality analysis did not specifically identify high BOD as a cause of low DO, though an association with bacterial contamination may exist. The water quality assessment only examined BOD in the water column, although it may be that high BOD in sediments may contribute to low DO in the water column. Furthermore, BOD can contribute to the depression of DO levels even at lower concentrations. It is also possible that low DO is a natural condition for the upper reaches of the stream. For instance, influx of groundwater with low DO could be causing the low DO condition in the stream.

Since fecal coliform and low DO may be related, finding and removing the source of pathogenic bacteria may improve conditions with respect to dissolved oxygen. As with fecal coliform, sources may include urban runoff, sanitary sewer overflows or aging infrastructure (leakage, and/or failure of connections, lift stations, etc.), illicit connections of sanitary sewers or other waste discharge pipes to storm sewers, and animal waste including pets, horses, manure application, and urban wildlife (geese, other birds, raccoons, deer). More sampling and monitoring are especially necessary in subbasins 100 and 200 to specifically identify the location of low DO inputs (e.g., tributaries, outfalls) and thereby begin to identify sources.

According to the land use pollutant loading assessment, land uses that are likely contributors to DO problems typically include commercial, industrial, institutional, multi-family, and transportation, and — to a lesser degree — residential. However, due to abundance, residential and commercial land uses contribute by far the greatest amounts of BOD, and should be targeted for WMR implementation should no specific source of DO impairment be found. It is interesting to note that subbasins 100 and 200, which contain little of these land uses, are the subbasins experiencing problems with DO. As mentioned above, it is possible that the DO situation is not attributable to land use at all, but is instead a natural stream condition or more closely related to fecal coliform levels and a related source of organic enrichment.

Increasing the May to November DO levels in subbasins 100 and 200 to consistently meet the Illinois standard of 5.0 mg/L will help Thorn Creek meet the general use standards. Average DO levels for these months are between 3.5 mg/L and 4.5 mg/L. Meeting the designated use requires a percentage increase of approximately 10 percent in May, June, and November, and approximately 40 percent in July, August, and September in subbasins 100 and 200.

WMRs 1, 2, 4, 8, 11, 13, 14, 15, 16, 17, 18, 20, 22, 28, 29, and 32 can help improve DO concentrations. The total pollutant load reductions expected from implementing these recommendations are difficult to estimate, but any increase in DO levels will be beneficial. If all of the recommendations listed above are implemented, the necessary increases may be achievable. However, as already mentioned, low DO may be a natural condition for these stream reaches and improvement may not be attainable. If the impairment is related to fecal coliform concentrations leading to oxygen consumption in the water column, improving the DO condition may depend on addressing fecal coliform loading first. Additional monitoring along the stream, along major and minor tributaries, and at stormsewer outfalls and other point sources should be prioritized to obtain better, more specific data regarding the location and potential source of low dissolved oxygen. Recommendations for addressing low DO are similar to those for fecal coliform.

3.2.3. HYDROLOGIC DISTURBANCE / FLOW ALTERATIONS

The increased volume of flow during storm events in the Thorn Creek watershed is due primarily to hydrologic modification of the stream and tributaries and to land use change throughout the watershed. This is an impairment that should be addressed. Sources include urban development and runoff in all subbasins. The lack of an Illinois standard for hydrologic disturbance precludes the establishment of target reductions for attaining stream use designations.

Developed and agricultural land use types are typically responsible for most hydrologic disturbance, and these land uses should be prioritized for watershed management recommendation and best management practice implementation. Undeveloped, unmodified lands also should be prioritized for protection to prevent further alteration of the hydrology of the watershed.

WMRs 1, 3, 4, 5, 8, 10, 13, 14, 15, 16, 26, 27, and 28 can help reduce the impact of hydrologic disturbance. The improvement expected from implementing these recommendations is difficult to estimate without a comprehensive hydrologic model of the watershed (WMR 9).

3.2.4. DUMPING AND DEBRIS

While not identified in the water quality assessment itself, fly dumping and debris in the stream were identified by stakeholders as an impairment needing attention. Specific locations, subbasins, or land use types were not identified. The presence of any litter or garbage in the stream is a water quality violation according to the State of Illinois. Thus, this must be reduced 100 percent to meet the water quality standard. Lack of enforcement of anti-dumping laws was identified as the primary source of the impairment. Due to the urbanized nature of much of the watershed it is doubtful that trash and debris can be reduced by 100 percent, even with the enforcement of anti-dumping laws and stream clean-ups. However, more frequent stream clean-ups bring additional benefits such as education and resident involvement. WMRs 8, 26, 27, and 30 can help reduce the presence of trash and debris in the stream.

3.2.5. AQUATIC LIFE TOXICITY (TOTAL DISSOLVED SOLIDS, CHLORIDES, AND SULFATES)

Total dissolved solids (TDS) include substances such as chlorides from road salt that are carried in the water column. A variety of constituents, both harmful and benign, fall within the TDS category, making it difficult to assess the real impact on aquatic resources and uses. The assessment revealed elevated levels of TDS and sulfates throughout the majority of the stream course. However, the IEPA has twice adjusted concentration standards upwards for Thorn Creek, putting the elevated levels within the permitted range. Sources may include urban runoff, road salt storage and application, and point discharges or illicit stormsewer connections. These constituents are not being identified as impairments in Thorn Creek, and thus target reductions have not been established. However, concentrations and stream conditions should be closely monitored to identify adverse effects of these constituents on stream health. More frequent and detailed monitoring for chlorides throughout the year may help determine the nature of impairment due to salinity and salting of roadways for winter ice and snow control.

The sources of TDS are not known with a level of specificity necessary to implicate one or another subbasin or critical area; the TDS contamination problem exists throughout the stream course. Clearly the Rhodia silica plant that came online in 1995 is a source of flow to the Thorn Creek Basin Sanitary District plant, but there does not appear to be an increase in the average TDS concentration below the TCBSD plant as compared to sampling stations immediately upstream of the plant, indicating that the silica discharge is not responsible for the overall increase in TDS levels over time. While not a strong trend, there does appear to be a cyclical monthly pattern in TDS levels, with slightly higher concentrations in winter months and lower concentrations in summer months. This would support the generally-held understanding that TDS levels increase in winter months due to road salt application for snow and ice control. Average TDS concentrations in subbasin 100, which has lower development density and fewer roads needing snow and ice control, are approximately half that of downstream subbasins, indicating that salt application may be a cause of high TDS levels. Since TDS levels fall within revised standard limits set by the IEPA, TDS is not an impairment needing immediate attention. However, watershed management recommendations are made to address aquatic life toxicity, which includes TDS and other components. More frequent and detailed monitoring for chlorides throughout the year may help corroborate this conclusion and begin to isolate TDS constituents needing attention.

According to the land use pollutant loading assessment, land uses that are likely contributors to TDS typically include transportation, commercial, industrial, and vacant land and wetlands. When accounting for the amounts of these land uses, the greatest contributors to TDS are transportation, vacant and wetlands, commercial, residential, and open space. These should be targeted as the priority land uses requiring watershed management recommendation and best management practice implementation if no specific if TDS is determined to be an impairment at some future time.

Although the Illinois Pollution Control Board and the Illinois EPA found that "granting the adjusted standard for sulfate and TDS would have no measurable adverse effect on aquatic life in Thorn Creek and the Little Calumet River,"[1] sulfate concentrations show an increasing trend over time for most sampling points, and may become an issue in the future should this trend continue. The average concentration of sulfate increases from upstream to downstream and remains high in downstream reaches. The Rhodia silica operation is a likely source of sulfate. Due to the revised IEPA water quality standards for sulfate, sulfate is not considered an impairment of Thorn Creek, but monitoring of sulfate concentrations should be continued.

WMRs 1, 2, 4, 8, 11, 13, 14, 15, 16, 17, 28, 30, and 32 can help reduce aquatic life toxicity contamination. The pollutant load reductions expected from implementing these recommendations are difficult to estimate, and significant reductions are unlikely due to point source discharge containing these constituents. However, significant reductions should be able to be achieved if all of the recommendations are implemented. Additional monitoring along the stream, along major and minor tributaries, and at stormsewer outfalls and other point sources (WMR 8) should be prioritized to obtain better, more specific data regarding the location and potential sources of contamination.

[1] Case AS 2001-09.

3.2.6. NUTRIENTS AND ALGAL GROWTH

3.2.6.1. Phosphorus

Phosphorus is often the limiting nutrient for controlling vegetative growth in aquatic systems. Too much phosphorus can cause high growth of algae, which, during nighttime respiration and upon death and decomposition, can lower dissolved oxygen concentrations and thereby impair aquatic life. High phosphorus loading is likely impairing the stream throughout its course and should be addressed, though the level of impairment is difficult to quantify due to the lack of a state standard that indicates the potential for algal growth. However, the Illinois Water Quality Report 2004 provides a guideline of 0.61 mg/L of total phosphorus in streams for identifying a potential cause of impairment to aquatic life use.

Urban runoff, point source discharges, illicit storm sewer connections, and agricultural activity are likely sources of phosphorus loading. The highest phosphorus concentrations occur at and below the Thorn Creek Basin Sanitary District discharge, indicating that this point source is likely the primary source of impairment (Table 3-2). However, reducing loading at and below the District, which is operating within permitted limits established by the Illinois Environmental Protection Agency, may be an unreasonable expectation due to the presence of the Rhodia silica plant phosphorus discharge to the facility.

Table 3-2. Reductions Needed to Meet Phosphorus Target

Subbasin	Average P concentration (mg/L)	Target concentration	Percentage reduction needed to meet target
100	NA	0.61	NA
200+300	1.15	0.61	96
400+500	0.23	0.61	74
600	4.04	0.61	99
700	3.34	0.61	99
800+900	2.38	0.61	98

Since no Illinois standard exists for phosphorus concentrations in streams, setting reduction targets is difficult. Even if all non-point sources of phosphorus could be eliminated, the major contribution of phosphorus from the sanitary plant would remain. Furthermore, though some filamentous algae has been reported in the creek, whether this is problematic for the creek is unclear. Thus, prioritizing non-point source phosphorus reduction may not be the highest and best use of resources for controlling nonpoint source pollution in Thorn Creek. Nonetheless, should this issue become a priority, recommendations to reduce non-point source phosphorus loading are made below.

3.2.6.2. Nitrogen

High ammonia–nitrogen loading is likely impairing the stream throughout its course and should be addressed. Sources may include urban runoff, including pet and wildlife waste, point source discharge, illicit storm sewer connections, and agricultural activity. As with phosphorus, the Thorn Creek Basin Sanitary District is a likely source of nitrogen that cannot be addressed by setting nonpoint source reduction targets. Nonetheless, recommendations to reduce nonpoint source ammonia–nitrogen loading are made in Table 3-3 below.

Table 3-3. Reductions Needed to Meet Nitrogen Target

Subbasin	Average NH_3-N concentration (mg/L)	Target concentration (summer/winter)	Percentage reduction needed to meet target
100	0.21	0.33/0.14	0/33
200+300	0.04	0.33/0.14	0/0
400+500	0.37	0.33/0.14	11/62
600	0.34	0.33/0.14	3/60
700	0.52	0.33/0.14	37/73
800+900	NA	0.33/0.14	NA

3.2.6.3. Recommendations for Addressing Nutrients

According to NIPC's land use pollutant loading assessment, land uses that are likely contributors to phosphorus typically include transportation, industrial, institutional, multi-family, and commercial. However, due to its abundance, residential land use is by far the greatest land use contributor of phosphorus and should be targeted as the priority of land uses requiring watershed management recommendation and best management practice implementation if no specific "smoking gun" source can be located. For ammonia–nitrogen, the contributing land uses include commercial, industrial, transportation, institutional, and multi-family, but, again, residential is the primary contributing land use due to abundance, followed by commercial, agricultural, and industrial. These last four should be targeted as priority land uses for remediation should no specific source be identified.

While both of these nutrients can lead to algal blooms and associated impairments, the presence of such blooms has not been identified as a problem. However, the forested and shaded nature of the stream may be preventing sunlight from reaching the water in most locations, which would also prevent algae from blooming. Considering the presettlement forested condition of the stream corridor and the potential for greater impairment should the forest shade be removed, natural area managers should endeavor to maintain the forested nature of the corridor.

WMRs 1, 2, 4, 8, 11, 13, 14, 15, 16, 17, 18, 20, 22, 28, 29, 32, and 33 can help reduce phosphorus and nitrogen contamination. Due to the presence of a significant point source, the pollutant load reductions expected from implementing these recommendations can likely only address a fraction of the phosphorus load and nitrogen load. Should the state's requirements for wastewater treatment become more restrictive, resulting in a decrease of the point source nutrient load, then implementation of these measures for nonpoint source nutrient reduction may become a higher priority. [2]

[2] *Sources: Illinois EPA Water Quality Report* 2000, 2002, and 2004; Illinois DNR Critical Trends Assessment Program, Thorn Creek Area Assessment, 1999; NIPC assessment of data from Thorn Creek Basin Sanitary District and Metropolitan Water Reclamation District; *Thorn Creek Steam Inventory and Opportunity Assessment*, Eubanks and Associates, Inc., 2002; Illinois EPA Storet, Station IDs MWRDSTOR - WW97 and WW54 at www.epa.gov/storet/dw_home.html.

4. THORN CREEK WATERSHED IMPROVEMENT PLAN

4.1. Watershed Management Recommendations

A broad range of potential watershed management practices can help protect and restore urban watersheds. These practices must be reviewed for applicability to the Thorn Creek watershed and the identified watershed planning goals. A number of resource-based goals were identified, including protection of habitat, reduction of flooding, improvement of recreational resources, and protection of water quality. Appropriate watershed management practices must be recommended based on the identified causes and sources that led to a particular use impairment. It is important that recommended practices be tailored to the specific conditions, needs, and priorities of the watershed. Once relevant practices have been identified and agreed upon, they can be prioritized and developed into an action plan for the Thorn Creek watershed.

In addition to resource-based concerns, stakeholders identified coordination, regulation, leadership, monitoring, and public involvement as additional goals. Objectives and actions addressing these priorities will enhance the achievement of the natural resource, water quality, and flood mitigation goals.

This section identifies 45 general management practices for addressing the identified issues in the Thorn Creek watershed. These practices are intended as initial guidance and do not necessarily represent the full range of potential activities that can improve the watershed. Some of the activities are directly related to the need for more information (i.e. updated hydrologic and hydraulic studies, existing stormwater facility inventory, etc.) before detailed implementation planning can proceed.

Recommended management strategies and practices have been generally categorized as:

- **Policy and Planning**
- **Structural**
- **Non-Structural**
- **Coordination and Education**

Each practice has been numbered from 1 to 45. Relevant practices have been associated with each of the identified sources of impairments in the Watershed Management Recommendations Matrix (Section 4.1.4) and relate back to the goals developed for the watershed. Following this general discussion, a subset of watershed management recommendations dealing centrally with water quality improvement are presented in more detail (Section 4.2).

4.1.1. POLICY AND PLANNING

1. Adopt and enforce flexible local zoning and subdivision regulations that allow adaptable, nontraditional designs for development, stormwater management, and nonpoint source pollution reduction measures. Regulations should limit runoff volume increases, minimize impervious surface area, and minimize soil compaction during and following construction. Use *South Suburban Mayors and Managers Association Storm Water Strategy: Model Ordinances*.

2. Adopt requirements for treatment of stormwater runoff quality from new developments and for retrofitting older stormwater detention facilities needing replacement or upgrade.

3. Enact and enforce ordinances to protect floodplains, riparian buffer areas, flood prone areas, natural depressional storage areas, and other natural retention and drainage features. Acquire and protect floodplains for flood prevention, open space, and environmental enhancement along the mainstem and tributaries.

4. Adopt and enforce ordinances, programs, and practices that protect natural areas and sensitive features from new development and human activities and that minimize unavoidable disturbances of high quality natural areas.

5. Identify and protect aquifer recharge zones, wellhead areas, highly permeable soils with high infiltration capacity, and areas susceptible to groundwater contamination.

6. Utilize the *Northeastern Illinois Regional Greenways Plan* (NIPC), *Water Trails Plan* (NIPC), *South Suburban Calumet Area Open Space Initiative, Biodiversity Recovery Plan* (Chicago Wilderness), and local plans, especially land acquisition plans of the Forest Preserve Districts of Cook and Will Counties, as guides for coordinating watershed open space planning and recreational development. Identify areas for recreational opportunity enhancement and expansion, such as abandoned railroad and road rights-of-way, utility and private easements, as well as improved parking and access to these resources.

7. Develop a habitat preservation plan that identifies unprotected and/or open space opportunities within the watershed and that prioritizes high quality habitat sites (including Illinois Natural Areas Inventory sites), large habitat patches, connecting greenways, and potential buffers for protection, expansion, and enhancement. Develop short and long term maintenance, management, and monitoring plans.

8. Collect current baseline scientific data for the watershed, including information on the location, capacity, and impact of retention/detention within the watershed. Develop detailed short and long term watershed monitoring strategies and a standard list of indicators.

9. Prepare updated hydrologic and hydraulic models. Update existing floodplain maps, predict future conditions, and evaluate effectiveness of recommended best management practices (BMPs) for restoration of hydrologic conditions. Identify potential floodwater storage sites designed to be natural-looking and aesthetic, an enhancement to the environment, and yielding recreational and water quality benefits. Identify possible threats to loss of stream baseflow due to diversion.

10. Develop comprehensive plans for watershed management, stormwater management, land use, and flood hazard mitigation for Thorn Creek and all significant tributaries and incorporate into local plans and policies.

11. If connecting new wastewater discharges to existing regional plants is not possible, promote the use of alternative wastewater treatment/disposal methods such as constructed wetlands, land treatment, and wastewater reuse.

4.1.2. STRUCTURAL

12. Raise the height of bridges and roadways that are overtopped or damaged during floods.

13. Acquire, protect, restore, and/or construct wetlands and wetland hydrology within the watershed to provide habitat, floodwater detention capacity, and water cleansing. This may include removal of flood control structures and wetland drainage tiles.

14. Reconfigure existing impervious surfaces to reduce area. Reduce and disconnect proposed impervious area by utilizing alternative parking lot designs, reduced street widths, reduced building-to-street setbacks, and cluster development. Utilize permeable paving blocks for low traffic parking areas, emergency access roads, and driveways to increase infiltration and reduce runoff volumes and pollutant loads.

15. Utilize natural drainage and infiltration measures to reduce runoff volumes, to filter pollutants from runoff water, and to improve infiltration of stormwater into the ground. These measures include swales, vegetated filter strips, infiltration trenches and basins. Implement lot level BMPs to capture stormwater such as green roofs, rain barrels, rain gardens, permeable pavement, and natural landscaping. Maintain, restore, and enhance natural drainage and storage systems that can serve multiple objectives such as stormwater conveyance, storage, and habitat.

16. Utilize wet bottom or wetland detention basin designs and retrofit existing inadequate or outdated detention basins and flood control facilities to reduce pollutant loads and to provide habitat and passive recreation opportunities. Monitor, maintain, and clean out stormwater detention facilities, storm drains, and catch basins to ensure effective operation and provide maximum detention, water quality benefits and habitat.

17. Eliminate illicit sanitary/industrial/commercial connections to storm sewers.

18. Reduce infiltration/inflow to sanitary sewers to minimize overflows and bypasses.

19. Monitor and maintain septic systems to prevent contamination of ground and surface water, and remediate or replace problem septic systems.

20. Eliminate or address sanitary / combined sewer system failures to reduce frequency of overflow events.

21. Promote and enhance recreational amenities and facilities such as canoe launch sites, portages, road crossings, hiking trails, interpretive signs, and trailhead facilities such as parking lots and comfort stations. Enhance trails, trail access, and alternative transportation networks by connecting mainstem trails to residential areas, trails along tributaries, and protected natural areas.

22. Actively manage and restore riparian vegetation, stream banks and channels, streambeds, aquatic habitats, natural meanders, pool-riffle sequencing, and unique channel sections of exposed limestone bedrock that have been modified or degraded in order to improve water quality and aquatic biodiversity. Consider environmentally-friendly bioengineering techniques where appropriate.

23. Actively manage and restore terrestrial ecosystems that have been modified or degraded, emphasizing control of non-native or invasive species and improving biodiversity. Prioritize high quality sites; unique, threatened, or endangered sites; and those that support threatened and endangered species. Also prioritize areas that provide buffers, reduce habitat fragmentation, and create connectivity. Plant native vegetation, use prescribed burning where necessary, and practice integrated pest management, avoiding the use of pesticides.

24. Provide passage and remove barriers to wildlife movement throughout and between habitat areas, such as highways, dams, and weirs.

4.1.3. NON-STRUCTURAL

25. Assess repetitively damaged structures not protected by flood control structures, and remove, relocate, elevate, or floodproof damaged structures.

26. Maintain stream channel conveyance capacity through channel maintenance and measures to reduce soil erosion and sedimentation while maintaining in-stream habitat.

27. Conduct stream cleanups, removing trash and debris to improve aesthetics and maintain channel flow. Leave some natural elements as habitat features.

28. Utilize deep-rooted natural vegetation instead of turf grass and ornamental plants to increase stormwater infiltration, reduce the need for pesticides and fertilizers, filter pollutants from runoff, and provide habitat for native species. Plant native trees appropriate to the local ecotype to increase interception and uptake of precipitation. Utilize natural vegetation buffers along all water bodies and natural areas to filter out damaging pollutants, to allow natural streamflow, to protect stream banks from erosion, and to serve as transitional areas between natural communities and the built environment. Development within buffer areas should be strictly limited. Land for buffers may need to be purchased or secured through conservation easements to ensure adequate protection.

29. On agricultural lands, use soil conservation techniques such as windbreaks, vegetated swales, terraces, natural buffers (filter strips), and conservation tillage practices to reduce erosion and to filter pollutant runoff from agricultural landscapes.

30. Improve road maintenance practices to remove potential pollutants, such as through regular street sweeping, and reduce the use of road salt in winter.

31. Monitor, maintain, and/or clean up landfills and other industrial sites to prevent leakage and contamination of ground and surface water.

32. Utilize sustainable lawn care practices, reduce the use of pesticides and fertilizers on yards and agricultural lands, and properly use and dispose of household chemicals and wastes.

33. Work closely with landowners, especially those that adjoin or buffer protected or critical natural areas, to enhance habitat on private properties through the use of natural landscaping and other means.

34. Work with industry, agriculture, municipalities, and residents to improve water conservation measures and reduce water waste and leakage.

4.1.4. COORDINATION AND EDUCATION

35. Improve coordination, communication, information accuracy, and decision-making between states, counties, municipalities, private and non-profit organizations, and residents.

36. Coordinate recreational, flood control, habitat, and water quality objectives so that multiple objectives can be achieved with available resources.

37. Encourage public/private partnerships to implement the watershed-based plan, to enhance funding opportunities, and to demonstrate the feasibility of such partnerships.

38. Encourage grassroots watershed planning and management by watershed stakeholders.

39. Identify and recruit volunteer and agency watershed and subwatershed leaders to direct and coordinate activities.

40. Reward watershed improvement efforts with recognition, awards, events, and publicity.

41. Develop and distribute resident information brochures and encourage broader community education efforts, especially regarding individual impacts on watershed resources and the importance of restoration practices.

42. Develop public relations strategies to educate, involve, and invigorate the public and community leaders, and to increase the public perception of the creek. Include watershed awareness events and the use of the media. Promote the benefits, economic and otherwise, of a healthy watershed.

43. Provide technical assistance to local governments and community groups. Provide and encourage communities and landowners to seek technical and financial assistance to help implement best management practices and protect watershed resources.

44. Utilize and promote demonstration projects to educate the public, local officials, and developers.

45. Provide opportunities for all watershed communities, school groups, the public, and the private sector to get involved in monitoring, restoration, clean-up, and other watershed improvement efforts and opportunities.

4.1.5. SUMMARY OF IMPAIRMENTS, CAUSES, AND SOURCES

						Relevant Watershed Management Recommendations																																												
Goal area	**Goals and Objectives**	**Impairments**	**Causes**	**Sources (Current and Historic)**	**Total**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**
HABITAT And NATURAL RESOURCES	Protect and restore terrestrial and aquatic habitat quality and quantity within the watershed. (Resource Priority 1)	Degraded terrestrial habitat and biodiversity	Loss of habitat/ connections	Development (Land use conversion)	11			√	√		√	√			√				√								√	√	√				√					√												
				Agricultural activity	9			√	√		√	√															√	√	√				√	√																
			Exotic and invasive species	Residential/business landscaping with invasives or turf grass	4																							√					√				√	√												
				Spread from existing infestations	5							√																√					√				√	√												
			Loss of natural "management" mechanisms	Elimination of fire	3							√															√	√																						
				Loss of predators	3				√			√																√																						
			Human disruption on nesting, feeding, shelter, pollination	Pesticides	3																												√				√	√												
				Pets (dogs and cats)	2																																√	√												
				Nuisance species (e.g., raccoons, deer, Canada geese)	4																							√					√				√	√												
			Change in surface or groundwater hydrology	Development (Land use conversion)	14	√		√	√	√				√	√			√	√	√	√							√			√		√			√														
		Degraded aquatic habitat and biodiversity	Water quality impairment	(See Water Quality Goal)	--																																													
			Habitat alteration (pools, riffles, meandering, cover, streambanks)	Channelization	4			√	√																		√				√																			
				Bank modification and destabilization	9	√		√	√										√		√						√				√		√					√												
			Hydrologic disturbance / flow alterations (increase or decrease of streamflow)	Urban runoff	10	√	√	√	√					√					√	√	√										√		√																	
				Loss of baseflow	4	√				√								√		√																														
				Flow reduction for irrigation or other use	1									√																																				
				Online lakes / impoundment / dams	2									√															√																					
			Sediment toxicity (phosphorous)	Urban runoff	9	√	√		√										√	√	√												√		√	√														
				Point discharges / illicit storm-sewer connections	3											√						√														√														
				Agricultural activity	6				√		√	√						√		√														√																
			Draining, filling, and degradation of wetlands	Agricultural activity	6				√		√	√						√		√														√																
				Development (Land use conversion)	8			√	√		√	√			√			√		√	√																													
			Exotic and invasive species	Spread from existing infestations	4																							√					√				√	√												
				Introduction of new species	3																							√									√	√												

					Relevant Watershed Management Recommendations																																												
Goal area	Goals and Objectives	Impairments	Causes	Sources (Current and Historic)	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
			Loss/reduction/degradation of natural riparian buffer	Agricultural activity	5			√	√																				√						√	√																			
				Development (Land use conversion)	6			√	√						√				√										√						√																				
				Inappropriate management	6			√	√																				√	√									√	√														
			Loss of natural "management" mechanisms	Lack of natural management mechanisms	3				√																						√												√														
			Lack of recolonization	No refuges or sources of colonization	5				√			√																√	√	√																								
				Lack of connections to high quality habitats	6			√	√			√																√	√	√																								
WATER QUALITY	Goal: Protect and enhance surface water quality to support uses designated for Thorn Creek by the Illinois Environmental Protection Agency. (Resource Priority 2)	Impaired Water Quality	Aquatic life toxicity (total dissolved solids, chlorides, sulfates)	Urban runoff	11	√	√		√				√					√	√	√	√												√		√		√														
				Road salt and storage/ highway maintenance and runoff	6	√			√				√							√	√														√															
				Point discharges / illicit stormsewer connections	3								√			√						√																											
			Nutrients (phosphorous and nitrogen) and algal growth	Urban runoff	11	√	√		√				√					√	√	√	√		√										√				√														
				Point discharges / illicit stormsewer connections	4								√			√						√	√																										
				Agricultural activity	6								√					√		√	√														√			√														
			Organic enrichment/low dissolved oxygen	Urban runoff	10	√	√		√				√					√	√	√	√												√				√														
				Animal waste	5								√							√															√			√	√													
				Sanitary sewer overflows / failure	5								√			√							√	√	√																								
				Lack of stream habitat structure (pools/riffles)	1																							√																						
				Illicit stormsewer connections	3								√			√						√																											
			Contamination (fecal coliform and possibly indicating presence of other bacteria and pathogens)	Urban runoff	10	√	√		√				√					√	√	√	√												√				√														
				Sanitary sewer overflows / failure	4								√			√							√		√																								
				Animal waste	5								√							√															√			√	√													
				Illicit stormsewer connections	3								√			√						√																											
			Hydrologic disturbance / flow alterations (increase or decrease of streamflow)	Urban runoff	2				√				√							√																														
				Development (Land use conversion)	13	√		√	√	√			√	√	√			√	√	√	√										√		√																		
			Fly dumping / garbage	Lack of enforcement	2								√																			√																	

					Relevant Watershed Management Recommendations																																												
Goal area	**Goals and Objectives**	**Impairments**	**Causes**	**Sources (Current and Historic)**	**Total**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**
WATER SUPPLY	Goal: Protect and enhance ground water quality and quantity. (Resource Priority 3)	Groundwater reduction	Usage / pumping	Agricultural activity	1																																			√										
				Urban and industrial activity	1																																			√										
			Loss of recharge / infiltration areas	Agricultural activity	4					√	√								√	√																														
				Urban development	9	√			√	√	√				√				√	√	√												√																	
		Groundwater contamination	Unprotected wellhead areas	Agricultural activity	2					√	√																																							
				Urban development	5	√			√	√	√				√																																			
			Unprotected recharge / infiltration areas	Agricultural activity	5					√	√							√	√	√																														
				Urban development	9	√			√	√	√				√			√	√	√																√														
			Release / introduction of contamination	Sewer failure / leakage	2											√							√																											
				Failing septic systems	2											√								√																										
				Spills/dumping	2					√																										√														
RECREATION And ACCESS	Goal: Increase, improve, and promote recreational resources, opportunities, and access throughout the watershed for social and economic benefits. (Resource Priority 4)	Parts of Thorn Creek are aesthetically unpleasant.	Bank erosion	Hydrologic disturbance	6	√			√					√					√	√							√																							
				Loss of buffer	6			√	√		√																√						√					√												
			Trash and debris	Urban environment / illegal dumping	3																						√						√					√												
			High turbidity	Urban runoff	10	√	√		√									√	√	√	√										√				√		√													
				Bank erosion	6	√			√										√								√				√		√																	
				Loss of buffer	6			√	√																		√				√		√					√												
				Agricultural activity	2				√																									√																
			Algae	Nutrients	10	√	√		√									√	√	√	√												√	√			√													
			Oil and grease	Urban runoff	9	√	√		√									√	√	√	√												√		√															
		Limited recreation opportunities	Lack of trails along the entire length of Thorn Creek.	Lack of…	4						√	√			√											√																								
			Lack of access	Access primarily at stream crossings and inside forest preserve district holdings.	4						√	√			√											√																								
FLOODING	Goal: Reduce flooding and flood damages. Resource Priority 4)	Increased flood flows	Increased rate and volume of runoff	Urban development / runoff / loss of infiltration capacity	6	√									√				√	√	√												√																	
				Development with insufficient stormwater regulations	6	√								√	√					√	√										√																			
				Poor detention basin management.	4	√														√	√										√																			
			Loss of depressional storage	Agricultural activity	5			√	√		√			√						√																														

					Relevant Watershed Management Recommendations																																													
Goal area	**Goals and Objectives**	**Impairments**	**Causes**	**Sources (Current and Historic)**	**Total**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**
				Development (Land use conversion)	9	√		√	√		√			√	√				√	√											√																			
		Flood damages	Encroachments on floodplain	Historical development within the floodplain / inadequate floodplain protection ordinances	8			√	√		√			√	√					√									√	√																				
				Development based on outdated floodplain maps	5			√						√	√					√										√																				
			Creek obstruction	Bridges, culverts, debris	4												√									√			√				√																	
EDUCATION And STEWARDSHIP	Goal: Educate the public, public officials, community leaders, businesses, and developers about the watershed and their impact and role in protecting watershed resources. (Coordination Priority 2 (tie))	Lack of…			7								√																										√						√	√	√	√	√	
	Goal: Increase involvement in watershed leadership, stewardship, monitoring, and volunteer activities. (Coordination Priority 2 (tie))				17				√		√	√	√		√																	√							√		√	√	√	√	√	√	√	√	√	√
COMMUNICATION, COORDINATION, And GOVERNANCE	Goal: Increase coordination, cooperation, research, and informed decision-making among governments, agencies, non-profits, and the private sector. (Coordination Priority 1)	Lack of…			9						√		√		√																								√		√	√	√					√		√
	Goal: Improve procedures and ordinances so that they are up to date, aligned with watershed protection goals, aligned with adopted plans, and enforced/enforceable. (Coordination Priority 3)				11	√	√	√	√	√	√				√																								√			√						√		√
				Total		24	10	19	40	11	20	13	20	11	18	9	1	16	22	32	19	5	5	2	2	3	16	14	7	2	11	2	27	9	5	5	17	16	4	2	2	3	2	1	2	2	2	4	2	3

4.2. Watershed Management Recommendations for Water Quality Improvement

The following Watershed Management Recommendations (WMR) are a subset of the 45 identified practices identified and address water quality impairments noted in the water quality assessment in Section 3. The specific objectives they further can be found from the WMR Matrix in Section 4.1.5. The six impairments addressed in this section are, in no particular order:

- Fecal Coliform (FC)
- Dissolved Oxygen (DO) — reductions expressed as decreases in BOD
- Hydrologic Modification (HM)
- Phosphorous and Nitrogen (PN)
- Aquatic Life Toxicity (TX) — Trace Metals (TM) and Hydrocarbons (HC)
- Debris and Dumping (DD)

When possible, estimates of the expected pollutant load reduction resulting from the recommended WMRs have been calculated. Section 4.3 and Appendix C present provide further information on these estimates. In most cases, pollutant load reductions (Section 4.3) and costs (Section 4.4) have been provided on a per-unit basis. Cumulative progress toward the pollutant load reduction goals presented in Section 3 will be tracked as WMRs are implemented. Funding sources that could potentially be used for WMR implementation are discussed in Section 4.6. Watershed stakeholders were also asked to assign these WMRs to responsible parties and to prioritize them. The results of this effort were used to develop the summary action plan presented in Section 4.8.

4.2.1. POLICY AND PLANNING RECOMMENDATIONS

WMR 1*: Adopt and enforce flexible local zoning and subdivision regulations that allow adaptable, non-traditional designs for development, stormwater management, and nonpoint source pollution reduction measures. Regulations should limit runoff volume increases, minimize impervious surface area, and minimize soil compaction during and following construction. Use* South Suburban Mayors and Managers Association Storm Water Strategy: Model Ordinances*.*

Impairments Addressed: FC, DO, PN, TX, HM

Priority Areas: All subbasins, but primarily where significant acreages of new development and stormwater runoff may occur and where existing regulations are deficient or limiting, i.e., vacant or agricultural portions of subbasins 100, 200, 300, and 900. This WMR is also applicable for infill development or redevelopment of previously developed properties, which can be retrofitted to reduce stormwater runoff volume and improve its quality.

Cost Estimate: Costs for regulations are difficult to estimate, but would consist primarily of municipal staff time and resources to research and write new regulations and carry through approval, adoption, and enforcement processes.

Expected Impairment Reductions: Expected impairment reductions resulting from policies and regulations are difficult to estimate, especially due to the variability of enforcement and variances.

WMR 2: *Adopt requirements for treatment of stormwater runoff quality from new developments and for retrofitting older stormwater detention facilities needing replacement or upgrade.*

Impairments Addressed: FC, DO, PN, TX, HM

Priority Areas: All subbasins, but less critical in subbasins with substantial percentages of protected natural land or open space (100, 200, 600, 700, and 800) that are contributing less urban stormwater to Thorn Creek.

Cost Estimate: Costs for regulations are difficult to estimate, but would consist primarily of municipal staff time and resources to research and write new regulations and carry through approval, adoption, and enforcement processes.

Expected Impairment Reductions: Expected impairment reductions resulting from policies and regulations are difficult to estimate, especially due to the variability of enforcement and variances.

WMR 3: *Enact and enforce ordinances to protect floodplains, riparian buffer areas, flood prone areas, natural depressional storage areas, and other natural retention and drainage features. Acquire and protect floodplains for flood prevention, open space, and environmental enhancement along the mainstem and tributaries.*

Impairments Addressed: HM

Priority Areas: All subbasins, but primarily where new development is occurring, i.e., in undeveloped portions of subbasins 100, 200, and 300.

Cost Estimate: Costs for regulations are difficult to estimate, but would consist primarily of municipal staff time and resources to research and write new regulations and carry through approval, adoption, and enforcement processes. Costs for acquisition and protection of floodplains are equally difficult to estimate and depend largely on property values and whether or not structures exist on the property targeted for acquisition.

Expected Impairment Reductions: Expected impairment reductions resulting from policies and regulations are difficult to estimate, especially due to the variability of enforcement and variances.

WMR 4*: Adopt and enforce ordinances, programs, and practices that protect natural areas and sensitive features from new development and human activities and that minimize unavoidable disturbances of high quality natural areas.*

Impairments Addressed: FC, DO, PN, TX, HM

Priority Areas: All subbasins, but primarily where new "greenfield" development is occurring, i.e., in undeveloped portions of subbasins 100, 200, and 300.

Cost Estimate: Costs for regulations are difficult to estimate, but would consist primarily of municipal staff time and resources to research and write new regulations and carry through approval, adoption, and enforcement processes.

Expected Impairment Reductions: FC, DO, PN, TX, HM – Expected impairment reductions resulting from policies and regulations are difficult to estimate, especially due to the variability of enforcement and variances.

WMR 5: *Identify and protect highly permeable soils with high infiltration capacity, aquifer recharge zones, well-head areas, and areas susceptible to groundwater contamination.*

Impairments Addressed: HM

Priority Areas: Prioritize basins with undeveloped lands (100, 200, 300, and 900) for protection from development, and basins with urbanized lands (300, 400, 500, 600, and 900) for prevention of contamination.

Cost Estimate: Costs for acquisition and protection of these sensitive areas are difficult to estimate and depend largely on property values and whether or not structures exist on the property targeted for acquisition.

Expected Impairment Reductions: Expected pollutant load reductions resulting from policies and regulations are difficult to estimate, especially due to the variability of enforcement and variances.

WMR 8: *Collect current baseline scientific data for the watershed, including information on the location, capacity, and impact of retention and detention within the watershed. Develop detailed short and long term watershed monitoring strategies and a standard list of indicators.*

Impairments Addressed: FC, DO, PN, TX, DD, HM

Priority Areas: All subbasins.

Cost Estimate: Costs for collecting baseline data are difficult to estimate and depend on the scope and scale of the collection effort. A general monitoring strategy is included with this plan, but a more detailed monitoring strategy and list of indicators can be developed for the watershed or subwatersheds. An inventory of the existing stormwater management facilities in the watershed could be completed for approximately $10,000.

Expected Impairment Reductions: This WMR would not directly reduce pollutant loads; however, it will provide additional valuable information that can be used to implement and locate other WMRs that may address any of the priority constituents.

WMR 9: *Prepare updated hydrologic and hydraulic models. Update existing floodplains, predict future conditions, and evaluate effectiveness of recommended best management practices (BMPs) for restoration of hydrologic conditions. Identify potential floodwater storage sites designed to be natural-looking and aesthetic, an enhancement to the environment, and yielding recreational and water quality benefits. Identify possible threats to loss of stream baseflow due to potential diversion proposals.*

Impairments Addressed: HM

Priority Areas: All subbasins.

Cost Estimate: Preparing detailed hydrologic and hydraulic models can be very cost intensive and can range upwards of $100,000, but are essential to identifying areas for improving flood control.

Expected Impairment Reductions: This WMR would not directly improve the hydrologic conditions or water quality in Thorn Creek, but the information and tools that are generated will be used to analyze proposed projects and WMRs and to develop a more detailed understanding of the waterway.

WMR 10: *Develop comprehensive plans for watershed management, stormwater management, land use, and flood hazard mitigation for Thorn Creek and all significant tributaries and incorporate into local plans and policies.*

Impairments Addressed: HM

Priority Areas: All subbasins.

Cost Estimate: Costs for developing plans and incorporating them into local plans and policies consist primarily of staff time and resources to research and write new regulations and carry through approval, adoption, and enforcement process.

Expected Impairment Reductions: Expected pollutant load reductions resulting from policies and regulations are difficult to estimate, especially due to the variability of enforcement and variances.

WMR 11: *If connecting new wastewater discharges to existing regional plants is not possible, promote the use of alternative wastewater treatment/disposal methods, such as constructed wetlands, land application, and wastewater reuse.*

Impairments Addressed: PN, HM

Priority Areas: Subbasins that may experience new development and demands for wastewater service (subbasins 100, 200, and 300).

Cost Estimate: Alternative wastewater treatment methods can be costly in comparison to connecting to the existing wastewater system. Costs are difficult to estimate due to the variability in project scale and scope. However, alternative methods also can provide additional benefits not provided by standard wastewater treatment facilities, such as groundwater recharge, habitat, and environmental education opportunities.

Expected Impairment Reductions: Some benefits over traditional wastewater treatment could include better performance for nutrients, and properly implemented alternative methods would eliminate failing or poorly managed septic systems. Alternative systems will also improve hydrology by increasing groundwater recharge. P (34-97%) N (73-96%), HM (20-45%)

4.2.2. STRUCTURAL RECOMMENDATIONS

WMR 13: *Acquire, protect, restore, and/or construct wetlands and wetland hydrology within the watershed to provide habitat, floodwater detention capacity, and water cleansing. This may include removal of flood control structures and wetland drainage tiles.*

Impairments Addressed: FC, DO, PN, TX, HM

Priority Areas: All subbasins where wetlands currently exist or where opportunities for wetland restoration exist. Prioritize acquisition and protection of existing unprotected wetland systems in headwater watersheds 100, 200, and 300. Prioritize restoration of wetland systems in protected natural areas such as forest preserve districts along Thorn Creek (subbasins 100, 200, 400, 600, 700, 800, and 900).

Cost Estimate: The costs of acquisition for wetlands depend on property values. The costs of protecting existing wetlands using local ordinances are typically limited to the staff time required to establish and implement policies and regulations. Wetland creation and restoration, on the other hand, are variable and can be quite costly, but $30,000 per acre is a good working estimate. Disabling (breaking or plugging, but not removing) drainage tiles to restore wetland conditions can cost $1,000 per acre.

Expected Impairment Reductions: FC (77%), DO (63%), P (39-51%) N (13-36%), TX (HC 90%), TM 36-69%), HM (0-80%)

WMR 14: *Reconfigure existing impervious surfaces to reduce area. Reduce and disconnect proposed impervious area by utilizing alternative parking lot designs, reduced street widths, reduced building-to-street setbacks, and cluster development. Utilize permeable paving blocks for low traffic parking areas, emergency access roads, and driveways to increase infiltration and reduce runoff volumes and pollutant loads.*

Impairments Addressed: FC, DO, PN, TX, HM

Priority Areas: Previously developed areas of all subbasins, but reconfiguration of impervious area is primarily important in more densely urbanized subbasins 300, 400, 500, 600, and 900. For new development in undeveloped portions of the watershed (subbasins 100, 200, 300 and 900), minimize impervious area construction.

Cost Estimate: Complete retrofits of impervious areas are difficult to estimate because they depend on local characteristics of the site. However, permeable paving blocks and porous paving installations can cost approximately $5 to $10 per square foot. The costs of implementing the other practices (i.e., reducing impermeable surfaces through wise front-end design) also are difficult to estimate, but they typically result in lower costs of development due to the reduced infrastructure and paving required.

Expected Impairment Reductions: FC (nd[1]), DO (80-90%), PN (nd), TX (TM 90-100%), HM (0-100%

WMR 15: *Utilize natural drainage and infiltration measures to reduce runoff volumes, to filter pollutants from runoff water, and to improve infiltration of stormwater into the ground. These measures include swales and vegetated filter strips. Implement lot level BMPs to capture stormwater such as green roofs, rain barrels, rain gardens, permeable pavement, and natural landscaping. Maintain, restore, and enhance natural drainage and storage systems that can serve multiple objectives such as stormwater conveyance, storage, and habitat.*

Impairments Addressed: FC, DO, PN, TX, HM

Priority Areas: All subbasins. Some of the developed areas in subbasins 300, 400, 500, 600, and 900 can be retrofit to include these features. High density development typically cannot accommodate all of the natural drainage measures, such as swales, but lot level BMPs can be installed at most development densities. Natural drainage and storage systems that exist in more undeveloped (agricultural, vacant, or open space) portions of subbasins 100, 200, 400, 600, 700, 800, and 900 should be protected from new development impacts and restored to natural condition.

Cost Estimate: Rain gardens and bioswales can cost from $2 to $5 per square foot or $1,500 each for larger designs. Naturalizing streambanks and buffers costs about $30 per linear foot. Revegetating existing swales with native vegetation can cost $30 to $50 per linear foot. Vegetated buffers and filter strips can cost $5 to $10 per square foot or up to $2,000 per acre. Green roofs cost between $10 and $20 per square foot. Rain barrels cost approximately $20 to $150 each depending on type, but can be made cheaply by homeowners. Permeable pavement can cost $5 to $10 per square foot. Natural landscaping costs vary but $2,000 to $4,000 per acre is a good working number. Maintaining these installations can range from $500 per acre per year for native landscapes to $3 or $4 per square foot per year for rain gardens. Creating or restoring wetlands can cost $30,000 per acre. Stabilizing stream-

[1] nd = No Data

banks with bioengineering techniques can cost from $15 to $100 per linear foot, depending on severity of erosion and technique employed.

Expected Impairment Reductions: FC ((–50)-55%), DO (30-83%), P ((–14)-51%) N (nd), TX (HC 62-81%, TM (14-80%), HM (0-100%)

WMR 16: *Utilize wet bottom or wetland detention basin designs and retrofit existing inadequate or outdated detention basins and flood control facilities to reduce pollutant loads, and to provide habitat and passive recreation opportunities. Monitor, maintain, and clean out stormwater detention facilities, storm drains, and catch basins to ensure effective operation and provide maximum detention, water quality benefits and habitat.*

Impairments Addressed: FC, DO, PN, TX, HM

Priority Areas: All subbasins. Retrofitting existing detention basins is appropriate for already urbanized areas with detention in subbasins 300, 400, 500, 600, and 900. Future development in undeveloped portions of subbasins 100, 200, and 300 should use wet detention designs for all new development.

Cost Estimate: Wet bottom and wetland detention basins cost $17,000 to $22,000 to create or restore per acre-foot of detention storage, $500 per acre for maintenance and management. Creating and/or restoring wetlands can cost $30,000 per acre. Native landscaping, such as wetland plantings, often costs between $2,000 and $4,000 per acre.

Expected Impairment Reductions: FC (65-77%), DO (50-72%), P (24-58%) N (13-36%), TX (HC 83-90%, TM 24-73%), HM (0-10%)

WMR 17: *Eliminate illicit sanitary, industrial, and commercial connections to storm sewers.*

Impairments Addressed: FC, DO, PN, TX

Priority Areas: All subbasins, but most likely a problem in more urbanized subbasins with a higher density of commercial and industrial land uses (300, 400, 500, 600, and 900.) Monitoring of all outfalls along the Thorn Creek mainstem is essential to identifying whether and where illicit connections exist.

Cost Estimate: Eliminating illicit connections from residences to storm sewers is relatively inexpensive, approximately $500 each. Locating and remediating industrial and other larger scale illicit connections can cost much more, from tens to hundreds of thousands of dollars depending on the scale of the problem and solution.

Expected Impairment Reductions: The expected reduction is on par with the difference between raw sewage and treated sewage effluent from a wastewater treatment plant. As such, the gains can be substantial. The biological oxygen demand from an illicit connection is reduced dramatically, perhaps over 95 percent, which could have a substantial positive effect on DO if there are many illicit connections. FC (varies), DO (varies), P (21%) N (nd), TM (62-94%)

WMR 18: *Reduce infiltration / inflow to sanitary sewers to minimize overflows and bypasses.*

Impairments Addressed: FC, DO, PN, TX

Priority Areas: All subbasins, but primarily urbanized subbasins 300, 400, 500, 600, and 900. Early monitoring is essential to identifying whether and where overflow events and/or leakage are occurring.

Cost Estimate: Costs for reducing the infiltration and inflow of storm sewers to sanitary sewers are difficult to estimate but they can be high depending on the scale of the problem and solution.

Expected Impairment Reductions: The expected reduction is on par with the difference between raw sewage and treated sewage effluent from a wastewater treatment plant. FC (varies), DO (varies), P (21%) N (nd), TM (62-94%)

WMR 20: *Eliminate or address sanitary and/or combined sewer system failures to reduce frequency of overflow events and leakage.*

Impairments Addressed: FC, DO, PN, TX

Priority Areas: All subbasins, but primarily urbanized subbasins 300, 400, 500, 600, and 900. Early monitoring of sewer systems is essential to identifying whether and where overflow events and/or leakage are occurring.

Cost Estimate: Costs for identifying and rectifying combined sewer system failures are difficult to estimate but they can be high depending on the scale of the problem and solution.

Expected Impairment Reductions: The expected reduction is on par with the difference between raw sewage and treated sewage effluent from a wastewater treatment plant. FC (NA), DO (varies), P (21%) N (nd), TM (62-94%)

WMR 22*: Actively manage and restore riparian vegetation, stream banks and channels, streambeds, aquatic habitats, natural meanders, pool-riffle sequencing, and unique channel sections of exposed limestone bedrock that have been modified or degraded in order to improve water quality and aquatic biodiversity. Consider bioengineering techniques where appropriate.*

Impairments Addressed: DO, PN

Priority Areas: Primarily subbasins 100 and 200, but beneficial to entire stream length.

Cost Estimate: Pool riffle sequences can cost approximately $1,000 each to install. Naturalizing streambanks and buffers costs about $30 per linear foot. Channel maintenance and management, such as removing debris, can cost approximately $500 per blockage to remove. Vegetated buffers and filter strips can cost $5 to $10 per square foot or up to $3,000 per acre. Stabilizing streambanks with bioengineering techniques can cost from $15 to $100 per linear foot, depending on severity of erosion and technique employed. Revegetating existing swales with native vegetation can cost up to $50 per linear foot. Natural landscaping costs vary but can generally be estimated at $2,000 to $4,000 per acre.

Expected Impairment Reductions: DO (nd), P (50%), N (40%)

4.2.3. NON-STRUCTURAL RECOMMENDATIONS

WMR 26: *Maintain stream channel conveyance capacity through channel maintenance and measures to reduce soil erosion and sedimentation while maintaining in-stream habitat.*

Impairments Addressed: DD, PN

Priority Areas: Stream reaches in all subbasins.

Cost Estimate: Channel maintenance and management, such as removing debris, can cost approximately $500 per blockage to remove. Pools and riffles cost approximately $1,000 to install. Revegetating and stabilizing streambanks can cost from $30 to $50 per linear foot.

Expected Impairment Reductions: Load reductions will be computed based on the implementation of discrete projects that prevent the loss of sediment and eliminate debris. DD (var), P (var) N (var)

WMR 27: *Conduct stream cleanups to improve aesthetics, remove trash and debris, and maintain channel flow. Leave some natural elements as habitat features.*

Impairments Addressed: DD

Priority Areas: Stream reaches in all subbasins, but primarily in more urbanized subbasins (300, 400, 500, 600, and 900) where debris is more likely to accumulate in the stream. Specific areas where debris is known to accumulate and block stream flow should be checked more regularly than other areas.

Cost Estimate: Stream cleanup costs vary depending on scale and effort, but each event may cost between $500 and $1,500.

Expected Impairment Reductions: DD (nd)

WMR 28: *Utilize deep-rooted native vegetation instead of turf grass and ornamental plants to increase stormwater infiltration, reduce the need for pesticides and fertilizers, filter pollutants from runoff, and provide habitat for native species. Plant native trees appropriate to the local ecotype to increase interception and uptake of precipitation. Utilize native vegetation buffers along all water bodies and natural areas to filter out damaging pollutants, to allow natural streamflow, to protect stream banks from erosion, and to serve as transitional areas between natural communities and the built environment. Development within buffer areas should be strictly limited. Land or conservation easements for buffers may need to be purchased to ensure adequate protection.*

Impairments Addressed: FC, DO, PN, TX, HM

Priority Areas: All subbasins, but primarily in more urbanized subbasins 300, 400, 500, 600, and 900. Prioritize all land uses directly adjoining streams and other water resources to filter and infiltrate stormwater runoff. Target residential, agricultural, and institutional land uses (business parks, campuses, park districts) containing large expanses of turf grass lawns or fields where animal waste (pets and urban wildlife such as geese) is likely to accumulate and where fertilizers containing nitrogen and phosphorous are likely to be applied. Also target properties adjoining protected natural areas such as forest preserves to soften the transition between natural and developed land.

Cost Estimate: Naturalizing streambanks, swales and buffers can cost between $30 and $50 per linear foot. Buffers and filter strips can cost $5 to $10 per square foot or up to $3,000 per acre. Natural landscaping generally costs $2,000 to $4,000 per acre. Acquisition of land or conservation easements depends on property values. Streambank stabilization can cost between $15 and $100 per linear foot depending on the technique employed.

Expected Impairment Reductions: FC ((–50)-0%), DO (30-50%), P ((–14)-50%) N (0-44%), TX (HC 62-75%, TM 14-71%), HM (0-20%)

WMR 29: *On agricultural lands, use soil conservation techniques, such as windbreaks, vegetated swales, terraces, natural buffers (filter strips), and conservation tillage practices (crop stubs and roots left in the ground) to reduce erosion and to filter pollutant runoff from agricultural landscapes.*

Impairments Addressed: FC, DO, PN

Priority Areas: Subbasins with significant amounts of working agricultural land (primarily subbasin 100, but also parts of subbasins 300 and 900).

Cost Estimate: Buffers and filter strips can cost $5 to $10 per square foot or up to $3,000 per acre. Naturally vegetating swales can cost $50 per linear foot. Planting windbreaks can cost $50 to $500 per tree or shrub depending on size and age. Conservation tillage practices can be less expensive then conventional tillage due to the reduced effort needed. Removal of existing drainage tiles can cost about $1,000 per acre.

Expected Impairment Reductions: FC ((–50)-0%), DO (30-50%), P ((–14)-50%), N (0-44%)

WMR 30*: Improve road maintenance practices, such as regular street sweeping, to remove potential pollutants. Reduce the use of road salt in winter.*

Impairments Addressed: TX, DD

Priority Areas: All subbasins, but primarily in more urbanized subbasins (300, 400, 500, 600, and 900) where road density is greatest and debris in streets and gutters is more likely to accumulate and be flushed into storm drains.

Cost Estimate: Costs for improving or modifying road maintenance practices are difficult to estimate and depend on effort and changes needed. Reducing the use of road salt in winter to control snow and ice can save on maintenance costs for municipalities. Municipalities should prioritize reduced salt application close to water resources and other sensitive natural areas. Alternatives to salt are generally more expensive than salt, but are also typically less destructive of environmental resources.

Expected Impairment Reductions: TX (nd), DD (nd)

WMR 32: *Utilize sustainable lawn care practices, reduce the use of pesticides and fertilizers on yards and agricultural lands, and properly use and dispose of household chemicals and wastes.*

Impairments Addressed: FC, DO, PN, TX

Priority Areas: All subbasins. Prioritize all land uses directly adjoining streams and other water resources, as pesticides and fertilizers and other chemicals tend to flow directly into streams at concentrations detrimental to aquatic organisms. Target residential, agricultural, and institutional land uses (business parks, campuses, park districts) containing large expanses of turf grass lawns or fields where animal waste (pets and urban wildlife such as geese) is likely to accumulate and where fertilizers containing nitrogen and phosphorous are likely to be applied. Also target properties adjoining protected natural areas such as forest preserves to soften the transition between natural and developed land.

Cost Estimate: The costs of changing land management practices to be more environmentally friendly are negligible. After an initial investment of time to research and learn alternative means of management and/or the proper application of pesticides and fertilizers, costs are no more than conventional management methods. In fact, some alternative practices cost less than conventional. Conversion to native landscaping often costs about $2,000 to $4,000 per acre.

Expected Impairment Reductions: FC (nd), DO (nd), PN (nd), TX (nd)

WMR 33: *Work closely with landowners, especially those that adjoin or buffer protected or critical natural areas and streams, to enhance habitat on private properties through the use of natural landscaping and other means.*

Impairments Addressed: DO, PN

Priority Areas: All subbasins. Prioritize all land uses directly adjoining streams and other water resources. Target residential, agricultural, and institutional land uses (business parks, campuses, park districts) containing large expanses of turf grass lawns or fields where animal waste (pets and urban wildlife such as geese) is likely to accumulate and where fertilizers containing nitrogen and phosphorous are likely to be applied. Also target properties adjoining protected natural areas such as forest preserves to soften the transition between natural and developed land.

Cost Estimate: Natural landscaping and the use of native vegetation for buffers along streams and natural areas can cost from $30 per linear foot of streambank to $3,000 per acre for buffers and filter strips. Restoring upland areas to natural or native conditions can cost approximately $2,000 to $4,000 per acre.

Expected Impairment Reductions: FC ((–50)-0%), DO (30-50%), P (50%) N (40%)

4.3. Expected Pollutant Load Reduction Estimates

Table 4-1 presents estimates for percent reduction in pollutant loading based on the research identified in Appendix B. The numbers represent the highest reductions achieved; actual reduction rates may be lower than those shown depending on local conditions and other factors. In some cases, such as for hydrologic modification, the recommended management measure is highly variable dependent on the specific project design. A case may be made that some of the WMRs for which no reduction percentage estimates are listed will result in indirect pollutant load reductions. Since indirect benefits are difficult to quantify, however, the table below lists only direct reductions where possible to estimate.

Table 4-1. Expected Effect of Watershed Management Recommendations on Pollutant Loading (% Reduction)

WMR	Fecal Coliform (FC)	Dissolved Oxygen (DO)†	Phosphorous and Nitrogen (PN)	Aquatic Life Toxicity (TX)	Debris and Dumping (DD)	Hydrologic Modification (HM)
1	*	*	*	*	NA	*
2	*	*	*	*	NA	*
3	NA	NA	NA	NA	NA	*
4	*	*	*	*	NA	*
5	NA	NA	NA	NA	NA	*
8	*	*	*	*	*	*
9	NA	NA	NA	NA	NA	*
10	NA	NA	NA	NA	NA	*
11	NA	NA	34-97 (P) 73-96 (N)	NA	NA	20-45
13	77	63	39-51 (P) 13-36 (N)	90 (HC) 36-69 (TM)	NA	0-80
14	nd	80-90	nd	90-100 (TM)	NA	0-100
15	(–50)-55	30-83	(–14)-51 (P)	62-81 (HC) 14-80 (TM)	NA	0-100
16	65-77	50-72	24-58 (P) 13-36 (N)	83-90 (HC) 24-73 (TM)	NA	0-10
17	NA	Varies	21 (P)	62-94 (TM)	NA	NA
18	NA	Varies	21 (P)	62-94 (TM)	NA	NA
20	NA	Varies	21 (P)	62-94 (TM)	NA	NA
22	NA	nd	50 (P) 40 (N)	NA	NA	NA
26	NA	NA	var (P)	NA	var	NA
27	NA	NA	NA	NA	nd	NA
28	(–50)-0	30-50	(–14)-50 (P) 0-44 (N)	62-75 (HC) 14-71 (TM)	NA	0-20
29	(–50)-0	30-50	(–14)-50 (P) 0-44 (N)	NA	NA	NA
30	NA	NA	NA	nd	nd	NA
32	nd	nd	nd	nd	NA	NA
33	(–50)-0	30-50	50 (P) 40 (N)	NA	NA	NA

† Pollutant removal estimates are made for reductions in Biological Oxygen Demand, not for Dissolved Oxygen. * Expected pollutant load reductions resulting from policies and regulations are difficult to estimate, especially due to the variability of enforcement and variances. NA = WMR does not apply to the pollutant. nd = No data exists with which to estimate pollutant load reductions. var = benefit limited to project area and varies by size of project. HC = hydrocarbons. TM = trace metals

4.4. Cost Estimates

Costs for preventive measures such as education, policy and regulatory changes, and improved coordination can vary widely by type and scope of action. Per-unit costs for structural and remedial BMPs can be estimated more easily, but actual costs will vary due to the project type, specifications, size, property values, and other characteristics. The estimates in Table 4-2 below should be used to compare practices and costs.

Table 4-2. Cost Estimates for BMPs.

WMR	Practice	Unit	Cost per unit
15,22,23,26,28,29,33	Naturalize streambanks and buffers	Linear foot	$30
22,26,27	Remove debris from streams Stream clean up events	Each blockage Event	$500 $500 to $1,500
15	Install rain gardens and bioswales Maintenance	Square foot Each Square foot	$2 to $5 $1,500 $3 to $4 per year
14,15	Install permeable paving blocks and porous pavement	Square foot	$5 to $10
15,28,29	Retrofit swales with native vegetation	Linear foot	$50
13,15,16	Create or restore wetlands	Acre	$30,000
15,22,23,26,28,29,33	Install buffers and filter strips	Square foot Acre	$5 to $10 $2,000 to $3,000
15,22,26,28	Stabilize streambanks with bioengineering Fiber Rolls A-Jacks Lunkers	Linear foot Linear foot Linear foot Linear foot	$100 $25 to $35 $30 to $75 $15
15,22,26,28,29,33	Stabilize streambanks and swales with native vegetation	Linear foot	$30
17	Remove illicit stormwater connections	Each (residential only)	$500
13,29	Remove drainage tiles	Each	$1,000
15,16,22,23,26,28,29,32,33	Native landscaping (prairie and wetland plantings)	Acre	$2,000 to $4,000
15	Rain barrels	Each	$20 to $150
15,16	Naturalize detention basins Management	Acre-foot of detention Acre	$17,000 to $22,000 $500
22, 26	Install riffles and pools	Each	$1,000

Source: Costs are based on information from Applied Ecosystem Services, Inc., Indian Creek Watershed Plan *(contract report for Lake County, Illinois Stormwater Management Commission, 2003); Northeastern Illinois Planning Commission,* Salt Creek: A Resource Worth Preserving — Best Management Practices for Reducing Non-Point Source Pollution *(June 2004); and Center for Urban Policy and the Environment, Indiana University-Purdue University Indianapolis, "An Internet Guide to Financing Stormwater Management," <stormwaterfinance.urbancenter.iupui.edu>.*

4.5. Thorn Creek Watershed Short Term Action Plan

The following table provides a selection of projects to undertake in the next three years. Each is categorized under one of the WMRs, whose priority for the stakeholders supplied the basic order for this table. Within this general framework, staff developed this short term action plan to provide a mix of practices: structural and non-structural, capital intensive and low cost, expert driven and volunteer oriented.

Start Year	WMR	Description	Site or Target Area	Estimated Cost	Financial/ Technical Assistance	Responsible Party
Year 1	3	Enact or improve ordinances to protect stream buffers, natural drainage areas, water quality, etc.	Riparian areas along mainstem and tributaries	Municipal staff time estimated at 200 hours or less using existing model ordinances	Technical assistance through NIPC and SSMMA	Municipalities
	8	Stream inventory	Mainstem and tributaries	Use volunteer labor; administrative costs vary	Grant assistance and local match	TCEP/TCRP
	3	Acquire floodplains for flood prevention, open space, etc.	Riparian areas along mainstem and tributaries, such as the Thorn Creek headwaters	Varies with acreage and land value; may range up to $10 million.	Grants, county bond issue.	Municipalities, forest preserve districts
	15	Install 3,000 feet of agricultural or urban buffer strips	Riparian areas along mainstem and tributaries	3,000 feet @ $60 per feet ($20–$100 range) = $180,000	Grant assistance and local match	TCEP/TCRP
	27	Conduct stream cleanups (continuing)	Mainstem and tributaries	Use volunteer labor and donated debris disposal; administrative costs vary	Grant assistance and local match	TCEP/TCRP
Year 2	4	Adopt conservation design ordinances	Entire watershed	Municipal staff time estimated at 100 hours or less using existing model ordinances	Technical assistance through NIPC	Municipalities
	15	Implement 5 naturalized landscaping, drainage, or infiltration projects	Entire watershed	5 projects @ $75,000 per project ($10–150,000 range) = $375,000	Grant assistance and local match	TCEP/TCRP
	30	Evaluate existing road maintenance practices for opportunities to reduce pollutants in runoff, reduce use of road salt, etc.	Entire watershed	TCEP or municipalities to coordinate review using consulting engineer at $10–20,000	Grant assistance and local match	Municipalities, counties, IDOT
	8	Collect baseline scientific data for the watershed: characteristics of retention/ detention within watershed, water quality constituents. Address specific data needs identified in Section 3.	Entire watershed	Varies with scope and depth, starting at $10,000 for preliminary investigation or expansion of existing programs, with potential long-term needs of $100,000 or more	Grant assistance and local match	Governors State University, other research institutions, TCBSD
Year 3	17	Initiate program to screen for illicit wastewater discharge connections to stormsewers	Entire watershed	Develop and initiate a screening program for $15–30,000 per municipality	Information on is readily available on successful screening programs.	Municipalities
	16	10 detention basin retrofits	Entire watershed	10 projects @ $50,000 per project ($25–75,000 range) = $500,000	Grant assistance and local match	TCEP/TCRP

4.6. Implementation Partners

The following parties are key potential partners whose support will lead to the realization of identified goals for the Thorn Creek watershed. The organizations below are listed because they are expected to fulfill one or more of the following functions: oversee or implement restoration/remediation strategies, acquire funding, organize or participate in data collection, provide regulatory or technical guidance, issue permits, monitor the success of the watershed plan, acquire land for restoration or protection purposes, and develop education strategies.

Corporate and Business Landowners (CBL)

The active participation of CBLs in the planning process can lead to significant positive impacts on the quality of the Thorn Creek watershed. Businesses can become involved by retrofitting existing facilities, managing their grounds and parking lots to reduce runoff volume and pollutant loadings, and sponsoring watershed events. New CBL development can also be designed to minimize runoff and pollutant loadings.

Counties (all departments) (CO)

Thorn Creek flows through Will and Cook Counties. Both counties have a similar role in land use planning, development, natural resource protection, and drainage system management in the unincorporated areas of the watershed. Working with the counties, especially their public works, health, and transportation departments can help ensure that Thorn Creek enjoys responsible, sustainable land use planning, road and sewer maintenance, and public health policies.

Developers (D)

The practices of developers can significantly impact a watershed. Developers should be encouraged to employ sustainable development techniques such as cluster development and naturalized drainage design.

Federal Emergency Management Agency (FEMA)

FEMA is the principal federal agency involved in flood mitigation and flood disaster response. Among its duties, FEMA is responsible for the National Flood Insurance program, helps municipalities develop and enforce floodplain ordinances, develops floodplain maps, and administers funding for flood mitigation plans and projects.

Forest Preserve Districts (FPD)

The Forest Preserve Districts of Cook and Will Counties contain much open space and a large portion of the riparian buffer of Thorn Creek. Protection of both these resources is crucial to successful protection efforts in the Thorn Creek watershed.

Golf Courses (GC)

Golf courses are important potential sites for the use of BMPs. Golf courses can help reduce pollutant loadings, especially nutrients, as well as runoff volume by incorporating BMPs into their golf course management programs.

Homebuilders (H)

Homebuilders should use BMPs during construction. Failure to use BMPs, or improper use, can lead to soil erosion and other pollutant discharges.

Illinois Department of Natural Resources (IDNR)

Several Offices within IDNR provide services that will be key to the implementation of the Thorn Creek watershed plan:

- The Office of Water Resources (OWR) is the state's lead organization for the regulation of flood-plain development as well as for the implementation and funding of structural flood control and mitigation.
- The Office of Realty and Environmental Planning (OREP) is responsible for natural resource and outdoor recreation planning. It also administers the Conservation 2000 Ecosystems Program, which provides technical and financial assistance through a grant program for natural resource protection and restoration.
- The Office of Resource Conservation (ORC) reviews Clean Water Act Section 404 wetland permits for impacts on fish and wildlife resources; it also protects fisheries and other aquatic resources through regulation, ecological management and public education.
- The Office of Capital Development (OCD) administers state and federal grants for open space programs.
- The Office of Scientific Research and Analysis (OSRA) conducts research and data collection provides this information to planners and formulates natural resource protection policy.

Illinois Department of Transportation (IDOT)

IDOT is responsible for the planning, construction, and maintenance of portions of the transportation network that covers the Thorn Creek watershed. Incorporation of best management practices and sustainable management measures into IDOT projects can help lead to improvements in the water quality present in the watershed.

Illinois Emergency Management Agency (IEMA)

In Illinois, IEMA is the state agency responsible for flood and disaster planning, emergency response, and hazard mitigation. IEMA works with local governments on flood mitigation plans and provides operational support during floods. IEMA also administers FEMA-funded programs in the state, including flood mitigation grant programs.

Illinois Environmental Protection Agency (IEPA)

Under the federal Clean Water Act and state legislation, IEPA is responsible for the protection of the state's water resources. Several IEPA activities are important to this plan:

- **Monitoring:** IEPA oversees data collection at various sites (rivers, streams, lakes, etc.) across the state, including the Thorn Creek watershed. The Illinois Water Quality Report (305(b)) summarizes these monitoring efforts.
- **Funding:** IEPA administers several state and federal grant programs. A primary example is the Section 319 Nonpoint source Pollution Control Program under the Clean Water Act.
- **Regulation:** IEPA regulates point and nonpoint source pollution discharges into the state's waters through regulatory and non-regulatory programs.

Illinois State Toll Highway Authority (ISTHA)

ISTHA manages and maintains Illinois's toll highways. The agency should be encouraged to employ BMPs during all of its road maintenance activities.

Metropolitan Water Reclamation District (MWRD)

The MWRD is responsible for the maintenance of much of metropolitan Chicago's sewage system and water reclamation plant capacity. MWRD also collects water quality data for Lake Michigan and many local rivers and streams. MWRD is leading the effort to develop Cook County's stormwater management program. Interaction with the MWRD through the South Suburban Mayors and Managers Association will be important for the Thorn Creek watershed.

Municipalities (all departments) (M)

Municipalities have the principal responsibility for land use and development planning in Illinois and across the country. Municipalities are therefore crucial to watershed protection efforts. By partnering with municipalities and encouraging the adoption of sustainable zoning and development practices, a watershed protection group can help temper water quality impairment. Municipalities are also a key part of any watershed protection strategy because they are responsible for the enforcement of local land use and development ordinances.

Natural Resources Conservation Service (NRCS) / Soil and Water Conservation Districts (SWCD)

NRCS and SWCD provide technical expertise and information on conservation, development, management, and wise use of natural resources to landowners and land managers, county and local governments, and local organizations. Areas of expertise include streambank stabilization and soil erosion/sediment control, wetland and habitat restoration, community planning, environmental education, and natural resource maps and reports. NRCS and SWCD also administer several cost-share programs targeted to water quality, wetland restoration, and other watershed priorities.

Northeastern Illinois Planning Commission (NIPC)

NIPC provides technical and planning assistance to watershed protection groups. NIPC has developed model ordinances tailored to the region for stormwater management, sediment control, streams and wetlands, and floodplains. NIPC also offers technical assistance and training opportunities to local governments and watershed groups. NIPC also helps local governments apply for state and federal funding programs.

Park Districts (PD)

Park districts often control a large amount of open space in a watershed. Parks also contain many recreational opportunities and trails, several bordering Thorn Creek. Partnerships with local park districts can help ensure the preservation of open space while also facilitating recreational and other community opportunities that can help increase support for watershed protection efforts.

Private Residential Landowners (PRL)

The activities of residential landowners, often unknowingly, can have a significant impact on the quality of a watershed. Practices such as excess lawn fertilization, connection of downspouts to the sewer system, or destruction of riparian buffers can be significant sources of nonpoint pollution. Watershed protection efforts should educate residents on the consequences of their actions and present alternatives. More positively, political pressure from local residents on municipal or county officials can lead to increased emphasis on watershed protection. Many local residents already play important roles in watershed planning and protection efforts.

South Suburban Mayors and Managers Association (SSMMA) / Councils of Governments (COGs)

The COG in the Thorn Creek watershed, the SSMMA, can help address watershed issues that cross town, city, and county boundaries, such as transportation and infrastructure, economic development, water quality and environmental quality, recreation, and growth management. COGs typically assist communities through communication, planning, policymaking, coordination, advocacy, and technical assistance. As part of the Cook County stormwater management program, the SSMMA will be organizing a Watershed Planning Council for the Little Calumet River. Thorn Creek stakeholders should provide input to the SSMMA on this effort.

Thorn Creek Basin Sanitary District (TCBSD)

TCBSD provides wastewater treatment service for the communities of Chicago Heights, Homewood, Park Forest, South Chicago Heights, Steger, and Crete. The Sanitary District is governed by a board of trustees that is appointed by the elected legislative representatives of the communities served by the Sanitary District. The Sanitary District's discharges are a major source of flow in Thorn Creek. It is also a primary source of data for the Watershed Resource Inventory and a major stakeholder in this watershed based planning process.

Thorn Creek Ecosystem Partnership (TCEP)

TCEP is a public–private cooperative of volunteer watershed stakeholders formed in 1997 to preserve, protect, and enhance local natural systems and integrate them into the life and future of the community through coordination and cooperation. It is largely funded through the Conservation 2000 programn administered by IDNR. The partnership can help with advocacy, management of watershed projects, grant applications and review, and general coordination of watershed activities.

Thorn Creek Restoration Coalition (TCRC)

The mission of the volunteer TCRC is to provide a viable and accessible multi-use waterway. The Coalition functions through restoration projects with technical support and oversight of advisory agencies.

Townships (T)

While unincorporated townships generally play a secondary role in watershed protection, they often have responsibility for road upkeep and occasionally sponsor drainage system improvement projects. The use of BMPs by townships, especially for road maintenance, can help improve water quality within the watershed.

U.S. Army Corps of Engineers (USACE)

USACE plays a major role in wetland protection and regulation through Section 404 of the Clean Water Act, which requires USACE to administer permit applications for alterations to wetlands. The USACE Chicago district has also established a Wetlands Restoration Fund.

U.S. Fish and Wildlife Service (USFWS)

The USFWS provides technical assistance to local watershed protection groups. It also administers several grant and cost-share programs that fund wetland and aquatic habitat restoration.

4.7. Potential Funding Sources for Watershed Restoration Activities

Implementation of the Thorn Creek Watershed Based Plan will require the development of numerous partnerships. Local groups as well as state and federal agencies will need to be involved. No single program or funding source will be sufficient to fully implement the Watershed Based Plan.

The development of partnerships is often a time-consuming process. Each project will be different. Each will raise different ecological, political and financial issues. Different projects will also attract different partners. In sum, each project will be idiosyncratic.

Since each project will be different, specific staff or volunteers should strive to develop relationships with individual agencies and organizations, recognizing that the funding opportunities might not be readily apparent. Often, watershed groups find that writing proposals or applications is not sufficient to obtain funding. Groups generally receive funds only after a concerted effort to seek out and engage specific partners for specific projects, fitting those projects to the interests of the agencies and organizations.

Partnerships can also focus on resources other than monetary funding, such as technical assistance. In the following pages, several state and federal programs are listed. In combination with local efforts, these programs can play an important role in the implementation of the Thorn Creek Watershed Plan.

U.S. Army Corps of Engineers (USACE)

The Army Corps' Civil Works programs involve the planning, design, construction management, operation and maintenance of water resources projects to meet the nation's flood and storm damage reduction, navigation, environmental restoration, hydropower, recreation and other water related needs.

Flood Hazard Mitigation and Riverine Ecosystem Restoration Program ("Challenge 21") — focuses on non-structural, sustainable approaches to flood protection, including watershed-based planning, conservation of wetlands, relocation of buildings out of the floodplain, riparian restoration, and pre-disaster mitigation planning. Funding has not yet been authorized.

Eligibility: Local governments; study area must be within a floodplain.

Assistance: Federal–local cost share at 50 percent federal funding for studies and 65 percent for project implementation. Maximum federal allocation is $30 million.

Website: http://www.saw.usace.army.mil/floodplain/Challenge%2021.htm.

Contact: USACE (Headquarters) Planning Division, 20 Massachusetts Avenue NW, Washington, DC 20314. Phone: 202-761-4750

Continuing Authorities Program — provides USACE with the authority to respond quickly to water resources problems. Some of the legislative authorities of the program include Aquatic Ecosystem Restoration (Section 206), Environmental Dredging (Section 312), Environmental Restoration (Section 1135). See website for full listing.

Eligibility: Local public entities

Assistance: Federal–local cost share at percentages that vary depending on the program.

Website: The USACE Vicksburg District provides an overview of the Continuing Authorities Program at http://www.mvk.usace.army.mil/Offices/pp/Projects/Small_Projects_Program/basics.htm.

Contact: USACE Chicago District, 111 N. Canal St, Suite 600, Chicago, IL 60606. Phone: 312-846-5498

Federal Emergency Management Agency (FEMA)
Besides spearheading the federal response to natural and other disasters, FEMA manages a number of programs that assist communities in disaster planning and hazard mitigation.

Flood Mitigation Assistance (FMA) — Helps states and communities identify and implement measures to reduce the risk of flood damage to structures insured under the National Flood Insurance Program (NFIP). Gives planning grants to assist in the development of Flood Mitigation Plans as well as project grants for implementation measures that reduce flood losses, such as elevation, relocation, demolition, acquisition of insured structures and property, floodproofing, and minor structural projects that reduce the risk of flood to insured structures.

Eligibility: State agencies, NFIP communities, qualified local organizations, Tribal governments.

Assistance: Federal–local cost share at a maximum of 75 percent federal funding.

Website: http://www.fema.gov/fima/fma.shtm

Contact: FEMA Region 5, 536 South Clark St., Chicago, IL 60605. Phone: 312-408-5500

Hazard Mitigation Grant Program (HMGP) — used to implement long-term hazard mitigation measures following a major disaster declaration. Used in Illinois for post-disaster floodplain building buy-outs and elevation, relocation, retrofit, and demolition on public or private land.

Eligibility: State and local governments, qualified non-profit organizations, Tribal governments.

Assistance: Federal–local cost share at a maximum of 75 percent federal funding.

Website: http://www.fema.gov/fima/hmgp/

Contact: Illinois Emergency Management Agency, 110 East Adams Street, Springfield, IL 62701-1109. Phone: 217-782-8719. E-mail: RDavis@iema.state.il.us

Pre-Disaster Mitigation Program (formerly Project Impact) — for the implementation of a pre-disaster mitigation program by states and communities in reducing risk to the population, the costs and disruption caused by severe property damage, and the cost to all taxpayers of Federal disaster relief efforts. Funded projects include: acquisition, relocation, elevation, and strengthening of structures; development of standards to protect structures from disaster damage; and drainage improvement projects.

Eligibility: State and local governments, universities, territories, tribal governments.

Assistance: Federal–local cost share at a maximum of 75 percent federal funding, $3 million cap on federal portion.

Website: http://www.fema.gov/fima/pdm.shtm

Contact: FEMA Region 5, 536 South Clark St., Chicago, IL 60605. Phone: 312-408-5500

U.S. Environmental Protection Agency (USEPA)
In addition to issuing federal environmental regulations and enforcing federal environmental law, USEPA manages a number of grant programs on a variety of initiatives.

Clean Water Act Section 319 Grants — Provides funding for implementing corrective and preventative BMPs on a watershed scale, for the demonstration of innovative BMPs on a nonwatershed scale, and the development of information/education NPS pollution control programs. Administered by Illinois EPA.

Eligibility: State and local governments, nonprofits, individuals, businesses.

Assistance: Federal–local cost share at 60 percent federal funding. Funding on reimbursement basis.

Website: http://www.epa.state.il.us/water/financial-assistance/non-point.html

Contact: Illinois EPA, 1021 North Grand Avenue East, P.O. Box 19276, Springfield, Illinois, 62794-9276. Phone: 217-782-3362

Clean Water State Revolving Loan Funds (SRF) — Initially designed for wastewater treatment plant upgrades, USEPA now encourages the loans' use for other watershed and nonpoint source control measures. These can include projects such as agricultural and urban runoff control, wet weather flow control including stormwater and sewer overflows, buffers, wetland protection, and habitat restoration. Encourages community-based comprehensive watershed management. Currently IEPA targets its funding only to point source control, i.e., upgrading wastewater infrastructure, but there has been discussion of setting aside some SRF funds for nonpoint source control programs.

Eligibility: State and local governments, nonprofits, individuals, businesses.

Assistance: Funds projects at 100 percent of cost at a national average interest rate of 2.2 percent.

Website: http://www.epa.gov/owmitnet/cwfinance/cwsrf/

Contact: Illinois EPA, 1021 North Grand Avenue East, P.O. Box 19276, Springfield, Illinois, 62794-9276. Phone: 217-782-3362

Five Star Restoration Challenge Grants — This program brings together citizen groups, corporations, youth groups and students, landowners, and government agencies to undertake projects that restore streambanks and wetlands. Projects must include a strong on-the-ground wetland or riparian restoration component, and should also include education, outreach, and community stewardship. Jointly administered by the National Fish and Wildlife Foundation, the National Association of Counties, and the Wildlife Habitat Council, and mainly funded by USEPA.

Eligibility: Requires at least five or more partnering organizations.

Assistance: $5,000 to $20,000 with an approximately 28 percent grant acceptance rate. Competitive projects have at least a 1:1 match, but are often higher.

Website: http://www.nfwf.org/programs/5star-rfp.htm

http://www.epa.gov/owow/wetlands/restore/5star/

Contact: USEPA Wetlands Division, Room 6105 (4502 T), 1200 Pennsylvania Avenue, NW, Washington, DC. Email: price.myra@epa.gov

Water Quality Cooperative Agreements — To assist public or nonprofit organizations in developing, implementing, and demonstrating innovative that reduce wastewater related pollution. Primarily meant to fund exemplary projects (e.g., new BMPs) that increase and transfer knowledge. Not to be used for land acquisition and development.

Eligibility: States, public agencies, and nonprofit organizations.

Assistance: $10,000 to $500,000 with no local match requirement, although match offers are considered during evaluation.

Website: http://www.epa.gov/owm/wqca/2004.htm

Contact: USEPA Region 5, 77 W. Jackson Blvd. Chicago, IL 60604. Phone: 312-353-4378.=

Wetland Program Development Grants — Meant to address USEPA's national wetlands program priorities: strengthening state comprehensive wetland program, developing a comprehensive wetland monitoring and assessment program, improving the effectiveness of compensatory mitigation, and refining the protection of vulnerable wetlands and aquatic resources. Must advance wetland programs on a national basis.

Eligibility: States, local governments, public agencies, interstate agencies.

Assistance: $50,000 to $420,000 grants with 25 percent local match. May partially fund proposals.

Website: http://www.epa.gov/owow/wetlands/grantguidelines/

Contact: US EPA Region 5, 77 West Jackson Blvd., Chicago, IL, 60604. Phone: 312-886-0241 Email: garra.catherine@epa.gov.

Assessment and Watershed Protection Program Grants — Intended to develop innovative approaches to watershed protection, make a contribution to the body of restoration and management techniques, and transfer knowledge. Application of established techniques may be funded if doing so would contribute to the general understanding of an environmental problem. Awarded under Section 104(b)(3) of the Clean Water Act.

Eligibility: States, local governments, public agencies, nonprofit organizations, individuals.

Assistance: $5,000 to $80,000 with no local match requirement, although match offers are considered during evaluation as 10 percent of the ranking.

Website: http://www.epa.gov/owow/funding.html

Contact: USEPA Office of Wetlands, Oceans, and Watersheds, 1200 Pennsylvania Avenue, N.W., Washington, D.C. 20460. Phone: 202-566-1211, 202-566-1206

Targeted Watersheds Grants Program (formerly Watershed Initiative) — Funds projects that demonstrate innovative approaches to watershed restoration with an emphasis on interorganizational collaboration, market-based techniques, and demonstrable environmental improvement. Does not support activities directly required under the Clean Water Act.

Eligibility: Any public entity, but must be nominated by the state.

Assistance: $600,000 to $900,000 with 25 percent local match.

Website: http://www.epa.gov/owow/watershed/initiative/

Contact: USEPA Region 5, 77 W. Jackson Blvd. Chicago, IL 60604. Phone: 312-886-7742. Email: thomas.paul@epa.gov

State Wetlands Protection Grants — For development of new wetland protection, management, and restoration programs or refinement of existing programs. Can finance monitoring and assessment as well as river corridor restoration.

Eligibility: Primarily state governments, but has been expanded to include local governments and special districts.

Assistance: Federal–local cost share at 75 percent federal funding.

Website: http://www.epa.gov/region5/business/fs-swpg.htm

Contact: USEPA Region 5, Water Division, 77 W. Jackson Blvd. Chicago, IL 60604. Phone: 312-886-0241

US Department of Agriculture – Natural Resource Conservation Service (NRCS)

The NRCS is the successor agency to the Soil Conservation Service. It partners with state conservationists' offices and provides funding and technical assistance to landowners to promote soil and water conservation.

Environmental Quality Incentives Program (EQIP) — Sets up contracts to provide incentive payments and cost-shares to implement conservation practices.

Eligibility: Non-federal landowners engaged in farming or ranching.

Assistance: Federal share at a maximum of 75 percent, $450,000 aggregate cap on EQIP contracts. Beginning farmers and ranchers, as well as limited resource producers, may obtain a 90 percent cost-share.

Website: http://www.nrcs.usda.gov/programs/eqip/

Contact: USDA–NRCS, 500 C Street, SW Washington, D.C. 20472. Phone: (202) 566-1600

Conservation Reserve Program (CRP) — This voluntary program offers annual rental payments, incentive payments for certain activities, and cost-share assistance to remove highly erodible cropland or sensitive acres from crop production. Program encourages farmers to plant long-term resource-conserving vegetative cover to improve soil, water, and wildlife resources. Eligible practices include riparian buffers along streams, ditches, lakes, wetlands, and ponds; grass or contour filter strips; and windbreaks. Funds also may be used to retire agricultural floodplain land. Administrated by Farm Service Agency.

Eligibility: Non-federal landowners engaged in farming or ranching.

Assistance: Farmers receive compensation, based on agricultural rent, for retiring sensitive land over a multiyear contract.

Website: http://www.fsa.usda.gov/dafp/cepd/crp.htm

Contact: USDA–Farm Service Agency, 1400 Independence Ave, SW Washington, DC 20250-0506 Phone: 800-457-3642

Emergency Watershed Protection Program (EWP) — Meant to respond to damage caused by natural disasters. Provides assistance to reduce hazards to life and property in watersheds from erosion and flooding due to severe natural events. May be used for establishing vegetative cover, opening restricted channels, repairing diversions and levees, and to purchase floodplain easements on flooded land in non-urban areas.

Eligibility: Public and private landowners with a project sponsor, i.e., a state or local government or special government district. Applications must be submitted within 60 days of disaster or 10 days if exigent.

Assistance: Up to 75 percent federal cost-share for projects.

Website: http://www.nrcs.usda.gov/programs/ewp/

Contact: USDA–NRCS, Financial Assistance Programs Division, 1400 Independence Ave., SW, Room 6103A-S, Washington, DC 20250. Phone: 202-690-0793

Soil and Water Conservation Assistance — Provides cost share and incentive payments to farmers and ranchers to voluntarily address threats to soil, water, and related natural resources, including grazing land, wetlands, and wildlife habitat. Requires a conservation plan and certification of eligible conservation practices by state conservationist.

Eligibility: Farmers and ranchers who own or control land.

Assistance: 5 to 10 year contracts with NRCS, 75 percent federal cost share on a reimbursement basis for eligible practices, $50,000 maximum benefit.

Website: http://www.nrcs.usda.gov/programs/swca/

Contact: USDA–NRCS, 1400 Independence Ave., SW, Washington, DC 20250. Phone: 202-720-1873

Watershed Protection and Flood Prevention Program (PL 83-566) — Program includes Watershed Surveys and Planning as well as Watershed Operations. The latter provides funding for installing conservation practices in small watersheds for flood prevention, erosion and sediment control, water quality, habitat enhancement, wetland creation and restoration.

Eligibility: Sponsorship by a state/local government or special government district, watershed less than 250,000 acres, 20 percent of direct benefits of project accrue to agriculture.

Assistance: Project grants.

Website: http://www.nrcs.usda.gov/programs/watershed/index.html#Watershed_ops

Contact: USDA–NRCS, 14th and Independence Avenue, SW, Washington, DC 20250. Phone: 202-720-8770

Wetlands Reserve Program — Provides funds to purchase easements or assist in a cost-share agreement with landowners to restore wetlands and floodplain habitat on private land.

Eligibility: Individual landowners who have owned the land for at least one year.

Assistance: Permanent easement purchased by USDA with 100 percent of restoration funded by federal government; thirty year easement purchased by USDA with 75 percent of restoration funded federally; or restoration cost-share only with USDA contributing 75 percent of cost.

Website: http://www.nrcs.usda.gov/programs/wrp/

Contact: USDA–NRCS, 14th and Independence Avenue, SW, Washington, DC 20250. Phone: 202-720-1062

Wildlife Habitat Incentives Program (WHIP) — Provides funding and technical assistance for private landowners to develop and improve fish and wildlife habitat. Landowner enters into cost-share agreement with NRCS to, for instance, restore aquatic habitat through management or engineering measures.

Eligibility: Private lands and some federal, state, and local government lands.

Assistance: Cost-share for projects with increased assistance for agreements longer than 15 years.

Website: http://www.nrcs.usda.gov/programs/whip/

Contact: USDA–NRCS, 14th and Independence Avenue, SW, Washington, DC 20250. Phone: 202-720-1062

National Park Service (NPS)

Manages the nation's system of national parks, historic sites, and special areas and serves as a conduit for certain recreation-related conservation funding.

Land and Water Conservation Fund (LWCF) — Provides funds to states and localities for park and recreational land planning, acquisition, and development. Public access must be granted in perpetuity. Awarded through Illinois Department of Natural Resources, which also manages a similar program, using state funding, called the Open Space Lands Acquisition and Development (OSLAD) Program. Points are generally awarded for applications that place natural resources in protection.

Eligibility: Local government agencies with statutory authority to develop land for park purposes.

Assistance: Up to $750,000 for acquisition projects, with 50 percent match.

Website: http://dnr.state.il.us/ocd/newoslad1.htm

Contact: Illinois DNR, One Natural Resources Way, Springfield, IL 62702. Phone: 217-782-6302

Challenge Cost-Share Program (CCSP) — Provides matching funds for a variety of projects relating to conservation, natural area enhancement, and recreation. Tends to fund projects on or near lands managed by the National Park Service.

Eligibility: State and local governments, private nonprofit organizations.

Assistance: Up to $30,000 with 50 percent match.

Website: http://www.nps.gov/ncrc/programs/ccsp/index.htm

Contact: National Center for Recreation and Conservation, NPS, 1849 C Street NW (Org. Code 2220), Washington, DC 20240. Phone: 202-354-6912

U.S. Department of the Interior, Fish and Wildlife Service (USFWS)

The USFWS manages programs to protect wildlife and wildlife habitat by means such as issuing rules for hunters and anglers, administrating the Endangered Species Act (alongside NOAA), and awarding grants for environmental restoration.

Coastal Program — Provides grants that can be used for habitat restoration and in-stream habitat restoration, among other purposes.

Eligibility: Individuals, state and local governments, universities, non-profit organizations.

Assistance: Project grants at 50 percent local match. Award typically varies between $5,000 and $50,000.

Website: http://www.fws.gov/cep/cepcode.html

Contact: USFWS, Branch of Habitat Restoration, Room 400, 4401 N. Fairfax Blvd., Arlington VA 2220. Phone: (703) 358-2201

USFWS, 2651 Coolidge Rd, East Lansing, MI 48823. Phone: (517) 351-8470

Challenge Cost Share Program — Provides grants for conservation practices, ecosystem protection, and enhancement of wildlife and plant habitat.

Eligibility: Individuals, businesses, federal/state/local government units, universities, non-profit organizations.

Assistance: Project grants at 50 percent local match. Average award is about $7,800.

Website: See Catalog of Federal Domestic Assistance (15.642), http://www.cfda.gov.

Contact: USFWS, National Wildlife Refuge System, 4401 N. Fairfax Drive, Suite 670, Arlington, VA 22203. Phone: 703-358-1744.

Private Stewardship Program — Provides cost share funding for on-the-ground conservation practices by private landowners or community groups that benefit threatened or endangered species or otherwise at-risk species.

Eligibility: Individuals, businesses, private nonprofit organizations, local or county governments. States not eligible. Cooperating private landowners must be identified in proposals.

Assistance: Project grants at 10 percent local match. Average award about $70,000.

Website: http://endangered.fws.gov/grants/private_stewardship/index.html

Contact: USFWS Region 3, One Federal Drive, Fort Snelling, MN 55111-4056. Phone: 612- 713-5343

Partners for Fish and Wildlife Programs — Program to assist private landowners in restoring habitat in accordance with USFWS goals, including, for example, restoration of wetland hydrology, use of prescribed burns, planting with native vegetation, etc. Wetlands are the primary focus of the program in Illinois. Landowners enter into at least a 10 year agreement to refrain from returning the land to its former use or otherwise nullifying the restoration.

Eligibility: Non-state and non-federal landowners.

Assistance: Project grants at 50 percent local match.

Website: http://www.fws.gov/partners/

Contact: USFWS, Branch of Habitat Restoration, Room 400, 4401 N. Fairfax Blvd., Arlington VA 2220 Phone: (703) 358-2201

USFWS, 2651 Coolidge Rd, East Lansing, MI 48823. Phone: (517) 351-8470

Northeastern Illinois Wetlands Conservation Account — For restoration, enhancement, and/or replacement of wetland functions and values which have been degraded or destroyed as a result of activities conducted in violation of the Clean Water Act or the Rivers and Harbors Act. Also funds activities that promote understanding, appreciation, and stewardship of wetlands. Meant for on-the-ground restoration.

Eligibility: Governmental agencies, non-profit conservation organizations, and private home owner associations.

Assistance: Project grants between about $650 to $200,000, averaging at $38,000.

Website: http://www.fws.gov/midwest/chicago/neiwca2004rfp.htm

Contact: USFWS Chicago Illinois Field Office, 1250 South Grove Ave., Suite 103, Barrington, IL 60010. Phone: 847-381-2253

U.S. Department of Transportation (DOT)

Among its other duties, this federal agency regulates the federally mandated metropolitan planning process and administrates federal transportation funding.

Transportation Enhancement Program (TEA-21) — Projects can include, among other things, control technologies to prevent polluted highway runoff from reaching surface water bodies, scenic easements, pedestrian and bicycle trails, and wetland mitigation efforts including mitigation banking, wetland preservation and restoration, wetland planning, and natural habitats. Projects must relate to surface transportation and fall into one of twelve eligible categories. May be standalone projects unrelated to larger transportation facility. Funding disbursed through State of Illinois.

Eligibility: Local government units with taxing authority.

Assistance: 80 percent federal share of project costs in general, 50 percent for acquisition. Awards rarely over $2 million. Grant acceptance rate about 25 percent.

Website: http://www.fhwa.dot.gov/environment/te/overview.htm (Federal), http://www.dot.il.gov/ opp/itep.html (Illinois)

Contact: Illinois DOT, 2300 S. Dirksen Pkwy., Springfield, IL 62764. Phone: 217-782-7820.

National Oceanic and Atmospheric Administration (NOAA)

NOAA guides the conservation and management of coastal resources through a variety of mechanisms, including collaboration with the coastal resource management programs of states and US territories.

Coastal Zone Management Program (CZMP) — Voluntary program that assists states in implementing Coastal Zone Management programs approved by NOAA. Generally supports large and small projects by local governments and non-profit organizations through the Coastal Zone Enhancement Grants Program (Section 309, Coastal Zone Management Act). In November 2004, Gov. Blagojevich indicated that Illinois would join CZMP. It is expected that funding will become available for watershed projects in upcoming years.

Coastal Services Center Cooperative Agreements — Provides technical assistance and project grants through a range of programs and partnering arrangements, all focused on protecting and improving coastal environments.

Eligibility: Varies by program, but includes state and local governments, universities, non-profit corporations, and others.

Assistance: Project grants and cooperative agreements.

Website: http://www.csc.noaa.gov/funding/

Contact: 2234 South Hobson Avenue, Charleston, SC 29405-2413. Phone: 843-740-1200

Illinois Department of Natural Resources (IDNR)

Conservation 2000 — Supports nine conservation programs across three state agencies, such as the Ecosystem program to support the Ecosystem Partnerships.

Eligibility: Varies by program.

Assistance: Project grants, varies by program.

Website: http://dnr.state.il.us/orep/c2000/

Contact: IDNR Region 2, 2050 W. Stearns Road, Bartlett, IL 60103. Phone: 847-608-3100.

Urban Flood Control Assistance — IDNR Office of Water Resources technical assistance program that involves initial study process and determination of appropriate flood control solution. Depends on General Assembly appropriations for tributary studies and project feasibility investigations, focused on structural flood control solutions.

Eligibility: Local sponsorship, positive net benefit formally shown by benefit-cost analysis, membership in good standing in National Flood Insurance Program

Assistance: Varies with appropriation.

Website: http://dnr.state.il.us/owr/OWR_programs.htm

Contact: IDNR Office of Water Resources, One Natural Resources Way, 2nd Floor, Springfield, Illinois 62702-1271. Phone: (217) 782-4637.

Small Projects Fund — IDNR Office of Water Resources program that provides direct assistance to rural and smaller urban communities statewide to reduce stormwater related flood damages by alleviating localized, significant drainage and flood problems.

Eligibility: Local government sponsorship, membership in good standing in National Flood Insurance Program.

Assistance: Maximum of $100,000 per locality.

Website: http://dnr.state.il.us/owr/OWR_programs.htm

Contact: IDNR Office of Water Resources, One Natural Resources Way, 2nd Floor, Springfield, Illinois 62702-1271. Phone: (217) 782-4637.

4.8. Information and Education in the Thorn Creek Watershed

A watershed improvement plan must include a strategy for informing and educating the public and stakeholders about watershed issues and for encouraging them to take action and change behavior. This is especially true for non-point source pollution prevention because it is the product of activities of many people in the watershed. Furthermore, the general public is often unaware of the impact of day-to-day activities on environmental resources. An understanding of watershed issues and how individual activities can play a role in protecting water quality helps provide the motivation and basis for changing behavior. Informing and educating, providing opportunities for the public to get involved in watershed activities, and installing demonstration projects can help effect behavioral change.

This section of the plan provides a general strategy for information, education, and public involvement specifically for addressing the water quality impairments in the Thorn Creek watershed. However, the ideas and approach presented here can be adopted for a wide variety of watershed topics and issues from recreation to terrestrial habitat improvement. The principal Thorn Creek watershed organizations should consider developing a separate education committee to help build and implement a more detailed information and education campaign. Section 4.8.7 provides of summary table of the outreach strategies associated with the identified sources of impairment in the Thorn Creek watershed.

4.8.1. GOALS AND OBJECTIVES OF THE INFORMATION AND EDUCATION STRATEGY

The Thorn Creek Watershed stakeholders identified the following goals and objectives for Education and Stewardship.

Goal

- Educate the public, public officials, community leaders, businesses, and developers about the watershed and their impact and role in protecting watershed resources.

  Objectives

  - Develop and disseminate watershed planning and protection information to the public and community leaders and decision-makers.
  - Develop public relations and media strategies to educate, involve, and invigorate the public and community leaders and decision-makers.

Goal

- Increase involvement in watershed leadership, stewardship, monitoring, and volunteer activities.

  Objectives

  - Encourage stewardship, coordination, cooperation, and best management practice implementation with key corporate and political entities.
  - Create and implement short and long-term maintenance, management and monitoring plans for all protected open space including uplands, wetlands, waterways, stormwater conveyance and detention/retention facilities and lakes.

4.8.2. TARGET AUDIENCES

To define the audience for educational outreach, contacts should be made with people, organizations, and decision-makers within the Thorn Creek watershed community to determine their level of understanding of watershed issues and needs for further education. The intent is to include both existing partners, as well as stakeholders that previously have not been participants, and to be responsive to their needs for information.

The primary target audiences for this plan are residents, landowners, and local government officials. More specifically, potential target audiences include:

- Landowners and property managers along the stream bank and tributaries.
- Developers and property owners that will propose intensive land use changes.
- Municipalities, counties, park districts, forest preserve districts, and other local governments that manage land within the watershed.
- Residents and landowners within the watershed.
- Consultants (architects, engineers, planners, landscapers) working in the watershed.
- Organizations, committees, agencies, and groups interested in the future and management of Thorn Creek watershed resources.

The various target audiences will need to hear different messages through different delivery mechanisms, as determined through the initial contact mentioned above. Section 4.7.4 below provides a number of ideas for crafting and delivering messages for watershed information and education. While water quality and non-point source pollution are the primary issue areas for this plan, these messages should be linked with other related issues, such as terrestrial habitat improvement, recreation, water supply, and flooding.

4.8.3. POSSIBLE PARTNERING ORGANIZATIONS

Partnering organizations typically include the same organizations that will be responsible for implementing the watershed plan Watershed Management Recommendations. Each partner should couple all plan implementation efforts with parallel efforts to inform and educate.

- Citizen Advocacy Groups (CAG)
- Corporate and Business Landowners (CBL)
- Counties (all departments) (CO)
- Developers (D)
- Federal Emergency Management Agency (FEMA)
- Forest Preserve Districts (FPD)
- Golf Courses (GC)
- Homebuilders (H)
- Illinois Department of Natural Resources (IDNR)
- Illinois Department of Transportation (IDOT)
- Illinois Emergency Management Agency (IEMA)
- Illinois Environmental Protection Agency (IEPA)
- Illinois Tollway Authority (ITA)
- Metropolitan Water Reclamation District (MWRD)
- Municipalities (all departments) (M)
- Natural Resources Conservation Service (NRCS)
- Northeastern Illinois Planning Commission (NIPC)
- Park Districts (PD)
- Private Residential Landowners (PRL)

- Soil and Water Conservation Service (SWCD)
- Thorn Creek Ecosystem Partnership (TCEP)
- Thorn Creek Restoration Coalition (TCRC)
- Townships (T)
- United States Army Corps of Engineers (USACE)

4.8.4. IDEAS FOR IMPLEMENTING THE THORN CREEK INFORMATION AND EDUCATION STRATEGY

Estimated costs are included below, using **($ Amount)** boldface notation, if they have been implemented or calculated in the course of past projects.

General Guidance

- Keep messages simple and straightforward, with only two or three take-home points at a time, and use graphics and photos to illustrate the message.
- Identify and provide for the different needs of various audience groups. When interacting with a group, stress the dimensions of the Thorn Creek project that apply most to them. For example, when interacting with homeowners, focus on items like rain gardens, lawn care, riparian buffers etc. Develop a similar "menu" of topics for each target audience.
- Coordinate the information and education strategy with partner organizations.
- All materials and messages should promote the local watershed groups (TCEP and TCRC) with contact information and "how to get involved" information.
- Work to correct perception problems, such as Thorn Creek being viewed as a drainage ditch rather than as a community asset to be protected and enjoyed.
- Basic watershed science education (e.g., biology, the water cycle, stream ecology) may be needed when the audience has little knowledge about the creek or watershed.

Direct Mailing and Outreach

- Materials targeted to landowners and businesses along the creek to help them understand riparian systems, streambanks, and ways to improve them. **($3,000)**
- Individual quick-read "issue factsheets" on watershed issues periodically sent to municipal officials as well as other leaders and decision-makers. **($5,000)**
- One-on-one outreach, especially to municipal officials and other local decision makers. **($30,000)**

Media and Marketing Campaign

- Develop a media advisory board with media representatives, experienced public relations experts, and representatives from other watershed groups with media experiences.
- To respond to public inquiries prompted by media coverage, prepare a brochure for mailing that describes the TCEP and TCRC to those interested.
- Develop a Partnership website to publicize watershed efforts, events, basic watershed information, resources, and useful links.
- Create and implement a public relations and marketing campaign to include advertisements and outreach via local newspapers, village newsletters, community meetings, and TCEP/TCRC newsletters.

- Create a media kit and identify media outlets (radio, TV, newspaper), using the IDNR list of contacts as a starting point. **($2,500)**
- Use paid advertising — direct mail, newspaper ads, cable TV commercials — targeted to streamside landowners and residents.
- Send e-mail "alerts" to municipalities regarding water-related conferences, information, strategies, etc.
- Contribute articles to local periodicals and publications.
- Determine appropriate elements of a media packet, including a map of the watershed.
- Coordinate an entertaining, outdoor event for media representatives.
- Develop on-going media relations procedures.

Technical Workshops and Conferences

- Coordinate hands-on educational workshops highlighting nonpoint source pollution and existing restoration activities (e.g., streambank stabilization projects).
- Organize and fund a series of technical workshops targeted towards separate stakeholders, e.g., government officials, developers, professional consultants like engineers, landscape architects, etc., and private citizens. The workshops should educate each group as to what the current problems are in the watershed, what caused the problems, and what actions each target group can take to facilitate a solution. These technical workshops may be sponsored by organizations such as NIPC, Illinois Water & Environment Association (IWEA), IEPA, American Public Works Association (APWA), the Illinois Society of Professional Engineers (ISPE), and others. **($5,000 each)**
- General and technical workshops and presentations targeting municipal leaders, engineers, public works officials, planners, and others to teach basics of water quality and watershed management. Also utilize government associations such as the South Suburban Mayors and Managers Association.

Manuals and Technical Resources

- Encourage watershed communities to pursue technical assistance from the appropriate agencies to encourage compatible development in the watershed which minimizes non-point source impacts.
- Identify funding and sources of support and distribute to potential implementers in the watershed. Distribute IDNR list of grantors for watershed protection projects. **($3,000 for a funding guide.)**
- Provide annual grant writing workshops to target audiences.

Public Involvement, Stewardship, and Community Events

- Encourage development of subbasin leaders and groups to promote watershed education, volunteer, and stewardship opportunities. Encourage involvement of or leadership by municipalities in these new groups.
- Emphasize direct involvement opportunities such as stream clean-up events, canoe trips, watershed bus tours, river walks, restoration projects, and hands-on learning events. Hold special events for public officials and staff.

- Create a self-guided tour of the watershed highlighting scenic spots, natural areas, wetlands, trails, and areas of concern such as streambank erosion sites, stormwater outfalls, and urban run-off sites.
- Develop a recognition program for watershed improvement efforts of industry, business, schools, citizens, elected officials, and environmental groups implementing non point source pollution control projects. Hold an annual award ceremony. Publish a directory of outstanding Thorn Creek watershed management projects.
- Develop a storm drain stenciling or button campaign. Distribute door hangers to explain storm drain stenciling efforts
- Develop an "Adopt a Stream" program
- Arrange site visits and interpretive signs installed at BMP installation sites.
- Establish a hotline or notification system to report fly dumping or illicit sanitary sewer connections.

School Based Education

- Create a hands-on Thorn Creek watershed curriculum, including hands-on watershed ecology and nonpoint source pollution training for teachers, field trips, chemical test kits, nets, sampling equipment, wildlife identification books, etc.
- Hold workshops for teachers and an annual student congress.
- Develop and disseminate to educators a list of watershed education resources for use in K-12 classrooms.
- Maintain a group of trained student and teacher volunteers and create service learning opportunities for 1000 students annually such as clean ups and monitoring.
- Create and maintain a school network web site and water quality database.

Public Education

- Develop multiple messages — one broader message for the general public and a series of more specifically targeted messages for specific audiences along the creek (landowners, business owners, municipalities, etc.)
- Watershed map/poster/brochure that includes pollution control strategies, watershed principles, factoids about the watershed, etc. Focus on recreational opportunities.
- Install watershed road signs at stream crossings: "You are entering the Thorn Creek Watershed. Please help protect our stream." **($500 each)**
- Create an education program and materials as well as watershed conferences, workshops, and meetings for community leaders, government agencies, and the public.
- Hold river conferences and workshops for various audiences – municipalities, landscapers, riparian owners, etc.
- Create general watershed and water quality education materials including a watershed slide show on CD and enlist volunteers for distribution. **($3,000)**
- Develop hands-on educational workshops focused on restoration activities as well as a traveling exhibit.
- Design a set of BMP manuals for your various target audiences: residents, streamside landowners, business, municipalities, corporate campuses, educational campuses, religious organizations, etc.

- Create a database of grantors, grant programs and grant writing workshops.
- Create and disseminate a guide for responsible stormwater management in the Thorn Creek watershed or a pamphlet for landowners with small-scale practices. **($8,000)**
- Hold stormwater open houses for professionals, engineers, consultants, and planners to share knowledge and techniques.
- Coordinate the publication and distribution of a professionally produced watershed-awareness video developed to educate concerned citizens and students via classroom science classes.

Demonstration Projects
- Restoration projects.
- Demonstration projects such as detention basin retrofits. Capital projects are typically expensive, but they can provide both direct, physical improvement as well as public education.

Possible Message Delivery Mechanisms
- One on one contact.
- Presentations to targeted groups.
- Press releases and news articles in local papers.
- Public service announcements or programs on local cable channel.
- Watershed project newsletter.
- Watershed project website with links to related sites.
- Watershed tours.
- Watershed signs.
- Inserts in agency newsletters.
- Workshops targeted to specific audiences.
- Special events and activities such as water festivals, stream clean-ups, or storm drain stenciling.
- Presentations at regularly scheduled meetings of townships, planning commissions, associations, or other groups.

4.8.5. EVALUATING THE OUTREACH PLAN

Evaluation provides a feedback mechanism for ongoing improvement of your outreach effort and for assessing whether the effort is successful. It also builds support for further funding. The following ideas should be customized to particular needs of the party responsible for implementing the education and information campaign. For a number of these evaluation strategies, baseline information should be collected before the outreach activities begin and checked periodically throughout the outreach campaign to help measure progress and effectiveness.

Actual reduction in impairment of water quality in Thorn Creek is perhaps the best indicator of outreach effectiveness. While it is difficult to attribute water quality improvement to specific outreach strategy programs or actions, there is little doubt that increased understanding and involvement in the watershed is essential to watershed improvement. See Section 5 (Plan Implementation Evaluation) for specific information on education and monitoring strategy. Section 4.8.6 below contains a list of further resources for evaluating the outreach effort.

4.8.6. WATERSHED INFORMATION AND EDUCATION RESOURCES

The following resources include effective outreach messages, delivery techniques, and strategies to assist with developing an outreach campaign.

- See http://clean-water.uwex.edu/basins/basined.html for links to University of Wisconsin Extension and Wisconsin Priority Watershed Program resources, including "how-to" guides on educational programming and the promotion of voluntary approaches to reducing nonpoint source pollution.
- Water Quality Fact Sheets:
  - The Shoreland Stewardship Series— Water quality and natural resources articles of special interest to farmers, urban property owners, waterfront property owners and others.
  - Stormie's Clean Water Tips Series — A series of water quality fact sheets about stormwater runoff, featuring the character "Stormie."
  - Yard Care & the Environment Series — A series of water quality fact sheets for residential areas.
  - Polluted Urban Runoff – A Source of Concern — A detailed look at urban runoff pollution, including tips on how to prevent it.
  - Erosion Control for Home Builders — Methods of preventing soil erosion during home construction, including a look at lawn sodding and seeding, silt fences and a sample erosion control plan.
  - Standard Erosion Control Plan For 1-and 2-family dwelling construction sites — This worksheet includes a site diagram template and a checklist of site characteristics, erosion control practices, and management strategies.
  - Pet Waste and Water Quality — Why pet waste is a concern, and what you can do about it.
  - Brown Water, Green Weeds: Familiar Signs of Runoff Pollution — This worksheet includes information about the effects of runoff pollution on streams and wildlife. Sediments and nutrients cause many of the problems we see in streams and lakes.
  - Shoreline slideshow — http://clean-water.uwex.edu/pubs/margin/sld001.htm
  - Land and Water stewardship articles — http://cleanwater.uwex.edu/pubs/stewards/index.html
  - Educator gateway page — http://clean-water.uwex.edu/bassites.html
- The Stormwater Manager's Resource Center (www.stormwatercenter.net) has good information and includes a "program resources" page that provides a list of materials useful for watershed education.
  - *The Practice of Watershed Protection:* Section Ten — Compiles articles on watershed stewardship from all past issues of the Center's technical journal, *Watershed Protection Techniques*. The articles are available for viewing and download in .PDF format and cover topics such as watershed education, watershed advocacy, and pollution prevention.
  - Key topics are covered elsewhere in *The Practice of Watershed Protection* (numbers below refer to chapter numbers):
    - *Watershed Education*
      126. Understanding Watershed Behavior
      127. On Watershed Education

    - *Watershed Advocacy*
      128. Choosing the Right Watershed Management Structure
    - *Pollution Prevention at Home*
      129. The Peculiarities of Perviousness
      130. Toward a Low Input Lawn
      131. Homeowner Survey Reveals Lawn Management Practices in Virginia
      132. Nitrate Leaching Potential From Lawns and Turfgrass
      133. Insecticide Impact on Urban and Suburban Wildlife
      134. Minimizing the Impact of Golf Courses on Streams
      135. Groundwater Impacts of Golf Course Development in Cape Cod
    - *Pollution Prevention at Work*
      136. Practical Pollution Prevention Practices Outlined for West Coast Service Stations
      137. Practical Pollution Prevention Emphasized for Industrial Stormwater
      138. Milwaukee Survey Used to Design Pollution Prevention Program
      139. Rating Deicing Agents: Road Salt Stands Firm
      140. Pollution Prevention for Auto Recyclers

- GREEN (Global Rivers Environmental Education Network) at www.green.org/resources/ — Includes resources for watershed information and education programs as well as a helpful list of technical resources.
- Washington State Department of Ecology, Water Quality Program Showcase of Exceptional Education Products at http://www.ecy.wa.gov/forms/showcase/ — This tool is primarily designed for environmental educators in the Pacific Northwest to find outstanding products related to non-point water pollution. The site comes with a searchable database of education products that come in a variety of formats, such as publications, videos, classroom materials, etc. Contact information is provided for products, along with a brief description and a rating system based on execution, effectiveness, relevance, and adaptability.
- USEPA Office of Water, Office of Wetlands Oceans, and Watersheds
    - Outreach Page at http://www.epa.gov/owow/watershed/outreach/outreachnonjs.html — Has many materials available to help educators understand and promote watershed protection. The types of materials available include watershed-related pictures and clip art, activities for children, watershed education events, and links to watershed related web sites.
    - Watershed Academy Web http://www.epa.gov/watertrain/ — The Watershed Academy was started by the U.S. Environmental Protection Agency's Office of Water in 1994 to provide training courses and educational materials on the basics of a watershed approach. The website includes web-based training modules that present a broad, basic introduction to watershed management. The training modules cover many watershed management topics and are divided into six watershed training themes. Web modules contain 25 to 50 color illustrations and photos on various topics and contain links for those seeking greater detail. Self-tests enable trainees to check their retention and see immediate results. The length and complexity of each module vary, requiring 0.5 to 2 hours each to complete. Completing a series of 15 of these modules earns a Watershed Academy Web Training Certificate.
    - *Getting in Step: A Guide for Conducting Watershed Outreach Campaigns* is available from the EPA at www.epa.gov/owow/watershed/outreach/documents — This guide provides a detailed outline of a watershed outreach program designed to educate and involve the public and key stakeholders in your planning efforts.

- Purdue University's "Know Your Watershed" website at http://www.ctic.purdue.edu/KYW/ — Provides information for watershed partnerships.
- The Illinois Watershed Management Clearinghouse at www.watershed.uiuc.edu — Provides assistance both for individuals seeking to form a watershed group and for more experienced groups that need to research a specific topic in detail. The References and Resources page provides links and descriptions to other websites and online tools related to watershed planning.
- The Conservation Foundation at www.theconservationfoundation.org — Many education and outreach materials for watershed groups and other conservation organizations.
- USEPA Nonpoint Source Control Branch at www.epa.gov/owow/nps/index.html — Provides educational resources specifically for non point source pollution control.
- The Center for Watershed Protection at www.cwp.org — Provides resources for watershed education and outreach.

4.8.7. SOURCES OF IMPAIRMENT AND OUTREACH STRATEGY

Impairment	Source	Target Audiences	Priority	Messages	Delivery Mechanism	Responsible Organization*	Timeline
Fecal Coliform, Dissolved Oxygen, Phosphorus/Nitrogen, Toxics, Hydrologic Modification	Urban runoff	Homeowners, other landowners, general public	2	Route downspouts to pervious areas, keep car in good repair, wash car on lawn or at commercial facilities, use nontoxic products, use natural landscaping, etc.	Brochures given out at events or mailed with garbage or wastewater bills, radio PSAs and other print or broadcast media, etc. Collect existing educational materials or create new ones. Consider per-connection wastewater fee to pay for ongoing education.	TCEP, TCRC	3–7 years
Toxics	Road salt and storage / highway maintenance and runoff	Municipal and highway officials and crew	2	Salt runoff is contributing to lower water quality; alternative deicing agents and improved application techniques are available.	Training in use of alternative deicing agents or more careful management of salt application. Approach county and municipal transportation departments at management level. Fund and develop training course.	SSMMA	0–3 years
Fecal Coliform, Dissolved Oxygen, Phosphorus/Nitrogen, Toxics	Point discharges / illicit stormsewer connections	General public, businesses, institutions, municipalities	1	Community should support comprehensive program for detecting illicit stormsewer connections. Pollution prevention in industrial processes and institutional operations in the watershed is important to decrease amount of permitted point discharge.	Public information (brochures, radio, etc.) on stormsewer connections. Educate businesses on pollution prevention strategies specific to the industry, provide information on funding and technical assistance available. Devise incentive program for recognizing achievements of specific businesses in pollution prevention.	TCEP, TCRC, IEPA	0–3 years
Phosphorus/Nitrogen	Agricultural activity	Farmers and owners of agricultural land	2	Utilize incentive programs to plant and maintain buffers, install other BMPs	Distribute literature from Natural Resource Conservation service on conservation incentive programs through targeted outreach.	TCEP, TCRC, SWCD	3–7 years
Fecal Coliform, Dissolved Oxygen	Animal waste	Residents, municipal officials, agricultural operators	2	Pick up after your pets; discourage geese from congregating around detention areas.	Brochures given out at events or mailed with garbage or wastewater bills, radio PSAs, etc.	TCEP, TCRC, SWCD	3–7 years
Fecal Coliform, Dissolved Oxygen	Sanitary sewer overflows / failure	Municipalities and wastewater facility operators	1	Reducing sanitary overflow, pump station failures, and system leaks are an important part of improving water quality; make commitment and seek funding to upgrade systems; ensure that system performance agreements are being met.	Direct outreach to municipal officials; provide information on successful wet weather flow reduction programs and funding available.	NIPC, TCEP, TCRC, TCBSD	3–7 years
Hydrologic Modification	Development (land use conversion)	Municipalities and developers	1	Ordinances needed to prevent building in floodplains, to protect riparian buffers, etc. Cook County stormwater program now in development can provide guidance and direction.	NIPC and SSMMA hold workshop on water resources ordinances for municipal officials. Meet with municipal and county staff annually; request updates at TCEP meetings.	NIPC, SSMMA	0–3 years
Dumping And Debris	Lack of enforcement	Municipalities, forest preserve districts	1	Law enforcement is the best means of stopping dumping; existing regulations have to be enforced to be effective; benefit of enforcement outweighs added cost.	Outreach to elected officials to raise awareness of problem of non-enforcement.	SSMMA	0–3 years

*NIPC = Northeastern Illinois Planning Commission; TCEP = Thorn Creek Ecosystem Partnership; TCRC = Thorn Creek Restoration Coalition; SSMMA = Southwest Suburban Mayors and Managers Association; SWCD = Soil and Water Conservation District

4.9. Action Plan Summary for Water Quality Improvement

Watershed stakeholders were asked to identify parties responsible for implementing recommended actions and the timeframe (or priority) that is needed for an action to achieve its objectives. In the table below, 1 = short term (0–3 years), 2 = mid-term (3–7 years), 3 = long-term (7–15 years), and C = Continuing/periodic. This table represents the composite judgment of a relatively small number of stakeholders, not all of whom felt they could offer an opinion on each WMR (which accounts for the blank cells in the table). A rough measure of priority was computed by ranking average scores for each WMR, but the actual numerical differences between scores for each WMR were very small. The top eight priority WMRs were 3, 27, 30, 4, 5, 8, 17, and 10. The rankings and the table should be considered only suggestive.

			Watershed Management Recommendations Related to Water Quality																						
Partner	**Average**	**Median**	**1**	**2**	**3**	**4**	**5**	**8**	**9**	**10**	**11**	**13**	**14**	**15**	**16**	**17**	**18**	**20**	**26**	**27**	**28**	**29**	**30**	**32**	**33**
Corporate and Business Landowners	**2**	**2**	2	2						2	2		3	2	2	2	2	2			2	2		2	
Counties	**2**	**2**	2	1	1	2	2	1	1	1	2	3	2	2	3	2	2	2	2		2		1	2	C
Developers	**2**	**2**	2	2	1	1				2	2		3	2	3	2	2	2			2	2			1
Federal Emergency Management Agency	**1**	**1**			1	1		2	2	1															
Forest Preserve Districts	**2**	**2**			1	1	2	2	2	2	2	3	2	2	2	2	2		2	1	2		1	1	2
Golf Courses	**2**	**2**		2			1	1		2	1		3	2	2	2	2	2			2			2	1
Homebuilders	**1**	**2**	1	2	1	1	1	1					2	2	C	2	2	2			2				1
Illinois Department of Natural Resources	**2**	**2**			1	1	1	2	2	2	1	3	1	2						1	C	3			2
Illinois Department of Transportation	**2**	**2**					1	1	1	2			3	3	3		2	2					1		
Illinois Emergency Management Agency	**2**	**2**	2		1	1		2	2	2					3										
Illinois Environmental Protection Agency	**2**	**2**		1				C		1	2	3			3			1				3		C	2
Illinois State Toll Highway Authority	**2**	**2**						1	1	1		1		2	2		2	2							
Metropolitan Water Reclamation District	**1**	**2**	2	1			1	2	2	1	2	1		C		1	2	2							
Municipalities	**2**	**2**	2	2	1	2	1	2	2	2	2	C	2	2	3	1	2	2	2		2		1	2	
Natural Resources Conservation Service / Soil and Water Conservation Districts	**1**	**1**			1	1	2	2	2	1	1	3	1	1	1						C	2			
Northeastern Illinois Planning Commission	**1**	**1**					1	1	2	1	2	1	2	2	2				1		1			1	
Park Districts	**2**	**2**		2	1	1	2	1	1	2		3	2	2	2	1	2	2	2	1	2		1	2	2
Private Residential Landowners	**2**	**2**								2			2	2	C	2	2	2	2		2	2	C	2	1
South Suburban Mayors and Managers Association	**2**	**2**	1	1						2	2	1	2	2	2	2	2	2	2	1	2	2	1	2	
Thorn Creek Basin Sanitary District	**2**	**2**						2			2					1	2	2							
Thorn Creek Ecosystem Partnership	**2**	**2**			C			2	2	2	2	3	C	2	C	2	2	2	2	1	2	2			2
Thorn Creek Restoration Coalition	**2**	**2**								1				2					2	1	2				2
Townships	**2**	**2**	1	2	1	2		2		1	2	1	3	2	3	2	2	2	2	C	2		C	2	
U.S. Army Corps of Engineers	**2**	**2**	2		1	1	1	2	2	2	1	3													
U.S. Fish and Wildlife Service	**1**	**1**			1	1	2	1	2	1	1	2													2
Will County Farm Bureau	**3**	**3**																				2		3	3
Institutions (higher education, hospitals, etc)	**1**	**1**			1	1	1			2	2		2			1						1	1		
School Districts	**1**	**1**			1	1	1						2			1							1		
		Median	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**2**
		Average	**2**	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**2**

5. PLAN IMPLEMENTATION EVALUATION

5.1. Monitoring Water Quality Improvement

5.1.1. PURPOSE OF MONITORING

Monitoring is the means by which the implementation and effectiveness of the watershed plan and specifically the watershed management recommendations (WMRs) can be measured. This allows implementers to evaluate progress towards watershed goals and to adjust strategies accordingly. The effectiveness of non-structural WMRs that are designed to reduce non-point source pollution, such as education, policies and regulations, and coordination, can be difficult to measure. However, change in behavior following implementation of these WMRs can be assessed by gathering feedback through meetings with implementation partners and tools such as surveys and focus groups. Structural WMRs, on the other hand, can be assessed in terms of reduced pollutant loads discharged into the watershed as well as by the degree of decrease in stormwater runoff volume and flow.

The monitoring strategy table in Section 5.2 is intended to help track implementation of WMRs made in previous sections of this plan to address water quality impairments. The strategy identifies indicators that can help determine if recommendations are being implemented as the plan suggests. This monitoring information can then be compared with water quality chemistry monitoring data to determine whether the two are related and whether they are having the desired effect on water quality. Some of the columns in the table are to be filled in by parties responsible for monitoring. Progress on implementing the Thorn Creek Watershed Based Plan should be reviewed using the milestones and indicators identified in this plan every 5 years and the plan should be updated as needed.

5.1.2. ANALYTICAL MONITORING

Impairments that are measurable using analytical water quality monitoring techniques (fecal coliform, dissolved oxygen, nutrients, total dissolved solids, and aquatic life toxicity) should continue to be monitored as in the past. Daily and monthly sampling by the Illinois Environmental Protection Agency, Thorn Creek Basin Sanitary District, and the Metropolitan Water Reclamation District should be continued and new data should be added to the existing record so that trends may be tracked. The monitoring program will also be part of the implementation of WMRs. Expanded monitoring is needed to better locate the sources of impairment that have been identified. Within the priority subbasins, additional subbasin- and tributary-specific monitoring should be conducted for each of the four measurable water quality constituents to better identify potential source locations.

5.1.3. VISUAL AND ANECDOTAL MONITORING

Beyond analytical monitoring, nutrient loading and aquatic life toxicity can be monitored visually and anecdotally by those living along the stream and those involved in stream monitoring activities. Monitoring should be done regularly (e.g., weekly in summer months, monthly in winter months) by volunteers. Specifically, increases in nutrient loading may be identified by the increase or presence of algal blooms. Acute aquatic life toxicity may be identified visually by watching for fish kills or other kills of aquatic species such as insects or plant species, though these types of events do not necessarily implicate aquatic life toxicity as the cause.

The planningcommittee also requests additional monitoring. Due to the pilot nature of this study and IEPA's interest in measuring its efficacy, the Thorn Creek Ecosystem Partnership and watershed planning committee request that the IEPA make Thorn Creek a priority for sampling and monitoring. This will help determine progress and success in meeting water quality goals and the effectiveness of watershed plan development and implementation. The IEPA should work with the TCEP to develop an increased sampling schedule for the Thorn Creek mainstem and tributaries that is built around future implementation activities. This may be coupled with the use of student volunteers, e.g., through Governors State University or other local high schools and colleges, as well as volunteer and stewardship organizations such as the TCEP and the TCRC. It is suggested that the IEPA work closely with the two other organizations currently monitoring Thorn Creek, the TCBSD and the MWRD, to arrange a protocol and possible labor sharing.

Monitoring for dumping and debris will occur primarily by anecdotal and visual surveys as well as more formal surveys of the stream, recording data such as frequency of debris, locations of debris buildup, and typical contents of debris piles. The number of scheduled stream clean up events also will serve as an indicator of the amount of dumping and debris in the watershed.

Monitoring hydrologic modification will be a long term process of ongoing collection of flow data at the two USGS stations and the TCBSD.

5.1.4. QUALITY ASSURANCE PROJECT PLANS (QAPP)

Applications for water quality monitoring funding through the Section 319 program require a QAPP, which describes the intended monitoring component in detail and explains the reasoning behind it. By developing and then following the carefully designed monitoring procedures of a QAPP, the IEPA can be assured that the data collected under its guidance will be credible. Even if the plan implementation team does not intend to apply for Section 319 funds to implement its monitoring component, the QAPP process is a valuable aid in the development of a sound water quality monitoring program.[1]

[1] QAPP guidance can be found at www.epa.gov/quality/qapps.htmL.

5.2. Watershed Management Recommendation Implementation Monitoring Strategy

Watershed Management Recommendation	Indicator: how can effectiveness be measured?	Frequency of monitoring / milestone	Party responsible for monitoring	Notes
1 Improved zoning and subdivision regulations for development, stormwater, and non-point source pollution	# of communities adopting and enforcing new or modified policies and ordinances	Annual monitoring. All municipalities and counties have adopted and are enforcing revised policies and ordinances by 2010.		
2 Stormwater runoff quality treatment requirements	Acres of new developments using new treatment requirements; acre-feet of detention retrofits	Annual monitoring. 75% of new developments use stormwater quality requirements by 2007; 100% by 2010. 75% of detention retrofits use new requirements by 2007; 100% by 2010.		
3 Floodplain and natural drainage protection ordinances and protection	# of communities adopting and enforcing new and modified policies and ordinances; acres/ linear feet of floodplain and natural drainage areas protected and restored	Annual monitoring. All municipalities and counties have adopted and are enforcing revised policies and ordinances by 2010. 100% of floodplains protected by 2010.		
4 Natural area protection ordinances, programs, and practices	# of communities adopting and enforcing new and modified ordinances, programs, and practices; acres of natural areas protected	Annual monitoring. All municipalities and counties have adopted and are enforcing revised ordinances, programs, and practices by 2010. 50% of remaining natural area acreage protected by 2010.		
5 Groundwater and recharge area protection	Acres of wellhead protection areas, aquifer recharge areas, highly permeable soils, and sensitive aquifers protected	Annual monitoring. 75% of remaining unprotected groundwater areas protected by 2012.		
8 Watershed data collection and monitoring	# of data gaps filled; short and long term watershed monitoring strategies established	Biennial monitoring. 50% of data gaps filled by 2012. Short and long term monitoring strategies established by 2007.		
9 Updated hydrologic / hydrologic information	# of data gaps filled	Monitoring every five years. 100% of watershed floodplain maps updated by 2010.		
10 Multi-objective comprehensive plans	# of communities adopting plans addressing multiple watershed objectives	Biennial monitoring. All municipalities, counties, and forest preserve districts have adopted and are implementing multi-objective plans by 2010.		
11 Regional or alternative wastewater treatment for new discharges	# of new wastewater discharges in watershed that tap into regional treatment or use an alternative strategy	Annual monitoring. All new wastewater discharges use regional treatment facility or alternative strategy by 2008.		
13 Wetland protection and restoration	Acres protected, created, and restored; # of flood control structures / tiles removed	Annual monitoring. 100% of remaining wetlands protected by 2010.		
14 Reduce impervious area	Acres of potentially impervious area reconfigured or avoided	Annual monitoring. 50% of new development projects reduce impervious area by 2010; 50% of impervious area rebuild projects use pervious practices by 2012.		
15 Natural drainage and infiltration measures	# and acres of measures installed	Annual monitoring. 3 projects per year by 2010; 6 projects per year by 2015.		
16 Wet detention	Acres of wet detention created or retrofit; frequency of monitoring and management	Annual monitoring. All new detention uses wet detention techniques by 2012; all communities have adopted and are enforcing detention management plans by 2010.		
17 Eliminate illicit waste connections to storm sewers	# of illicit connections identified and removed	Annual monitoring. Study of illicit connections completed by 2008; 50% removed by 2010.		
18 Reduce infiltration to sanitary sewers	Peak flow / capacity exceedence figures from TCBSD	Annual monitoring. 50% reduction of capacity exceedences by 2007; 100% by 2010.		
20 Eliminate sanitary system / CSO failures	# of failing structures identified and remediated	Annual monitoring. Study of failing systems completed by 2008; 50% remediated by 2015.		
22 Manage and restore stream channel and aquatic and riparian habitat	Linear feet / acres of channel and riparian habitat actively managed or restored	Annual monitoring. 50% of stream channel and riparian habitat managed and restored by 2010; 100% by 2115.		
26 Maintain stream channel conveyance	Linear feet monitored and # of maintenance actions	Annual monitoring. 100% of stream course monitored and maintained as needed by 2008.		
27 Conduct stream clean ups	# of events / volunteer hours; +/-feedback on appearance	Annual monitoring. Increasing stream clean up volunteers and events until 2010; increasing positive feedback.		
28 Utilize native vegetation and landscaping	Acres of native landscapes and native buffers installed and restored; # of native trees installed / sales by nurseries; # streambank easements purchased	Annual monitoring. 5 native landscaping or restoration projects per year by 2007; 10 by 2010; increasing sales of native trees until 2010; all streambank miles protected by 2015.		
29 Use soil conservation techniques on agri-	Acres of farmLand using conservation practices	Annual monitoring. 90% of agricultural land using conservation techniques		

cultural land		by 2010.		
30 Improve road maintenance and reduce salt usage	Lane miles under improved maintenance; # of public works departments adopting new guidelines	Annual monitoring. 50% of lane miles under new management guidelines by 2010; 100% of public works departments using new guidelines by 2010.		
32 Manage yards and household chemicals sustainably	# of landowners contacted; sales of lawn care chemicals	Annual monitoring. All streamside landowners contacted by 2007; decreasing sales of lawn care chemicals/services until 2010.		
33 Enhance habitat on private property adjoining natural areas	Acres enhanced	Biennial monitoring. 10 identified private property habitat enhancement projects annually by 2008.		

5.3. Water Quality Objective Monitoring Strategy

Objective	Indicator	Milestones	Sampling locations	Sampling Frequency	Party responsible for monitoring	Mode of collection	Priority*
1. Reduce contamination (bacteria, fecal coliform, pathogens) from urban runoff; sanitary sewer overflows or aging infrastructure (leakage, and/or failure of connections, lift stations, etc.); illicit connections of sanitary sewers or other waste discharge pipes to storm sewers; and animal waste including pets, horses, and urban wildlife (geese, other birds, raccoons, deer).	Fecal coliform concentrations (count / 100 mL)	Reduce contamination concentrations by 50% by 2008, 80% by 2010, and 95% by 2012.	All subbasins: Stuenkel Road, Western Avenue, Route 30 bridge, East of Halsted Street, Joe Orr Road, USGS station #05536215, Western Avenue, Main Street, USGS station #05536275, Thornton, 170th Street. Additional dry weather screening and wet weather sampling along stream and tributaries and at stormsewer and point source outfalls in all subbasins to identify sources.		IEPA, TCBSD, MWRD	Physical sampling and lab analysis using accepted protocols	1
2. Reduce organic enrichment / low dissolved oxygen problems from urban runoff; sanitary sewer overflows or aging infrastructure (leakage, and/or failure of connections, lift stations, etc.); illicit connections of sanitary sewers or other waste discharge pipes to storm sewers; and animal waste including pets, horses, and urban wildlife (geese, other birds, raccoons, deer).	Dissolved oxygen concentrations (mg/L)	Increase dissolved oxygen levels in subbasins 100 and 200 by 10% in May, June, and November, and 40% in July, August, and September by 2008.	All subbasins: Stuenkel Road, Western Avenue, Route 30 bridge, East of Halsted Street, Joe Orr Road, USGS station #05536215, Western Avenue, Main Street, USGS station #05536275, Thornton, 170th Street. Additional dry weather screening and wet weather sampling along stream and tributaries and at stormsewer and point source outfalls in all subbasins to identify sources or dismiss condition as natural state of upstream reaches.		IEPA, TCBSD, MWRD	Physical sampling and lab analysis using accepted protocols	1
3. Reduce nutrient loads (phosphorus and nitrogen) and algal growth from urban runoff; point source discharges / illicit stormsewer connections; and agricultural activity.	Phosphorus and nitrogen (in the form of unionized ammonia) concentrations (mg/L)	Reduce phosphorus loads in subbasins 200 through 500 by 50% by 2008, 80% by 2010, and 95% by 2112. Reduce nitrogen loads in subbasin 100 by 30% by 2010; in subbasins 400 and 500 by 30% by 2010 and 60% by 2012; in subbasin 600 by 60% by 2012; and in basins 700 and 800 by 30% by 2010 and 70% by 2015.	All subbasins: Stuenkel Road, Western Avenue, Route 30 bridge, East of Halsted Street, Joe Orr Road, USGS station #05536215, Western Avenue, Main Street, USGS station #05536275, Thornton, 170th Street. Additional sampling along stream and tributaries and at stormsewer and point source outfalls in subbasins 100 through 600 above the Thorn Creek Basin Sanitary District to identify sources.		IEPA, TCBSD, MWRD	Physical sampling and lab analysis using accepted protocols	
4. Reduce aquatic life toxicity (primarily total dissolved solids, chlorides, and sulfates) from urban runoff, road salt and storage / highway maintenance and runoff, and point discharges / illicit stormsewer connections.	TDS, chloride, and sulfate concentrations (mg/L)	Aquatic life toxicity was not identified as impairment and thus specific load reduction milestones have not been set. However, continued monitoring by the TCBSD and MWRD is essential.	All subbasins: Stuenkel Road, Western Avenue, Route 30 bridge, East of Halsted Street, Joe Orr Road, USGS station #05536215, Western Avenue, Main Street, USGS station #05536275, Thornton, 170th Street. More detailed and frequent monitoring of chloride concentrations throughout the year to determine impact of road salting on concentrations. Additional sampling along stream and tributaries and at stormsewer and point source outfalls in all subbasins to identify sources.		IEPA, TCBSD, MWRD	Physical sampling and lab analysis using accepted protocols	4
5. Reduce fly dumping and debris loads in the stream.	Debris occurrence (count / stream mile); count of reported events	Reduce debris loads in all subbasins by 75% by 2008 and 90% by 2010.	All subbasins: Monitor known debris buildup areas.		TCRC, TCEP, FPD	Visual survey, anecdotal	3
6. Reduce hydrologic disturbance / flow alterations from hydrologic modification and urban development.	Average daily flow (cfs)	The lack of state standards precludes the development of reduction targets and, thus,	Thorn Creek Basin Sanitary District, USGS station #05536215, USGS station #05536275.		USGS, TCBSD, MWRD	Flow-O-meter data	2

		milestones have not been set. However, continued monitoring by the TCBSD and MWRD is essential.					

*Based on TCEP Technical Advisory Committee's ranking of priority water quality constituents, presented in Section 3.1.

5.4. Evaluation of Education Strategy

Target Group	Outreach/Evaluation Type	Evaluation Level	Evaluation Measure 1	Evaluation Measure 2	Evaluation Measure 3	Goals (numerical targets)
Public	Events, workshops, conferences	Output	Attendance	New and repeating	Segment demographically	
	Events, workshops, conferences	Outcome	Incoming test of knowledge	Outgoing test of knowledge	Segment demographically	
	Events, workshops, conferences	Input	Funds put toward educational activity			
	Survey	Outcome	Knowledge of watershed issues at time *a*	Knowledge of issues at time *b*	Segment demographically	
	Survey	Outcome	Behaviors engaged/not engaged in at time *a*	Behaviors engaged/not engaged in at time *b*	Segment demographically	
	Tracking	Output	Number of requests for information materials	Number of requests for technical assistance	Segment demographically	
Municipalities	Survey	Outcome	Actions taken/not taken at time *a*	Actions taken/not taken at time *b*		
	Tracking	Output	Number and type of articles on watershed issues in newsletters and programs	Number of municipalities including watershed information in newsletters and programs		
	Tracking	Outcome	Adoption of plan implementation strategies			
Media	Tracking	Output	Number of articles on watershed issues			

APPENDIX A: SELECTED FIGURES

Figure 1-1.

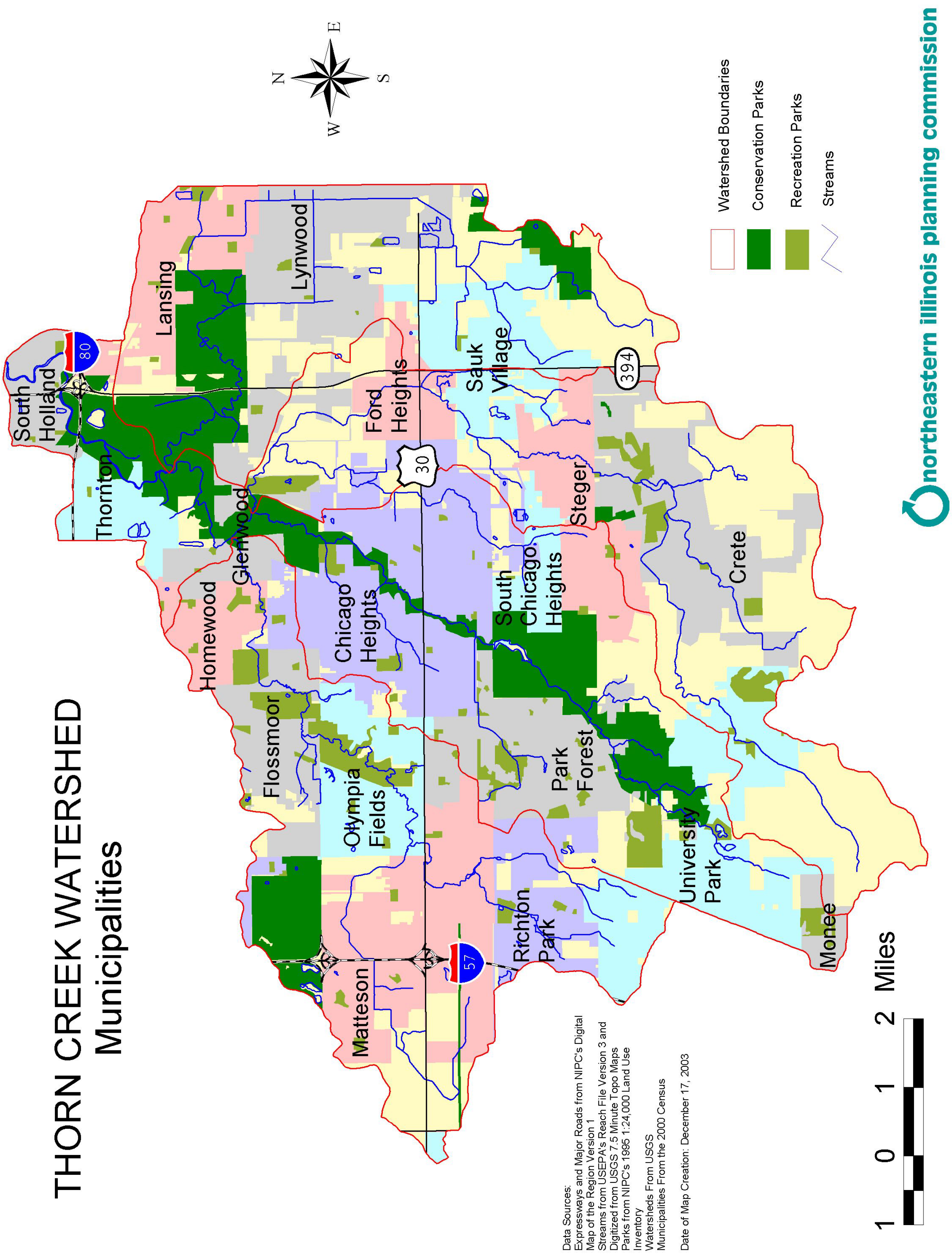

THORN CREEK WATERSHED
Municipalities
N
S
E
W
South Holland
Lansing
Lynwood
Thornton
Glenwood
Homewood
Ford Heights
Sauk Village
Chicago Heights
South Chicago Heights
Steger
Crete
Flossmoor
Olympia Fields
Park Forest
University Park
Richton Park
Matteson
Monee
80
394
30
57
Watershed Boundaries
Conservation Parks
Recreation Parks
Streams
northeastern illinois planning commission
Data Sources:
Expressways and Major Roads from NIPC's Digital Map of the Region Version 1
Streams from USEPA's Reach File Version 3 and Digitized from USGS 7.5 Minute Topo Maps
Parks from NIPC's 1995 1:24,000 Land Use Inventory
Watersheds From USGS
Municipalities From the 2000 Census
Date of Map Creation: December 17, 2003
1
0
1
2
Miles

Figure 2-1.

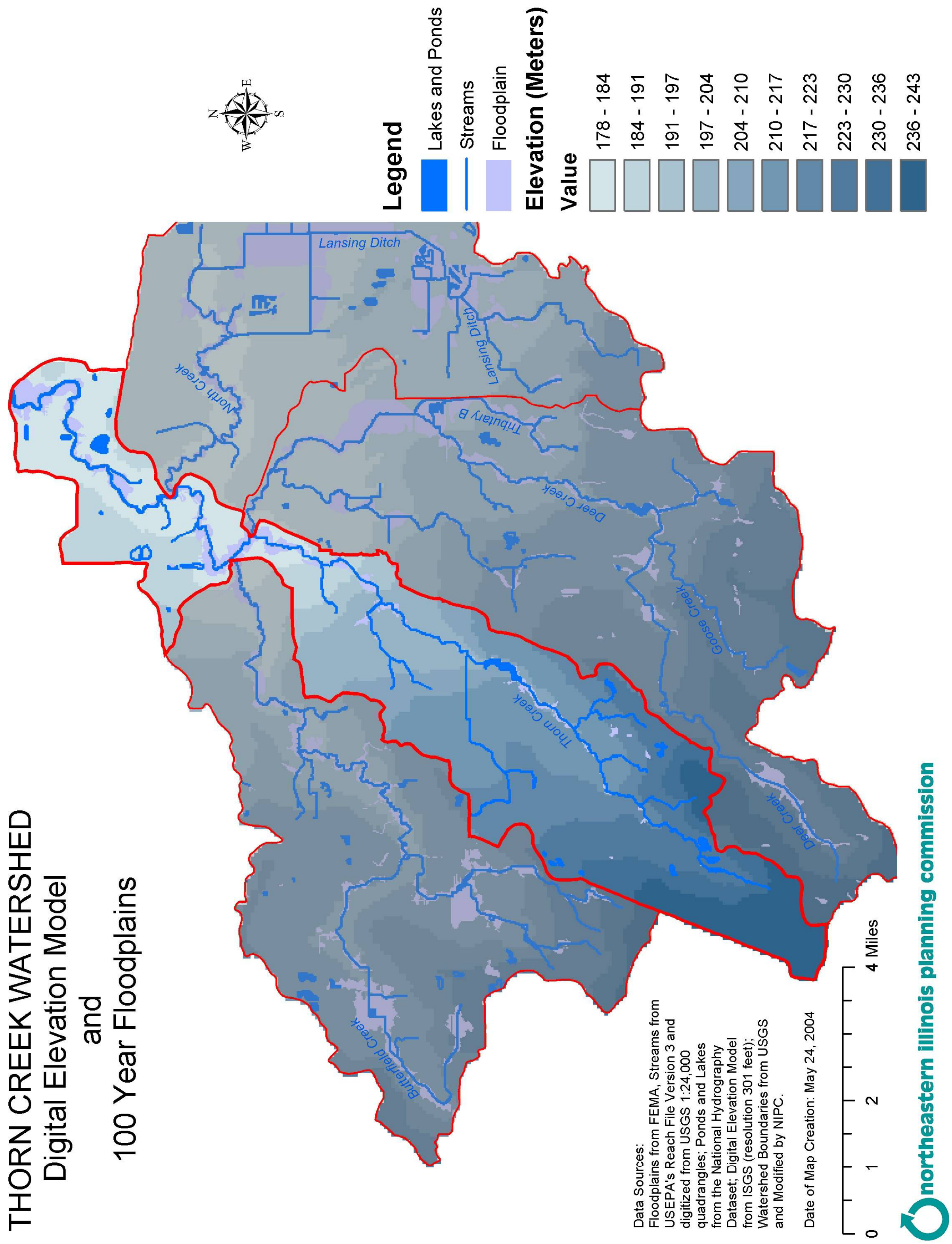

THORN CREEK WATERSHED
Digital Elevation Model
and
100 Year Floodplains
Legend
Lakes and Ponds
Streams
Floodplain
Elevation (Meters)
Value
178 - 184
184 - 191
191 - 197
197 - 204
204 - 210
210 - 217
217 - 223
223 - 230
230 - 236
236 - 243
N
E
S
W
Lansing Ditch
North Creek
Tributary B
Deer Creek
Goose Creek
Thorn Creek
Butterfield Creek
Data Sources:
Floodplains from FEMA, Streams from USEPA's Reach File Version 3 and digitized from USGS 1:24,000 quadrangles; Ponds and Lakes from the National Hydrography Dataset; Digital Elevation Model from ISGS (resolution 301 feet); Watershed Boundaries from USGS and Modified by NIPC.
Date of Map Creation: May 24, 2004
0
1
2
4 Miles
northeastern illinois planning commission

Figure 2-2.

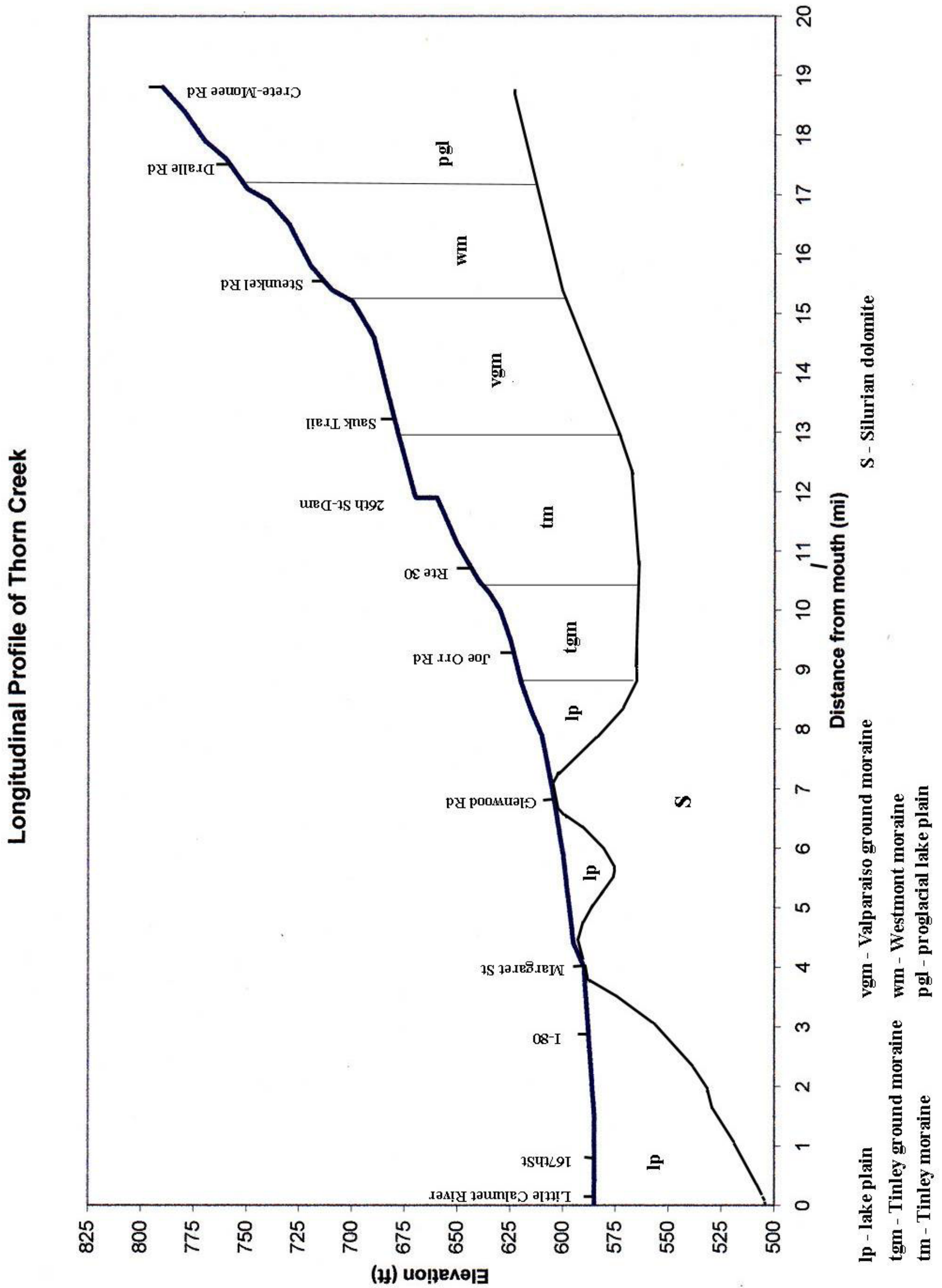

Longitudinal Profile of Thorn Creek
Elevation (ft)
Distance from mouth (mi)
Little Calumet River
167thSt
I-80
Margaret St
Glenwood Rd
Joe Orr Rd
Rte 30
26th St-Dam
Sauk Trail
Steunkel Rd
Dralle Rd
Crete-Monee Rd
lp
S
tgm
tm
vgm
wm
pgl
lp - lake plain
tgm - Tinley ground moraine
tm - Tinley moraine
vgm - Valparaiso ground moraine
wm - Westmont moraine
pgl - proglacial lake plain
S - Silurian dolomite

Figure 2-3.

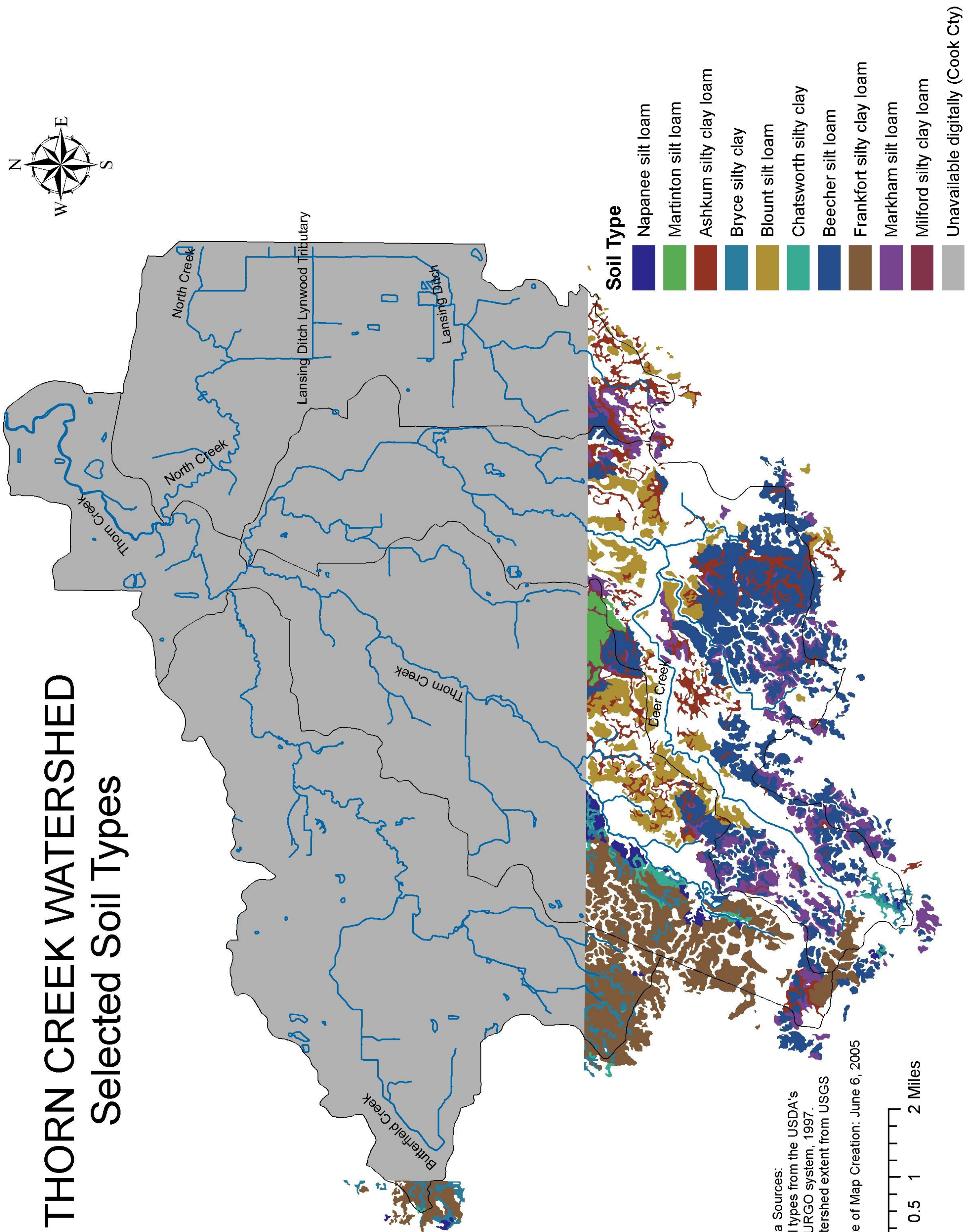

THORN CREEK WATERSHED
Selected Soil Types
Soil Type
Napanee silt loam
Martinton silt loam
Ashkum silty clay loam
Bryce silty clay
Blount silt loam
Chatsworth silty clay
Beecher silt loam
Frankfort silty clay loam
Markham silt loam
Milford silty clay loam
Unavailable digitally (Cook Cty)
North Creek
Lansing Ditch Lynwood Tributary
Lansing Ditch
Thorn Creek
Deer Creek
Butterfield Creek
N
E
S
W
Data Sources:
Soil types from the USDA's
SSURGO system, 1997.
Watershed extent from USGS
Date of Map Creation: June 6, 2005
0 0.5 1 2 Miles

Figure 2-4.

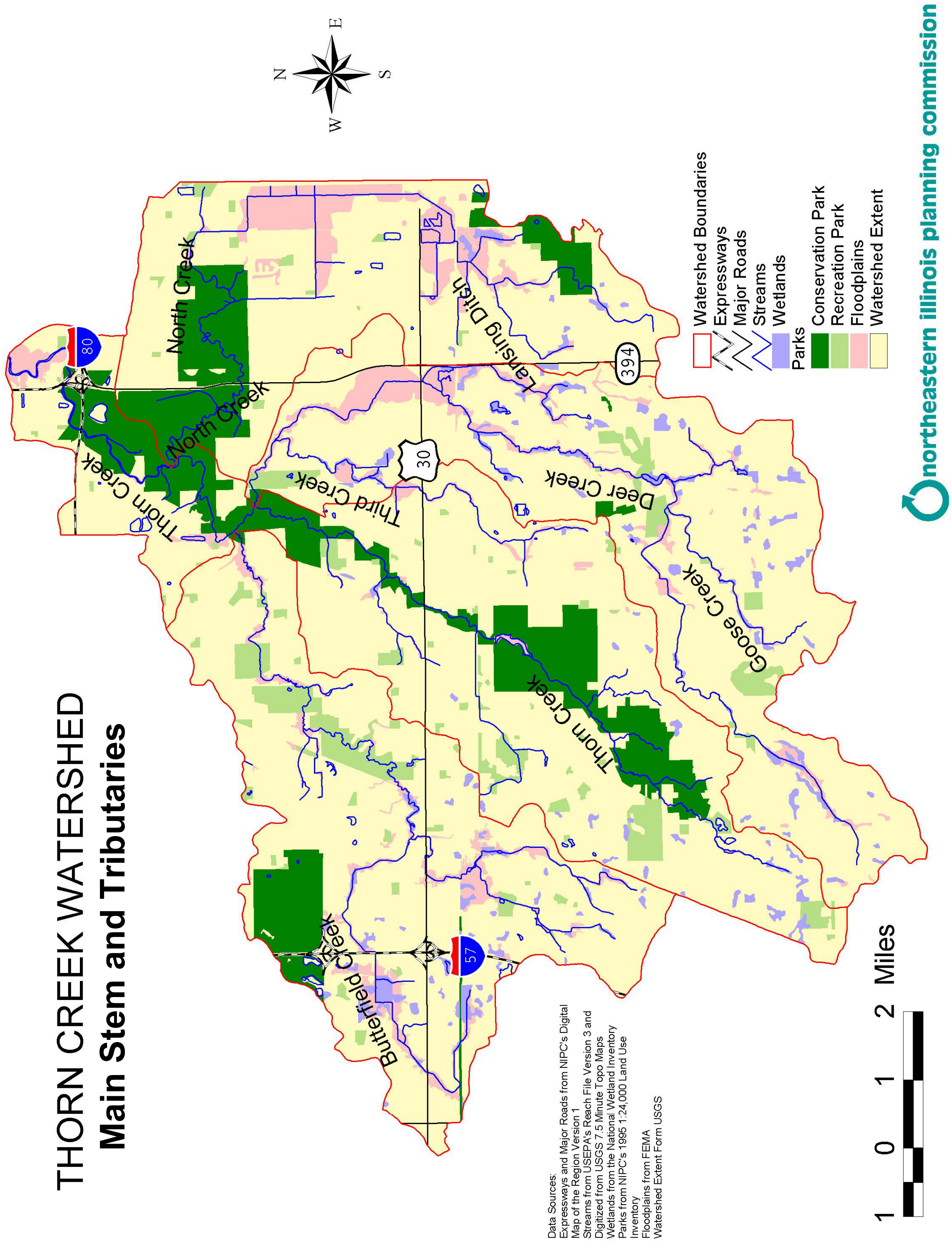

THORN CREEK WATERSHED
Main Stem and Tributaries
North Creek
North Creek
Thorn Creek
Third Creek
Deer Creek
Lansing Ditch
Goose Creek
Thorn Creek
Butterfield Creek
80
30
394
57
N
E
S
W
Watershed Boundaries
Expressways
Major Roads
Streams
Wetlands
Parks
Conservation Park
Recreation Park
Floodplains
Watershed Extent
northeastern illinois planning commission
1 0 1 2 Miles
Data Sources:
Expressways and Major Roads from NIPC's Digital Map of the Region Version 1
Streams from USEPA's Reach File Version 3 and Digitized from USGS 7.5 Minute Topo Maps
Wetlands from the National Wetland Inventory
Parks from NIPC's 1995 1:24,000 Land Use Inventory
Floodplains from FEMA
Watershed Extent Form USGS

Figure 2-22.

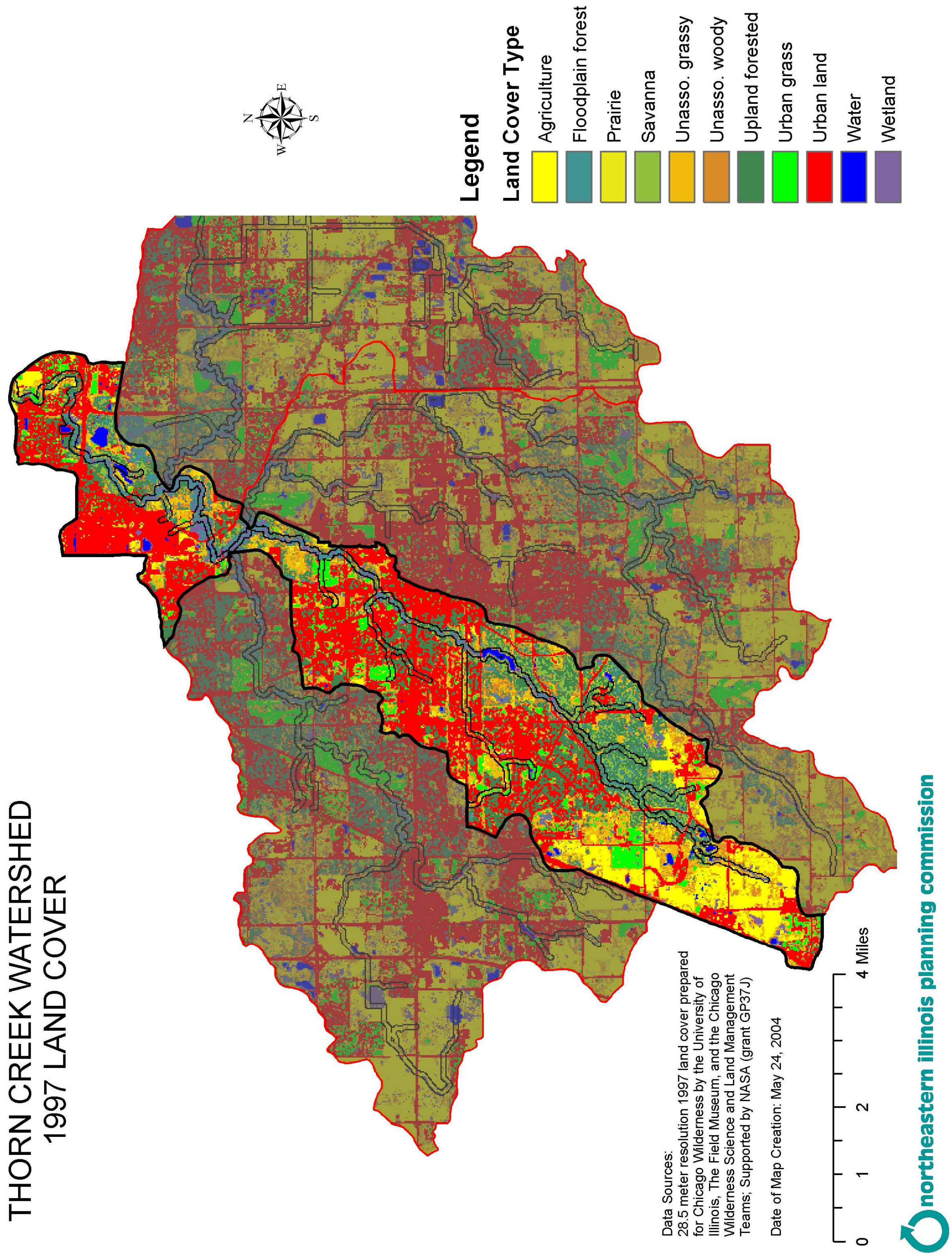

THORN CREEK WATERSHED
1997 LAND COVER
Legend
Land Cover Type
Agriculture
Floodplain forest
Prairie
Savanna
Unasso. grassy
Unasso. woody
Upland forested
Urban grass
Urban land
Water
Wetland
N
E
S
W
Data Sources:
28.5 meter resolution 1997 land cover prepared for Chicago Wilderness by the University of Illinois, The Field Museum, and the Chicago Wilderness Science and Land Management Teams; Supported by NASA (grant GP37J)
Date of Map Creation: May 24, 2004
0
1
2
4 Miles
northeastern illinois planning commission

Figure 2-23.

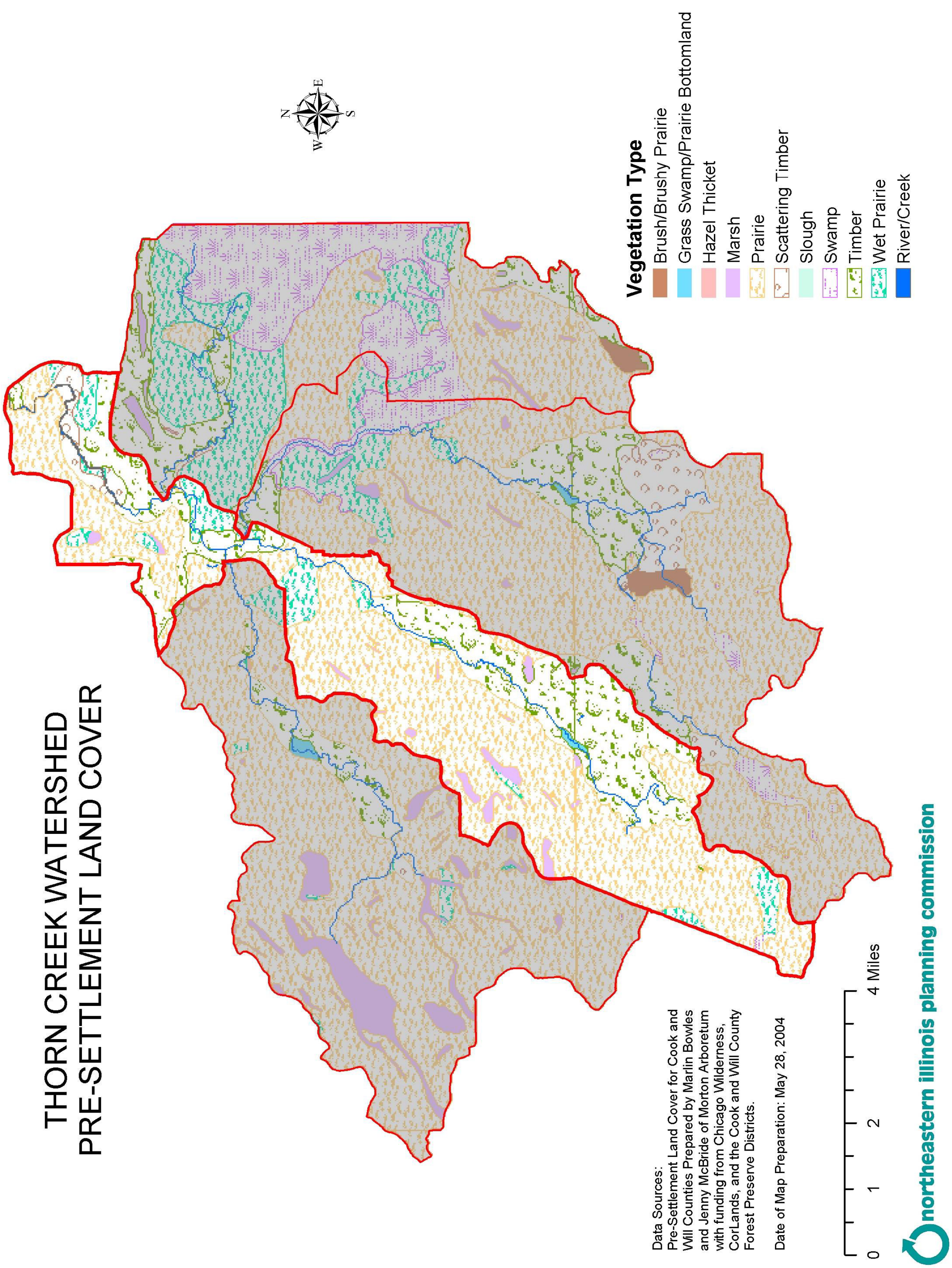

THORN CREEK WATERSHED
PRE-SETTLEMENT LAND COVER
N
E
S
W
Vegetation Type
Brush/Brushy Prairie
Grass Swamp/Prairie Bottomland
Hazel Thicket
Marsh
Prairie
Scattering Timber
Slough
Swamp
Timber
Wet Prairie
River/Creek
Data Sources:
Pre-Settlement Land Cover for Cook and Will Counties Prepared by Marlin Bowles and Jenny McBride of Morton Arboretum with funding from Chicago Wilderness, CorLands, and the Cook and Will County Forest Preserve Districts.
Date of Map Preparation: May 28, 2004
0
1
2
4 Miles
northeastern illinois planning commission

Figure 2-24.

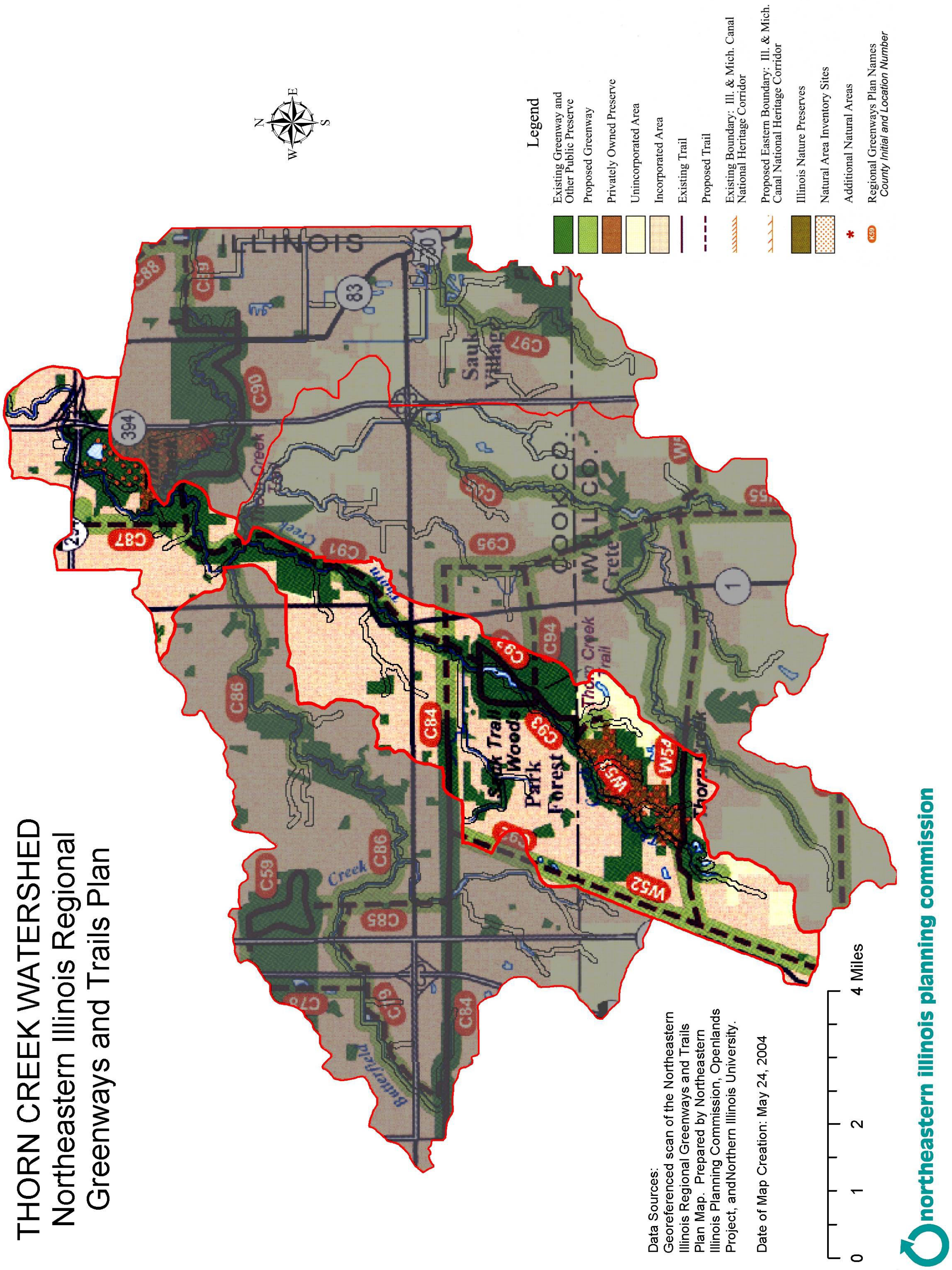
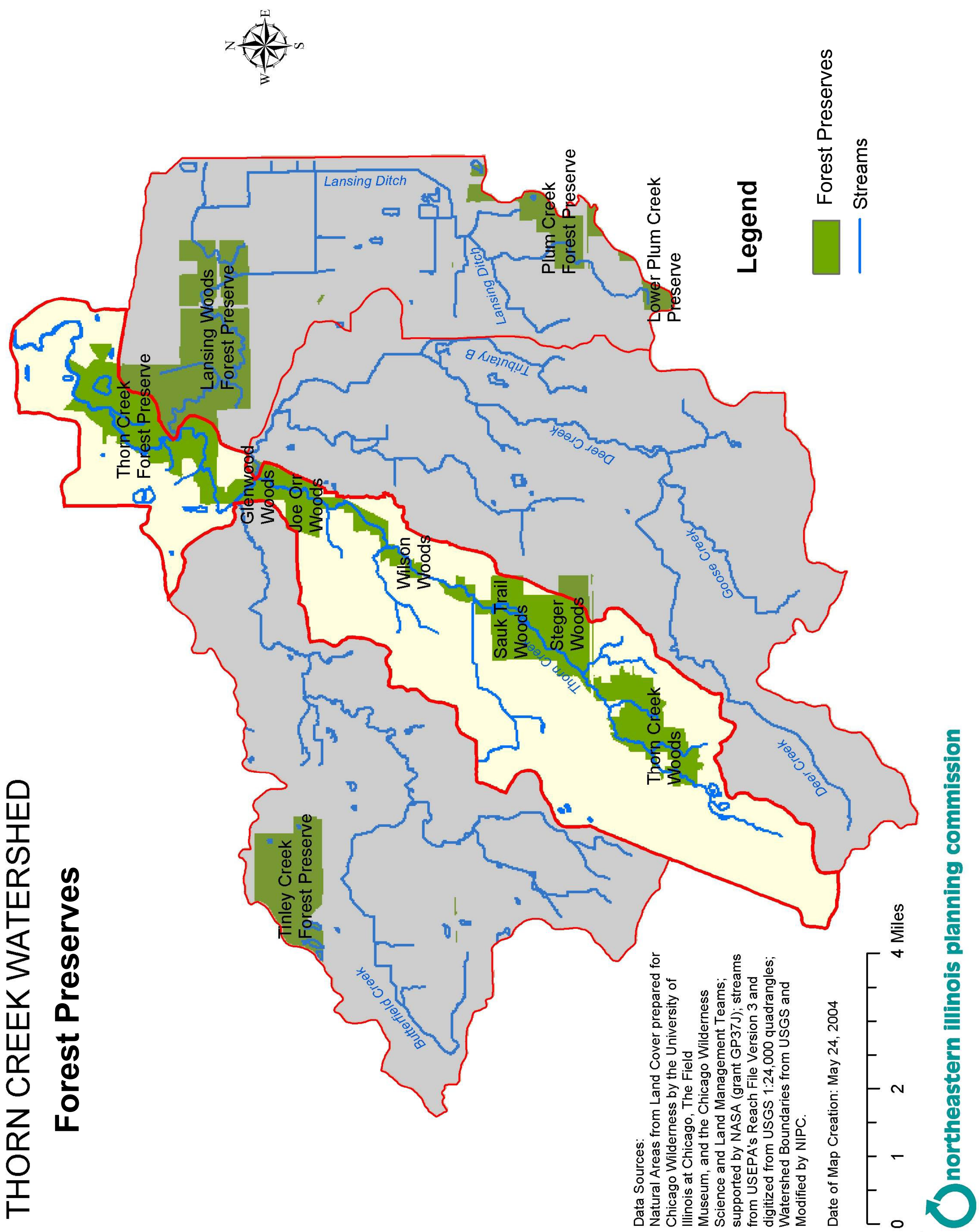

THORN CREEK WATERSHED
Northeastern Illinois Regional
Greenways and Trails Plan
Legend
Existing Greenway and Other Public Preserve
Proposed Greenway
Privately Owned Preserve
Unincorporated Area
Incorporated Area
Existing Trail
Proposed Trail
Existing Boundary: Ill. & Mich. Canal National Heritage Corridor
Proposed Eastern Boundary: Ill. & Mich. Canal National Heritage Corridor
Illinois Nature Preserves
Natural Area Inventory Sites
Additional Natural Areas
Regional Greenways Plan Names
County Initial and Location Number
Data Sources:
Georeferenced scan of the Northeastern Illinois Regional Greenways and Trails Plan Map. Prepared by Northeastern Illinois Planning Commission, Openlands Project, andNorthern Illinois University.
Date of Map Creation: May 24, 2004
0 1 2 4 Miles
northeastern illinois planning commission

Figure 2-25.


THORN CREEK WATERSHED
Forest Preserves
Legend
Forest Preserves
Streams
Thorn Creek Forest Preserve
Lansing Woods Forest Preserve
Plum Creek Forest Preserve
Lower Plum Creek Preserve
Glenwood Woods
Joe Orr Woods
Wilson Woods
Sauk Trail Woods
Steger Woods
Thorn Creek Woods
Tinley Creek Forest Preserve
Lansing Ditch
Tributary B
Deer Creek
Goose Creek
Thorn Creek
Butterfield Creek
Data Sources:
Natural Areas from Land Cover prepared for Chicago Wilderness by the University of Illinois at Chicago, The Field Museum, and the Chicago Wilderness Science and Land Management Teams; supported by NASA (grant GP37J); streams from USEPA's Reach File Version 3 and digitized from USGS 1:24,000 quadrangles; Watershed Boundaries from USGS and Modified by NIPC.
Date of Map Creation: May 24, 2004
0 1 2 4 Miles
northeastern illinois planning commission

APPENDIX B: NIPC WATER QUALITY ASSESSMENT

B-1. Water Quality Empirical Analysis

NIPC gathered water quality data from the Illinois EPA, Thorn Creek Basin Sanitary District (TCBSD), and the Metropolitan Water Reclamation District of Greater Cook County (MWRD) to assess the water quality of Thorn Creek. TCBSD and MWRD data, which were more extensive and more consistent than Illinois EPA data, were used for the majority of the analysis. The analysis examined the percentage of instances in which Illinois Pollution Control Board (IPCB) standards of sampled constituents were exceeded at each sampling location (Table B-1). For constituents lacking an IPCB standard, a generally accepted guideline was used to screen data. For those constituents and locations with excursions (exceedances) of greater than 5 percent of the samples, the data were graphed to screen for temporal patterns such as seasonal or long term trends. In addition to excursion frequency, we examined average concentrations of data spatially from the headwaters of the Thorn Creek mainstem to the outfall at the Little Calumet River (Table B-2). Correlating the data with sampling points and subbasin boundaries allowed us to assess which subbasins may contain causes and sources of impairment.

Table B-1. Exceedance Frequency of Water Quality Constituents above State Standards in Thorn Creek, 1997–2004

Source	Location Name	Location Description	Fecal	Fecal	NH3	DO	TDS	TDS (Joe Orr Road to Thornton)	TDS (Joe Orr Road to Deer Creek)	TDS (Deer Creek to Thornton)	TDS (Thornton to L. Calumet R.)	TP	SO4	SO4 (Joe Orr Road to Thornton)	SO4 (Joe Orr Road to Deer Creek)	SO4 (Deer Creek to Thornton)	SO4 (Thornton to L. Calumet R.)	pH	Chl A	Arse-nic	Nickel	Silver	Iron (Sol)
	IPCB Standards (acute/chronic for metals)		*200/100 mL*	*400/100 mL*	*0.33/0.14 mg/L*	*5 mg/L*	*1000 mg/L*	*2100 mg/L*	*2650 mg/L*	*2620 mg/L*	*2360 mg/L*	*0.05 mg/L*	*500 mg/L*	*1000 mg/L*	*1350 mg/L*	*1340 mg/L*	*1160 mg/L*	*6.5 - 9.0*	*7.3 ug/L*	*360/190 ug/L*	*26.67/ 16.2 ug/L*	*5 ug/L*	*1 mg/L*
TCBSD	STUEN-KEL	STUENKEL ROAD	71.64%	52.24%	33.70%	38.04%	0.00%					n/a	0.00%					0.00%	n/a	n/a	n/a	n/a	n/a
	Data points		67	67	92	92	0					0	59					92					
TCBSD	WESTERN	WESTERN AVE	90.97%	79.35%	31.30%	36.28%	0.00%					n/a	0.00%					0.00%	n/a	n/a	n/a	n/a	n/a
	Data points		155	155	214	215	1					0	105					215					
TCBSD	ABOVE	E OF HAL-STED ST	96.22%	91.60%	51.00%	2.44%	50.74%					93.33%	0.97%					0.00%	0.00%	0% / 0%	0.00%	0.00%	8.33%
	Data points		238	238	214	328	203					15	206					332	18	11	11	11	12
	TCBSD Wastewater Discharge																						
MWRD	LOC54 / Orr Rd	Joe Orr Road	88.57%	78.57%	0.00%	0.00%	68.57%	1.43%	0.00%			100.00%	40.00%	1.41%	0%			7.25%	40.00%	0% / 0%	0% / 1.43%	0.00%	1.43%
	Data points		70	70	68	69	70	70	70			70	71	71	71			69	10	70	70	70	70
TCBSD	BELOW	JOE ORR RD	84.69%	73.21%	48.00%	0.00%	68.46%	0.77%	0.00%			n/a	38.76%	1.55%	0%			0.00%	n/a	n/a	n/a	n/a	n/a
	Data points		209	209	214	324	130	130	130			0	129	129	129			330					
TCBSD	GLEN-WOOD	USGS STA #05536215	94.52%	83.56%	56.00%	0.93%	67.47%	1.61%	0%			100.00%	40.70%	0.39%	0%			0.00%	0.00%	n/a	n/a	n/a	n/a
	Data points		219	219	214	324	249	249	249			15	258	258	258			329	18				
TCBSD	GLNWD SCHOOL	GLENWOOD AT MAIN ST	96.43%	89.29%	48.00%	0.44%	52.48%	0%		0%		n/a	21.57%	0%		0%		0.00%	n/a	n/a	n/a	n/a	n/a
	Data points		140	140	214	225	101	101		101		0	102	102		102		228					
TCBSD	THORN-TON	THORNTON USGS#05536275	90.83%	70.00%	50.00%	3.47%	60.77%	0%		0%		100.00%	31.46%	0%		0%		0.00%	5.56%	0% / 0%	0% / 0%	0.00%	7.69%
	Data points		120	120	214	202	101	101		101		15	178	178		178		204	18	12	12	12	13
MWRD	LOC97 / 170th St.	170th Street	93.55%	67.74%	0.00%	9.68%	54.84%				0%	100.00%	35.48%				0%	3.33%	66.67%	0% / 0%	0% / 0%	0.00%	0.00%
	Data points		31	31	29	31	31				31	31	31				31	30	21	30	30	30	30

Table B-2. Average Water Quality Constituent Concentrations in Thorn Creek, 1997–2004

Sub-basin	Location	Data Source	TSS	Total P	NH3	BOD	DO*	Cu	Zn	TDS	Fecal	SO4	Chl A
		Standard	*80 mg/L****	*0.05 mg/L****	*0.33 /0.14mg/L^^*	*--*	*5 mg/L*	*varies*	*1 mg/L*	*1000 mg/L***	*400/100 mL*	*500 mg/L***	*7.3 ug/L ****
SB100	Steunkel	TCBSD	--	--	0.21	3.00	6.90	--	--	--	1120	62.9	
	Western	TCBSD	--	--	0.21	3.30	6.90	--	--	645.00	5066	98.2	
SB200+ 300	HBD05	IEPA	30.75	1.15	0.04	--	7.60	--	--	1101.00	--	206	0-12
SB400+ 500	Above	TCBSD	--	0.23	0.37	3.03	10.60	0.00	0.05	1109.20	6586	193.4	4.2
SB600	TCBSD Discharge^		2.73	3.84	0.39	2.57	7.47	--	--	--	75	--	--
	Loc54 / Orr Rd	MWRD	16.60	5.80	0.00	--	8.40	0.01	0.05	1200.00	9142	433	9
	Below	TCBSD	--	--	0.26	2.66	9.40	--	--	1192.90	6028	453	--
	Glenwood	TCBSD	--	2.48	0.37	2.94	8.50	--	--	1195.94	5332	463	4
SB700	HBD06	IEPA	20.50	5.40	1.07	--	5.70	--	--	1335.00	--	393	0-5
	Deer and Butterfield Confluence												
	Glenwood School	TCBSD	--	--	0.37	3.10	9.10	--	--	992.90	3913	342	--
	North Confluence												
	Thornton	TCBSD	--	1.60	0.33	2.60	8.70	0.01	0.05	1093.60	2915	399	4.9
	HBD04	IEPA	40.30	3.03	0.30	--	8.70	--	--	1026.00	--	388	--
SB800+ 900	Loc97 / 170th St.	MWRD	31.10	2.38	0.00	--	7.80	0.02	0.05	1122.90	3768	399	11.3

*Lower limit. Average over entire year does not account for seasonal variation. **Standard varies by reach. Base IL standard reported here.
*** Rule of Thumb. ^Average of all data from 2002 to 2004. ^^Summer/Winter limits

B-2. Land Use Pollutant Loading Model

A simplified model that estimates pollutant loads by land use was employed in the *Thorn Creek Watershed Based Plan* to determine which subwatersheds are the heaviest contributors to impaired water quality. This model applies pollutant export coefficients for each land use in pounds per acre per year to the acreage of each land use in a given subwatershed. Land use acreages by subwatershed were determined by overlaying in a GIS program NIPC's 1995 land use map with the subwatershed boundaries generated by the U.S. Geological Survey (USGS).

Table B-3. Land Use Pollutant Loading Model Assumptions

	Pollutant Export Coefficients by Land Use (Pound/Acre/Year)							Percent Impervious	
Land Use	TSS	Total P	Total N	BOD_5	Cu	Zn	TDS	Sewered areas	Non-sewered areas
Agriculture	153	0.18	2.4	3	0.0044	0.069	89.2	0%	2%
Commercial	1180	1.3	21	85	0.2	1.6	2830	90%	80%
Industrial	1240	1.5	14	50	0.21	1.3	1290	85%	75%
Institutional	1320	1.4	11	52	0.1	0.57	623	50%	25%
Multi-family	1320	1.4	11	52	0.1	0.57	623	50%	40%
Open Space	61	0.39	1	1	0.01	0.08	724	10%	2%
Residential	309	0.81	6	22	0.048	0.9	436	25%	10%
Transportation	2260	1.8	13	50	0.56	3.2	6060	90%	50%
Vacant and Wetland	100	0.22	1	2	0.01	0.1	1210	10%	2%
Water	0	0	0	0	0	0	0	0%	0%

The pollutant export coefficients are derived from a study performed in 1993 by Tom Price of NIPC for the Lake County Stormwater Management Commission. They are based on event mean concentrations (EMCs)—the total load generated by a storm event divided by the total event runoff volume—taken from literature values[1]. The equation used was as follows:

$$\text{Export coefficient (lb/ac/yr)} = ((P \times CF \times R_v) \div 12) \times C \times 2.72,$$

Where P = Annual precipitation (in/yr), 33 inches assumed
CF = Correction factor adjusting for storms with no runoff (typically 0.90)
R_v = Runoff coefficient = $0.05 + (0.009 \times I)$
I = Percent impervious
C = Event mean concentration (mg/l).

Annual pollutant loadings were estimated by summating the contributions of each land use in a subwatershed for a given pollutant. Loadings were then converted to water column concentrations by dividing by the annualized average daily flow readings (1993–2002) from the two USGS stream gages in the

[1] *Sources:* NIPC. 1979. *Areawide Water Quality Management Plan*; NIPC. March 1992. *Application of Urban Targeting and BMP Selection Methodology to Butterfield Creek, Cook and Will Counties, Illinois*; Prey, Jeffery J., Wisconsin Department of Natural Resources staff person. January 11, 1991. Letter to Holly Hudson, NIPC staff; Prey, Jeffery J. May 25, 1993. Fax letter to Tom Price, NIPC staff; U.S.EPA. December 1983. *Results of the National Urban Runoff Program, Volume 1, Final Report*; U.S.EPA. December 1989. *Urban Targeting and BMP Selection, An Information and Guidance Manual for State NPS Program Staff Engineers and Managers.*

watershed. For subwatersheds 100–600, the Glenwood gage (05536215) was used with the discharge volume of the Thorn Creek Basin Sanitary District subtracted. For the tributaries and 700, as well as the watershed as a whole, streamflow records from the Thornton gage (05536275) were used.

APPENDIX C: EFFECTIVENESS OF BEST MANAGEMENT PRACTICES

Many of the watershed management recommendations identified in Section 4.2 incorporate the use of best management practices (BMPs). To choose an appropriate BMP, it is essential to determine in advance the objectives to be met by the BMP and to calculate the cost and related effectiveness of alternative BMPs. Once the selection process is complete, technical experts will be needed to insure that the BMP is properly installed, monitored and maintained over time. The following information was used to develop Table 4-1 in Section 4.3. Table C-1 below describes the effectiveness of several of the BMPs recommended for Thorn Creek.

Table C-1. Effectiveness of BMPs Recommended for Thorn Creek

	BMP Objective						
BEST MANAGEMENT PRACTICE	Runoff Rate Control	Runoff Volume Control	Physical Habitat Preservation	Sediment Pollution Control	Nutrient Control	BOD Control	Other Pollutant Control*
Impervious Area Reduction	2	2	2	2	2	2	2
Impervious Area Disconnection	2	2	1	2	2	2	2
Filter Strips	2	2	2	2	2	2	2
Swales	2	2	1	2	2	2	2
Infiltration Devices	2	3	1	3	3	3	3
Porous Pavement	2	2	1	3	3	3	3
Wet Detention	3	1	2	3	2	3	2
Wetland Detention	3	1	2	3	2	3	2
Dry Detention	2	1	1	2	1	1	1
Settling Basins	2	1	1	2	2	2	2
Water Quality Inlets	1	1	1	2	1	1	1
Sand Filters	1	1	1	3	2	2	2
Rock Outlet Protection	1	1	2	2	1	1	1
Storage Area Cover	1	1	1	2	2	1	2-3
Street Sweeping	1	1	1	1-2	1	1-2	1-2
Source Controls	1	1	1	1	2	2	2
Stream Protection/ Restoration	2	1	3	2	2	2	1
Wetland Protection/ Restoration	2-3	2-3	3	2-3	2	2-3	2

Key
3 = Fully achieves objective 2 = Partially achieves objective 1 = Does not achieve objective

* Other pollutants include toxic compounds such as heavy metals and pesticides, fecal bacteria, petroleum based hydrocarbons, and deicing materials such as salt. A "2" in this column indicates that the BMP controls some of these pollutants but not others.

Source: Dreher, D.W. Management Program Action Plan for the Lake Michigan Watershed. Northeastern Illinois Planning Commission, 1994.

The Center for Watershed Protection (CWP) has compiled pollutant removal rates based on one hundred twenty-three performance-monitoring studies. Because performance can be extremely variable within a group of BMPs, estimates of BMP performance should be considered as a long-run average, not as a fixed or constant value.[1] Table C-2 below compares the median pollutant removal efficiencies among selected BMP groups for conventional pollutants.

Table C-2. Pollutant Removal Efficiencies for Selected Groups of BMPs

Median Stormwater Pollutant Removal Rate (Percent)							
Best Management Practice	**No. of Studies[1]**	**Total Suspended Solids**	**Total P[2]**	**Soluble P[3]**	**Total N[4]**	**Nitrate**	**Carbon[5]**
Detention pond	2	7	10	2	5	3	(–1)
Dry ED* pond	6	61	19	(-9)	31	9	25
Wet pond	30	77	47	51	30	24	45
Wet ED* pond	6	60	58	58	35	42	27
Ponds [A]	36	67	48	52	31	24	41
Shallow marsh	14	84	38	37	24	78	21
ED* wetland	5	63	24	32	36	29	nd
Pond/wetland	11	72	54	39	13	15	4
Wetlands	35	78	51	39	21	67	28
Surface sand filters	6	83	60	(–37)	32	(–9)	67
Filters [B]	11	87	51	(–31)	44	(–13)	66
Channels	9	0	(–14)	(–15)	0	2	18
Swales [C]	9	81	29	34	nd	38	67

* ED = extended detention [1]Number of performance monitoring studies [2]Total P = total phosphorus [3]Soluble phosphorus as measured as ortho-P, soluble reactive phosphorus or biologically available phosphorus [4]Total N = total nitrogen [5]Carbon = measure of organic carbon (BOD, COD or TOC) [A]Excludes conventional and dry ED ponds [B]Excludes vertical sand filters and vegetated filter strips [C]Includes biofilters, wet swales and dry swales

Source: Center for Watershed Protection

Since fecal coliform and dissolved solids were identified as impairments for Thorn Creek, BMPs must also be assessed in terms of these pollutants. The CWP reported various removal rates for fecal coliform, hydrocarbons, and selected trace metals (Table C-3).

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[1] *Sources:* Schueler, T.R. Comparative Pollutant Removal Capability of Urban BMPs: a Reanalysis. *Watershed Protection Techniques Technical Note* 95: 2(4), 1995. Claytor, R.A. and T.R. Schueler. *Design of Stormwater Filtering Systems*. Prepared for Chesapeake Research Consortium, 1996. Center for Watershed Protection. *Better Site Design: a Handbook for Changing Development Rules in your Community*. Prepared for the Site Planning Roundtable, 1998. Price, T.H. and Dreher, D.W. Assisted by CH2M Hill. *Urban Stormwater Best Management Practices for Northeastern Illinois*, 2000.

Table C-3. Pollutant Removal Efficiencies for BMPs (Center for Watershed Protection)

Median Stormwater Pollutant Removal Rate (Percent)						
Best Management Practice	**Bacteria** [E]	**Hydro-Carbons** [F]	**Cadmium**	**Copper**	**Lead**	**Zinc**
Detention and Dry ED* Ponds	nd	nd	54	26	43	26
Ponds [A]	65	83	24	57	73	51
Wetlands	77	90	69	39	63	54
Filters [B]	55	81	—	34	71	80
Channels	0	nd	55	14	30	29
Swales [C]	(–50)	62	42	51	67	71

* ED = extended detention. [A] Excludes conventional and dry ED ponds. [B] Excludes vertical sand filters and vegetated filter strips. [C] Includes biofilters, wet swales and dry swales. [D] The number of studies is less than 5 for some BMP groups for bacteria, TPH, Cd, so medians should be considered provisional. [E] Bacteria values represent mean removal rates. [F] Hydrocarbons measured as total petroleum hydrocarbons or oil/grease.

Source: Center for Watershed Protection

The Illinois EPA has also produced a table of pollutant removal rates (Table C-4). Generally, the Illinois EPA and CWP figures reinforce one another, providing greater confidence in the reliability of these removal rates figures.

Table C-4. Pollutant Removal Efficiencies for BMPs (Illinois EPA)

	Pollutant Removal Rate (Percent)				
Best Management Practice	**BOD**	**COD**	**TSS**	**Lead**	**Copper**
Vegetated Filter Strips	50	40	73	45	
Grass Swales	30	25	65	70	50
Infiltration Devices	83		94		
Extended Wet Detention	72		86	40	
Wetland Detention	63	50	77	65	
Dry Detention	27	20	57	50	
Settling Basin	56		81		
Sand Filters	40		82		
WQ Inlets	13	05	37	15	
Weekly Street Sweeping	06		16		
Infiltration Basin		65	75	65	
Infiltration Trench		65	75	65	
Porous Pavement		80	90	1	
Concrete Grid Pavement		90	90	90	
Sand Filter/Infiltration Basin		55	80	60	
WQ Inlet w/ Sand Filter		55	80	80	
Oil/Grit Separator		05	15	15	
Wet Pond		40	60	75	

Source: IEPA Nonpoint Source Unit, Pollutant Load Reduction Spreadsheets

Riparian buffers are another especially important management measure that could be used in the Thorn Creek watershed. Maintaining buffers along stream and river channels and lakeshores can reduce some of the water quality and habitat degradation effects associated with increased imperviousness, and thus runoff, in the watershed. Buffers provide hydrologic, wildlife habitat, recreational, and aesthetic benefits as well as water quality functions. Sediment, phosphorus, and nitrogen are at least partly removed from water passing through a naturally vegetated buffer (Table C-5).

The percentage of pollutants removed depends on the pollutant load, the type of vegetation, the amount of runoff and the character of the buffer area. As well, ideal buffer width can vary along the length of a channel. Adjacent land uses, topography, runoff velocity and soil, and vegetation types are all factors used to determine the optimum buffer width. Where a standard width is needed for regulatory purposes, 100 feet is considered a minimum buffer width for typical surface water requirements. Wider buffers are recommended for more sensitive areas such as high quality streams and wetlands.

Table C-5. Effectiveness of Riparian Buffers in Reducing Pollutant Loading

Pollutant	Potential Removal Rate (percent)*
Sediment	75
Total nitrogen	40
Total phosphorus	50
Trace metals	60–70
Hydrocarbons	75

* Potential removal rate based on combined 25-foot grass strip in outer zone and 75 foot forested buffer in middle and streamside zone.

Source: Schueler, T.R. Comparative Pollutant Removal Capability of Urban BMPs: a Reanalysis. *Watershed Protection Techniques Technical Note 95: 2(4), 1995.*