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Jackson Creek Watershed Plan

Technical Report

April 2009

Stormwater Management
Planning Committee

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LIST OF ACRONYMS

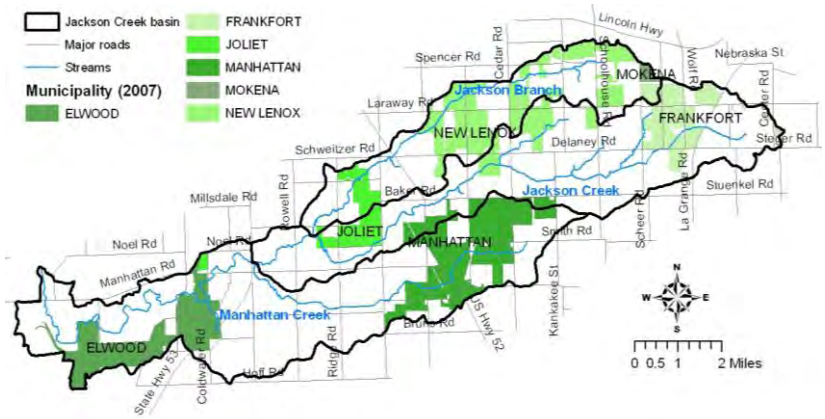
AC.....Acres
ADID ..... Advanced Identification
BMP.....Best Management Practice
BNSF .....Burlington Northern Santa Fe
C2000..... State grant program, now called Partners for Conservation
C-FAR .....Illinois Council on Food and Agriculture Research
CMAP ..... Chicago Metropolitan Agency for Planning
CRP ..... Conservation Reserve Program
CWA.....Clean Water Act
CWP ..... Center for Watershed Protection
CY ..... Cubic Yards
DNR .....Department of Natural Resources
EA ..... Each
ED .....Extended Detention
EI..... Erosion Index
EQIP ..... Environmental Quality Incentives Program
FAR .....Floor Area Ratio
FPDWC.....Forest Preserve District of Will County
GC .....IEPA code for Jackson Creek
GCA.....IEPA code for Manhattan Creek
GCB .....IEPA code for Jackson Branch
GIS .....Geographic Information System
HUC .....Hydrologic Unit Code
IDNR.....Illinois Department of Natural Resources
IEPA ..... Illinois Environmental Protection Agency
IBI ..... Index of Biotic Integrity
INAI .....Illinois Natural Areas Inventory
JATA.....Joliet Arsenal Training Area
LF.....Linear Foot
LS ..... Lump Sum
MBI ..... Macroinvertebrate Biotic Index
NA ..... Not Evaluated
ND .....Not Detected
NPDES..... National Pollutant Discharge Elimination System
NRCS..... Natural Resources Conservation Service
NWI ..... National Wetlands Inventory
RUSLE ..... Revised Universal Soil Loss Equation
SCS .....Soil Conservation Service
SSURGO ..... Soil Survey Geographic Database
STEPL .....Spreadsheet Tool to Estimate Pollutant Loads
SWCD ..... Soil and Water Conservation District
SY ..... Square Yards
TN .....Total Nitrogen
TP .....Total Phosphorus
TSS ..... Total Suspended Solids
USACE ..... United States Army Corps of Engineers
USEPA..... United States Environmental Protection Agency
USGS..... United States Geological Survey
WCSMO .....Will County Stormwater Management Ordinance
WWTP ..... Waste water Treatment Plant

1. INTRODUCTION

1.1 Overview

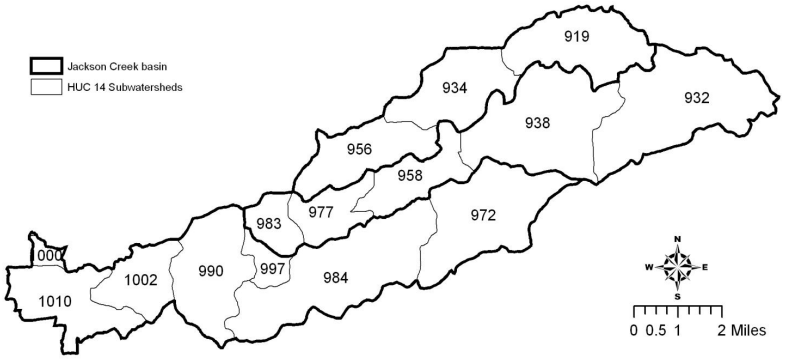
The Jackson Creek watershed is in east-central Will County. The 42 miles of stream in the Hydrologic Unit Code (HUC) 10 watershed (0712000409) drain 52.6 square miles of land, most of which is in row crops, into the Des Plaines River. Relatively little of the watershed is in an urban land use, although about 30 percent of the watershed was incorporated in 2007 within the municipal boundaries of Elwood, Frankfort, Joliet, Manhattan, Mokena, and New Lenox (Figure 1-1). The HUC 10 watershed includes Jackson Branch and Manhattan Creek as well as the main stem of Jackson Creek.

Figure 1-1. Municipal boundaries (2007)



The watershed can be divided further into three HUC 12 tributary drainages. These are shown in the heavy black lines in Figure 1-1, and are referenced in the plan as Jackson Branch, Jackson Creek (upstream from confluence with Manhattan Creek), and Jackson Creek + Manhattan Creek. The Jackson Branch tributary watershed is 10.8 square miles. New Lenox is the largest municipality in the Jackson Branch drainage and has a wastewater treatment plant discharge on the stream as well. The Jackson Creek mainstem upstream from the confluence with Manhattan Creek drains 18.8 square miles. The tributary including Manhattan Creek and Jackson Creek downstream from the confluence drains 23.0 square miles. Manhattan in the headwaters and Elwood near the mouth are the chief muncipalities in this drainage. Manhattan also has a treatment plant discharge on Manhattan Creek. The watershed can be broken up further for planning purposes into fifteen smaller subwatersheds at the HUC 14 level, as shown in Figure 1-2. These subwatersheds will be referenced later in the plan.

Figure 1-2. Subwatersheds



Source: IEPA subwatershed file. The numbering scheme for the subwatersheds is arbitrary.

Table 1-1. Incorporated area within Jackson Creek watershed (2007)

Municipality	Acres
City Of Joliet	906
Village Of New Lenox	2,874
Village Of Elwood	1,972
Village Of Frankfort	1,353
Village Of Manhattan	2,879
Village Of Mokena	94
Total	**10,079**

In its 2006 *Integrated Water Quality Report*,[1] the Illinois Environmental Protection Agency identified Manhattan Creek, Jackson Branch, and Jackson Creek upstream from Manhattan Creek as not supporting the aquatic life designated use. Designated uses of water bodies are set by states under the Clean Water Act (CWA), which under Section 305(b) requires the states to issue a report every two years evaluating the extent to which water bodies in the state are attaining their designated uses. Under Section 303(d) the states are required to list the stream reaches that are not meeting their designated uses. Causes and sources of impairment must be identified as well. In the 2006 report, the potential causes of the impairments in the streams in the Jackson Creek watershed were determined to be total phosphorus and total nitrogen (Table 1-2).

Table 1-2. Impairment information from 2006 303(d) list

Name	Impairment	Cause of Impairment
Jackson Creek d/s Manhattan Creek	Unimpaired	N/A
Jackson Creek u/s Manhattan Creek	Aquatic Life	Total Phosphorus
Manhattan Creek	Aquatic Life	Total Nitrogen Total Phosphorus
Jackson Branch	Aquatic Life	Total Nitrogen Total Phosphorus

This plan is intended to follow U.S. Environmental Protection Agency guidelines for watershed based plans[2] under the Clean Water Act and for the award of CWA Section 319 grants to control nonpoint source pollution, the type of pollution that includes sediment running off of cropland or oil from a parking lot but not a direct discharge from an industrial operation or a wastewater treatment plant. The guidelines specify that watershed plans should, at a minimum, contain the following nine elements:

(a) An identification of the causes and sources that need to be controlled to achieve pollutant load reductions estimated in this plan;
(b) An estimate of the load reductions expected for the management measures described under (c) below;
(c) A description of the non-point source management measures that will need to be implemented to achieve the load reductions estimated under (b) above;
(d) An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan;
(e) An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented;
(f) A schedule for implementing the non-point source management measures identified in this plan;
(g) A description of interim, measurable milestones for determining whether non-point source management measures or other control actions are being implemented;
(h) A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards; and
(i) A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) above.

[1] Available at http://www.epa.state.il.us/water/tmdl/303d-list.html. The decision to develop a watershed plan for Jackson Creek was based on the 2006 list. In the 2008 303(d) list, total nitrogen (TN) was removed as a potential cause of impairment. USEPA reversed IEPA's decision to remove TN and two other causes (see Federal Register at http://edocket.access.gpo.gov/2008/pdf/E8-30815.pdf), so there is the possibility that the 2008 list will have to be revised. Because of this the 2006 version is being treated as the most definitive current 303(d) list.
[2] *Nonpoint Source Program and Grants Guidelines for States and Territories* (Federal Register V. 68, No. 205, October 23, 2003)

1.2 Goals

The following goals for the watershed were developed by the Jackson Creek Watershed Advisory Committee and finalized in November 2007. More specific objectives are lettered beneath the goals.

1. Improve water quality in impaired segments of Jackson Creek and its tributaries at least to a point sufficient to remove the streams from the Illinois 303(d) list.

    a. Determine effects of wastewater flow and recommend treatment alternatives as necessary.[3]
    b. Estimate effects of future land use change in the watershed and recommend additional measures as necessary to protect water quality.
    c. Improve aquatic and riparian habitat in Jackson Creek and its tributaries.

2. Reduce current and potential future flood damage to properties along Jackson Creek and its tributaries.

    a. Identify current and future water resource problems for more detailed study, including the identification of older stormwater management infrastructure for retrofit.
    b. Locate and characterize buildings within the floodplain using the most recent available mapping.

3. Protect regionally and locally valuable natural resources within the watershed from degradation in hydrologic condition.

    a. Ensure that the dolomite prairie and threatened/endangered species within Midewin National Tallgrass Prairie are not damaged by upstream hydrologic changes and pollution.
    b. Identify important groundwater recharge areas and areas of high aquifer sensitivity to the extent practicable.
    c. Characterize the extent and effects of tile drainage within the watershed to the degree practicable and recommend any necessary changes to drainage policy in the county.

4. Identify and prioritize open space protection opportunities in concert with the Forest Preserve District of Will County (FPDWC) and other partners to preserve flood storage.

    a. Obtain recreational benefits from open space protection while minimizing any negative impacts to natural resources from recreational use.

[3] The funding for this project was provided under Section 319(h) of the CWA, which is oriented toward controlling nonpoint source pollution, while the water quality problems the watershed plan addresses are defined (in part) by the 303(d) list. This list indicates that wastewater treatment plants are a potential source of impairment for nutrients, so recommendations are made in the plan to control nutrients from point sources. Also, the watershed loading analysis performed for this plant indicates that wastewater treatment plants contribute a significant portion of the nutrient load in the watershed; for that reason it seems inappropriate to ignore their contributions.

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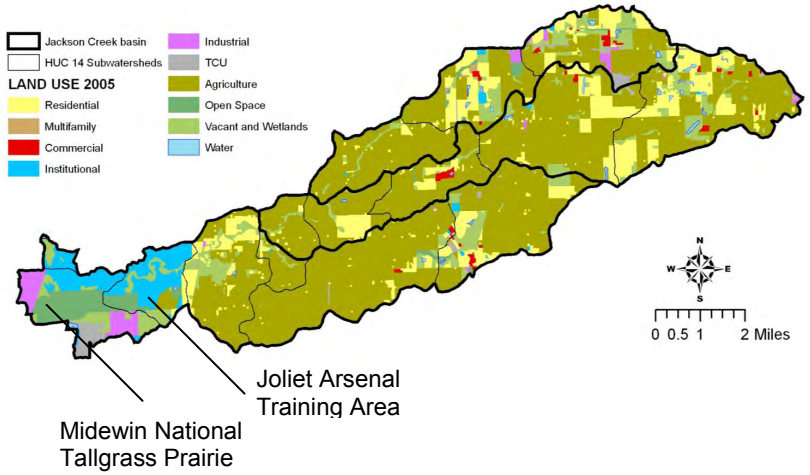
2. WATERSHED RESOURCE INVENTORY

2.1 Land Character

2.1.1 LAND USE AND LAND COVER

Agricultural uses dominate in Jackson Creek, mainly row cropping with a small amount of pasturage (Figure 2-1). The major crops are corn and soybeans. Tree farming occurs in the watershed, but sod farming is insignificant. Residential uses are the second largest land use category. This in turn is fairly evenly split between older, isolated large lot subdivisions in unincorporated areas and newer, higher density (2~3 dwelling units per gross acre) subdivisions with runoff controls in the growth areas of Manhattan and New Lenox. The locations of these different types of subdivisions can be inferred from the low intensity and medium intensity developed areas in the land cover map in Figure 2-2. There are very few commercial uses.

Figure 2-1. Land Use in 2005



Source: Draft, unreleased CMAP 2005 Land Use Inventory

Presettlement land cover in the watershed, as the Illinois Natural History Survey has divined from surveyors' notes in 1804–1843, was mostly prairie except for the area that is now Midewin and the Joliet Arsenal Training Area (JATA) which was and is still forested.[4] At the west end of the watershed there are large holdings by CenterPoint (Deer Run Industrial Park), the U.S. Forest Service (Midewin National Tallgrass Prairie), and the Army (JATA), although the Army has determined that it will stop operations in JATA and potentially transfer ownership to another party. There few sites owned by the Forest Preserve District of Will County, such as Jackson Creek Headwaters Preserve as well as the Wauponsee Trail and Old Plank Road Trail. Approximately 4.3 percent of the watershed is protected open space, including lands owned by park districts, the Forest Preserve District, and the Forest Service, and not including JATA. Other than a conservation easement on Round Barn Farm held by IDNR, there are no state-protected lands.

Table 2-1. Land use by HUC 12 tributary drainage

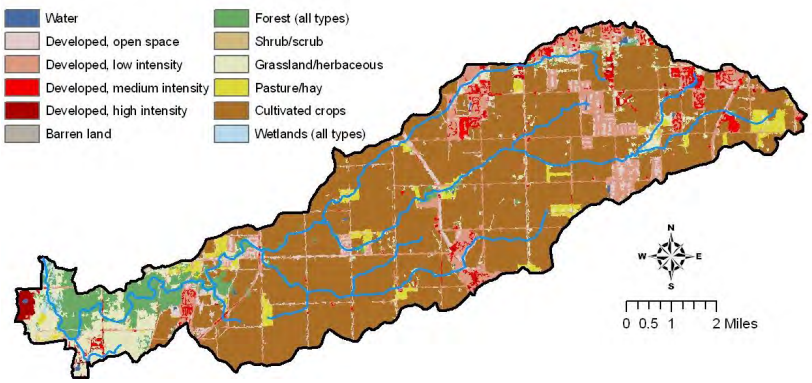
Land Use	Jackson Branch	Jackson Creek	Jackson Cr + Manhattan Cr	Total
Agriculture	4,161	8,601	8,601	21,362
Commercial	74	103	53	230
Industrial	139	36	479	654
Institutional	64	14	1,517	1,595
Multifamily	26	0	13	39
Open Space	129	21	893	1,043
Residential	1,248	2,254	1,286	4,787
Transportation	135	43	279	457
Vac/Wetlands	879	861	1,614	3,354
Water	38	97	33	167
Total	6,893	12,029	14,766	33,688

Source: Draft, unreleased CMAP 2005 Land Use Inventory

[4] Illinois Natural History Survey. August 2002. Land Cover of Illinois in the Early 1800s. Retrieved from: http://www.inhs.uiuc.edu/cwe/maps/glo.html

Total impervious area amounted to approximately 6 percent of the entire watershed, although development since then has likely increased this figure by a percentage point or two (Table 2-2). It includes all impervious cover, whether or not it is directly hydraulically connected to streams. A commonly used guideline is that impervious cover, at least for water quality purposes, should remain under ten percent. Best management practices have the ability to mitigate some negative effects of increased imperviousness, of course, but how much is not well understood.[5] None of the tributary drainages are above the ten percent level, although the smaller subwatersheds are in some cases. Unfortunately the highest levels of impervious coverage are found in the headwaters (subwatersheds 919 and 932, for example), where it is thought to do the most downstream damage. The relatively high impervious cover in subwatershed 1010 in the Elwood area, however, shows the influence of the industrial park.

Figure 2-2. Land Cover in 2001



Source: 2001 National Land Cover Dataset

Table 2-2. Imperviousness by subwatershed

Tributary drainage	Subshed	Acres	% Impervious
Jackson Branch	919	2,596	12%
	934	2,249	14%
	956	2,049	1%
Jackson Cr upstream from Manhattan Cr	932	4,431	10%
	938	4,038	6%
	958	1,537	3%
	977	1,193	2%
	983	831	1%
Jackson Cr + Manhattan Cr	972	3,390	6%
	984	4,405	2%
	990	2,594	5%
	997	522	2%
	1000	243	2%
	1002	1,459	3%
	1010	2,153	10%
Total		**33,688**	**6%**

Source: 2001 National Land Cover Dataset

2.1.2 TOPOGRAPHY AND SOILS

The watershed is flat with a relatively low stream gradient, except near the mouth as the creek enters the Des Plaines River valley where gradient approximately doubles. The average slope for the main stem is 0.0014 ft/ft or 7.4 ft/mi, but the 10-85 slope given by the USGS is 8.4 ft/mi.[6] Elevation changes from approximately 725 ft above sea level to 525 ft above sea level from headwaters to mouth. Topography changes fairly dramatically downstream of the Manhattan Creek confluence, as can be seen in Figure 2-3, where the creek cuts through bedrock formations. In general, cropland tends to lie in flatter areas of the watershed, while the steepest areas were put into pasturage or remained forested.

[5] Reviewed in Brabec, E., S. Schulte, and P.L. Richards. 2002. Impervious Surfaces and Water Quality: A Review of Current Literature and Its Implications for Watershed Planning. *Journal of Planning Literature* 16: 499–514.

[6] Computed using http://streamstats.usgs.gov/ilstreamstats/. The 10-85 slope is the slope between two points 10 percent and 85 percent of the distance away from the mouth.

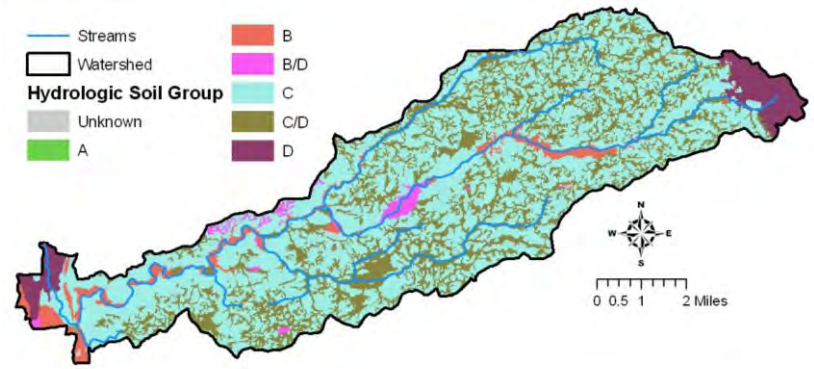
Figure 2-3. Slope

Source: USGS 30-m digital elevation model

2.1.2.1 Permeability

Silty soils predominate in the watershed.Almost all soil textures are characterized as either silty clay loam or silt loam. Soils are poorly drained in general, with most of the watershed in Hydrologic Soil Group C or D, an exception being small areas of soils along the main stem that are in Group B (Figure 2-4). Low infiltration rates of 0.4 – 1 in/h would be expected in most of the watershed based on soil texture.[7] Average permeability in the watershed as a whole has been calculated to be 0.623 in/h.[8]

Figure 2-4. Soil Hydrologic Group



Source: Will County SSURGO Database (NRCS)

2.1.2.2 Erodibility

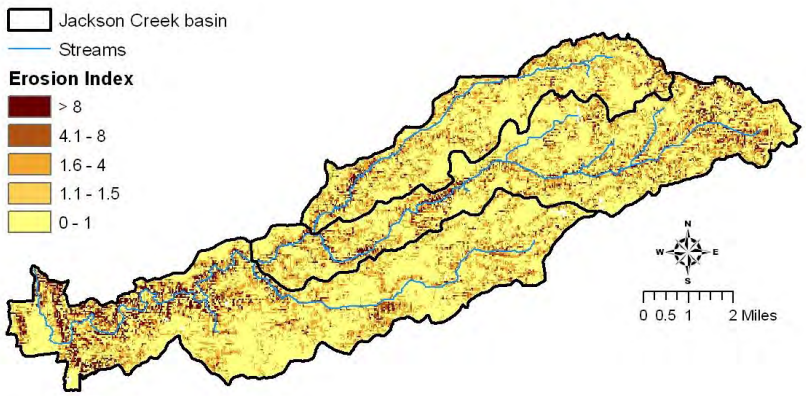
Erosion potential can be viewed as a function of the natural susceptibility of a soil to detachment by rain (*K*), the energy or erosivity of rainfall in the area (*R*), and finally the land slope and the length of the slope (*LS*). This is formalized in the Natural Resources Conservation Service's Erosion Index, derived from the Revised Universal Soil Loss Equation (RUSLE). The Erosion Index is a relative measure that compares potential soil loss to the tolerable loss rate (*T*) for the soil, so that the index is equal to $R \times K \times LS \div T$.[9] Comparing Figure 2-5 with Figure 2-3, it can be seen that erosion potential tends to track slope closely, reflecting the dominance of topography as a predictor of erosion in the Jackson Creek watershed.

[7] Natural Resources Conservation Service. Illinois Urban Manual Practice Standard: Infiltration Trench 847. Retrieved from: http://www.il.nrcs.usda.gov/technical/engineer/urban/standards/urbst847.html

[8] Computed using http://streamstats.usgs.gov/ilstreamstats/

[9] Areas with scores above eight are considered Highly Erodible Lands under Farm Bill benefit programs and trigger a requirement to employ various conservation practices to maintain eligibility.

Figure 2-5. Erosion potential

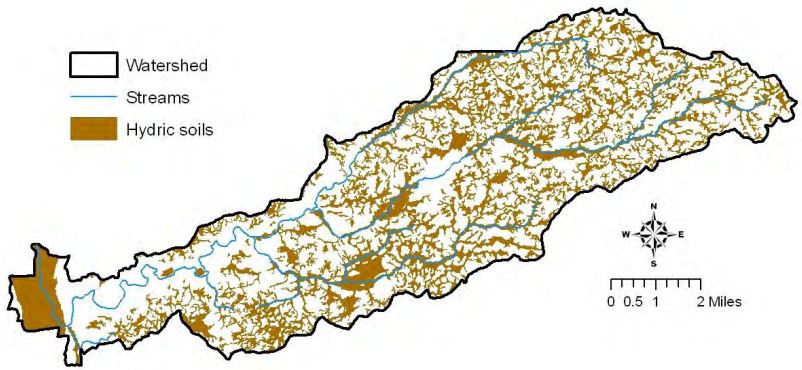


Source: computed from data in SSURGO

2.1.2.3 Hydric Soils

Hydric soils are those that developed under sufficiently wet conditions to support the growth and regeneration of hydrophytic vegetation (plants adapted to grow in water). These soils can be taken as indicators of where wetlands would be were vegetative and hydrologic conditions appropriate. (Wetlands themselves are defined by a combination of hydric soils, hydrophytic vegetation, and hydrologic properties as described in the Army Corps of Engineers Wetlands Delineation Manual). Figure 2-6 shows hydric soils in the watershed based on the general soil type. It should be pointed out that areas predominantly made up of hydric soils may have small "inclusions" of nonhydric soils, while areas predominantly made up of nonhydric soils may have inclusions of hydric soils.

Figure 2-6. Hydric soils



Source: Will County SSURGO Database (NRCS)

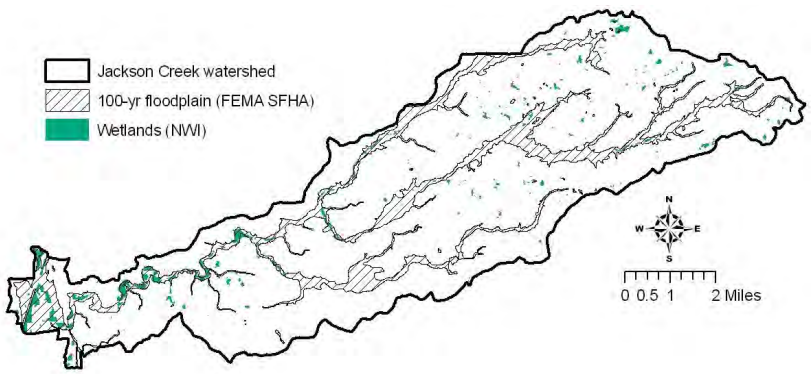
2.1.3 WETLANDS

Approximately 2.7 percent of the watershed has been mapped as wetland, according to the National Wetlands Inventory (NWI). Based on the extensive hydric soils in the watershed (Figure 2-6), historic wetlands have largely been destroyed as they have in most of northeastern Illinois. Much of the remaining wetland area is along the stream corridor downstream of the Manhattan/Jackson Creek confluence where land cover alteration has been limited (Figure 2-7). The NWI was conducted based on high-altitude aerial photography from the 1980s. This means that some wetlands will have been filled or altered and in some cases others created or expanded since then, while others were misidentified in the first place. Ducks Unlimited is undertaking an update to the NWI using 2005 and 2007 aerial photography.[10] The Advance Identification (ADID) studies done in other counties in the region have also tended to identify many more small wetlands than the NWI because of the NWI's limited resolution. Having an ADID study for Will County would be useful and was

[10] IEPA, Bureau of Water. 2007. *Wetland Monitoring and Assessment Program for the State of Illinois.* Available at: http://www.epa.state.il.us/water/water-quality/report-2007/WetlandFinalOct152007.pdf

recommended in the 1998 *Will County Stormwater Management Plan*. This plan recommends it as well.

Figure 2-7. Wetlands and floodplain



Wetlands have a number of widely-recognized potential benefits that cannot be explored in detail here. Two of these benefits, however, are especially important to this plan. First, natural wetlands in most cases remove nutrients from the water flowing through them, although they can export nutrients under some conditions.[12] Second, wetlands are generally thought to reduce flood flows and increase low flows. Reviews of the literature suggest that in most cases floodplain wetlands reduce or delay floods.[13] A study by the Illinois State Water Survey produced results supporting this idea, showing that for every one percentage point increase in the amount of wetland area in a watershed, various peak flow and flood flow measures decreased by well above one percent while low flow parameters increased (Table 2-3). This effect is more pronounced in northern Illinois than in other areas of the state. Thus, wetlands tend to moderate hydrologic extremes.

Table 2-3. Influence of wetlands on high and low flows

Parameter	Northern IL	Statewide
Peakflow / average precipitation	–7.9%	–3.7%
Peakflow / peak precipitation	–6.5%	–2.6%
Peakflow / total precipitation	–2.9%	–3.0%
Floodflow volume / total precipitation	–2.3%	–1.4%
Low flow exceeded 95% of time (Q_{95})	+15.0%	+7.9%
Low flow exceeded 99% of time (Q_{99})	+18.2%	+8.4%

Source: M. Demissie and A. Khan. 1993. *Influence of Wetlands on Streamflow in Illinois.* ISWS Contract Report 561. See Table 3, p. 26. Retrieved from: http://www.sws.uiuc.edu/pubdoc/CR/ISWSCR-561.pdf

The Will County Stormwater Management Ordinance (WCSMO) does not regulate isolated wetlands, those that are not connected to navigable waters of the United States and that are thus not under the jurisdiction of the Army Corps of Engineers. On the other hand, the Will County Lowland Conservancy Overlay District Ordinance[14] which applies to unincorporated county land does require a 75-foot setback from wetlands (if they are one-third acre or larger) containing a 25-foot strip of native vegetation. It does not require submittal of a wetland delineation report, assessment of quality and function, or mitigation. The municipalities all have stream and wetland protection ordinances with fairly similar provisions (see Section 2.3).

2.2 Water Quality

In the IEPA's 2006 *Integrated Water Quality Report*, Jackson Branch, Jackson Creek (above the conflence with Manhattan Creek), and Manhattan Creek were all listed as impaired for aquatic life use. Finding a means of correcting this problem is, of course, the primary

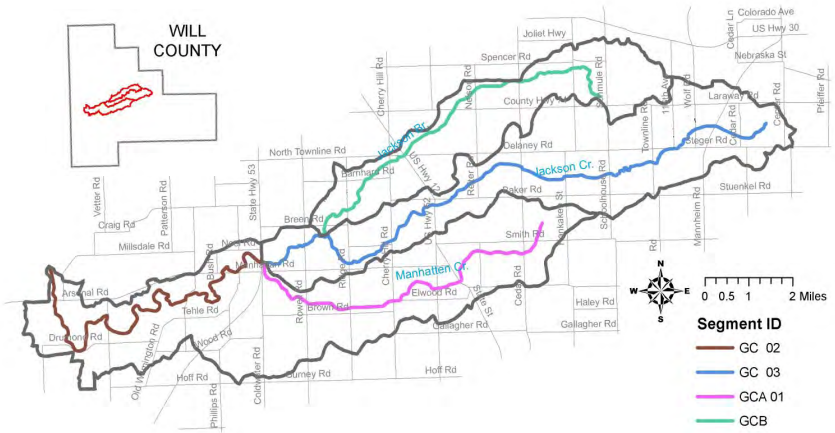
[12] See for example J. Fisher and M.C. Acreman. 2004. Wetland nutrient removal: a review of the evidence. *Hydrology and Earth System Sciences* 8(4): 673–685. Retrieved from: http://www.hydrol-earth-syst-sci.net/8/673/2004/hess-8-673-2004.pdf

[13] A. Bullock and M.C. Acreman. 2003. The role of wetlands in the hydrological cycle. *Hydrology and Earth System Sciences* 7(3): 358–389. Retrieved from: http://www.uicn.org/themes/wetlands/pdf/RoleWetlandsHydrologicalCycle.pdf

[14] Derived from a model ordinance produced by the Northeastern Illinois Planning Commission, available at http://www.cmap.illinois.gov/wastewater/ordinances/STWETLND.pdf

objective of this plan. IEPA refers to these streams by the stream segments shown in Figure 2-8. Only segment GC 02, in the higher gradient portion of Jackson Creek with a land cover of mostly forest and wetlands, is considered to be fully supporting aquatic life use.

Figure 2-8. IEPA stream segments



The following sections summarize the available chemical and biological data collected in Jackson Creek, Jackson Branch, and Manhattan Creek. Based on IEPA's identification of nutrient enrichment as a cause of impairment, nutrient loading from different sources in the watershed is estimated. Finally, nutrient load reductions needed are computed based on a method proposed by USEPA.

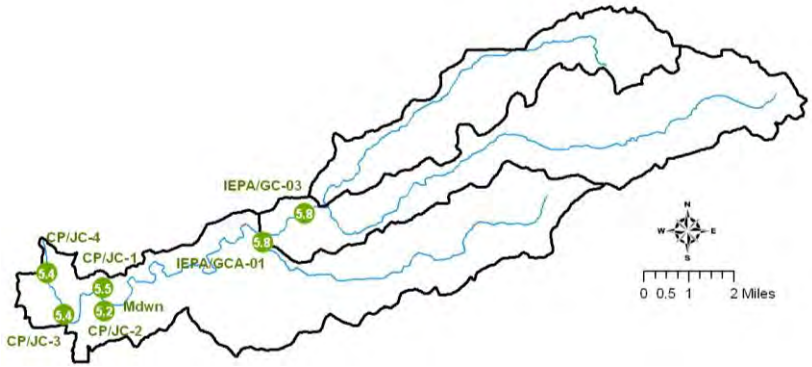
2.2.1 AQUATIC BIOLOGY

Biological data are used to make determinations of impairment to the ability of streams to support aquatic life. This section summarizes the available biological data to develop a picture of the health of the aquatic life in the stream system.

2.2.1.1 Macroinvertebrate Biotic Index

The Macroinvertebrate Biotic Index (MBI) measures the health of aquatic "bugs" — insect nymphs, snails, etc. collectively called *macroinvertebrates* — by combining abundance with pollution tolerance. The index ranges from 0 to 11, with *lower* scores indicating *higher* quality. IEPA uses a cutoff value of 5.9 to determine impairment, although this is typically combined with other available data in borderline cases, as this one is. Samples taken by IEPA in Manhattan and Jackson Creeks in 2003 both showed an MBI of 5.8.

Figure 2-9. MBI sample sites and measurements



Data collected by a CenterPoint contractor and by the Forest Service downstream near Midewin (Tables 2-4 and 2-5) appear to show a very modest improvement in 2003, with an average of 5.65, although one observation was above the 5.9 cutoff. Based on the available MBI data from 1997 forward, however, it seems evident that the macroinvertebrate populations in Jackson and Manhattan Creeks are healthy. Only two out of 34 total samples were above 5.9. Furthermore, analysis suggests that there is no statistically significant trend, either toward improvement or decline, in the MBI data for these two creeks. In general, however, it appears that MBI values improve near the

mouth of Jackson Creek. It is worth noting that there may be slight differences in the MBI methodology used by different researchers, so the data may not be exactly comparable.

Table 2-4. Macroinvertebrate Biotic Index data collected by CenterPoint

	Year						
Station	2001	2002	2003	2004	2005	2006	Avg
CP/JC-1	5.19	5.47	5.7	5.21	5.77	5.43	5.46
CP/JC-2	5.25	5.47	5.31	5.26	5.23	5.41	5.32
CP/JC-3	5.38	5.58	5.35	5.57	5.36	5.47	5.45
CP/JC-4	5.42	5.22	6.18	5.36	5.27	5.19	5.44
Avg	5.31	5.44	5.64	5.35	5.41	5.38	5.42
Date	10/3	9/11	6/25	7/9	6/27	7/18	

Source: Carlson Environmental, Inc. and Christopher B. Burke Engineering, LTD. 2007. 2006 Stormwater, water quality and aquatic macro-invertebrate sampling report, USACE #199900519. Prepared for CenterPoint Intermodal, LLC.

Table 2-5. Macroinvertebrate Biotic Index data collected by USFS

	Year						
Station	2001	2002	2003	2004	2005	2006	Avg
Midwn	5.23	4.25	5.67	5.27	6.2	4.7	5.22

Source: Midewin National Tallgrass Prairie Monitoring & Evaluation Report- 6/2006, US Forest Service

Table 2-6. Macroinvertebrate Biotic Index data collected by IEPA

	Station	
Stream Segment ID	GC-03	GCA-01
Collection Method	20-Jab	20-Jab
Collection Date	9/16/03	9/17/03
MBI	**5.8**	**5.8**

Source: IEPA

Data were also collected by IEPA on Jackson Branch in 2005 for a Facility-Related Stream Survey near the New Lenox #2 wastewater treatment plant (Table 2-7). These data suggest that Jackson Branch, too, is in fairly good condition, excepting the local influence of the treatment plant. The spatial pattern in the data has the expected pattern, with good conditions upstream from the outfall, a sharp decline just downstream, and partial recovery further downstream.

Table 2-7. Facility Related Stream Survey data for Jackson Branch

Station	A1	C1A	C1
Location	Jackson Br. Drive Bridge	60 feet d/s discharge	0.1 mile d/s discharge
MBI	4.8	8.8	5.8

Source: IEPA

2.2.1.2 Fish Index of Biotic Integrity

The Illinois DNR undertook a fish collection effort in 2003 whose results are shown in Figure 2-9.[15] The agency calculated scores for the Index of Biotic Integrity (IBI), an indicator that combines several different metrics and ranges from 10 to 60, with *higher* scores corresponding to *higher* quality waters. Like the MBI scores, fish IBI in the lower reaches of Jackson Creek is higher than upstream and in the tributaries, most likely because of higher habitat quality (higher gradient, natural stream corridor, etc.).

Table 2-8. Biological Stream Characterization system

Resource Description	Unique	Highly Valued	Moderate	Limited	Restricted
Biotic Class	A	B	C	D	E
IBI range	51-60	41-50	31-40	21-30	≤ 20

Source: Illinois Department of Natural Resources

Fish studies are also used to assign biological stream characterization (Table 2-8) ratings to streams on an ongoing basis. Under an interagency agreement with Illinois DNR, the IEPA uses DNR's IBI scores to assess impairment. The cutoff standard that IEPA uses for im-

[15] Stephen M. Pescitelli and Robert C. Rung. September 2003. *Evaluation of Fish Communities and Stream Quality in the Jackson Creek Watershed (Des Plaines River Basin).* Illinois Department of Natural Resources.

pairment is 41, corresponding to the breakpoint in the biological stream characterization system. In Manhattan Creek, the IBI was 38 in 2003, indicating impairment. In Jackson Creek, the IBI was 41, again suggesting a borderline case. These data are shown in Table 2-9.

Figure 2-10. IBI sample sites and measurements

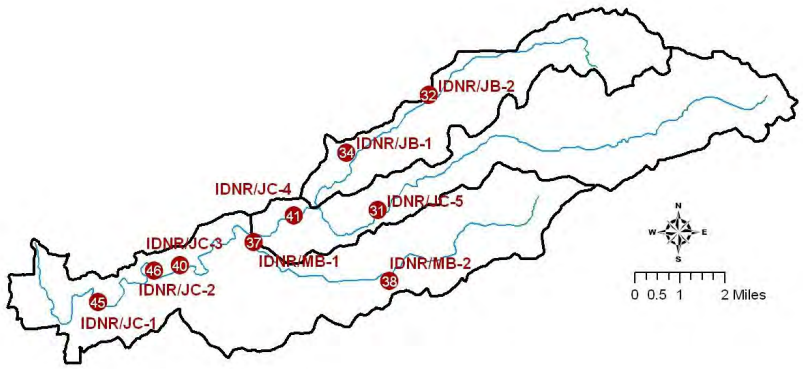


Table 2-9. IBI values in Jackson Cr, Jackson Br, and Manhattan Cr

Date	Location	IBI	BSC
9/15/2003	JC-1	45	B
9/15/2003	JC-2	46	B
9/16/2003	JC-3	40	C
9/16/2003	*JC-4	41	B
9/17/2003	JC-5	31	C
9/17/2003	**MB-1	37	C
9/17/2003	MB-2	38	C
9/17/2003	JB-1	34	C
9/17/2003	JB-2	32	C

* Same as IEPA station GC 03
** Same as IEPA station GCA 01
Source: Illinois Department of Natural Resources

The Forest Preserve District of Will County also sponsored a fish study in Jackson Creek in 2006. Fish diversity was considered to be above average with the occurrence of typical stream species as well as more unusual ones like creek chubsucker (*Erimyzon oblongus claviformis*) that prefer clean water and abundant native vegetation. Some of the species present suggest there is direct communication with the Des Plaines River.

2.2.2 STREAM PHYSICAL CONDITIONS

The available information on stream conditions focuses on habitat. As will be seen again with biological conditions below, stream habitat is better in Jackson Creek downstream of Jackson Branch and poorer upstream and in the tributaries. A good quality stream would tend to have, among other things, a higher percentage of coarse substrate (cobble, boulders, etc.) than fine substrate (mud, silt, sand), a sequence of pools and riffles rather than straight runs, and sufficient instream cover to offer habitat to fish (overhanging banks, vegetation, etc.). Illinois DNR has provided the most synoptic data on stream conditions (Table 2-10, locations in Figure 2-10). A subjective interpretation of these ratings is in Table 2-11.

Like many other streams in northeastern Illinois, Jackson Creek has been heavily channelized. While straightening and deepening streams improved conveyance and promoted drainage on agricultural land, it has drastically reduced the habitat value of streams. The channel had been modified at seven out of nine sites in Table 2-10. The problem of channelization is somewhat independent of nutrients as a cause of impairment and has to be addressed directly. How to do so depends on the context and the extent of recovery that can be hoped for.

Table 2-10. Stream conditions from Illinois DNR

Station	%Pool	%Riffle	%Run	% Coarse Substrate	% Fine Sub-strate	% Instream Cover	Channel Mod-ification	Channel Sta-bility
JC-1	40	40	20	100	0	20	No	Good
JC-2	50	40	20	100	0	30	No	Good
JC-3	95	5	0	100	0	15	Yes	Fair
JC-4	95	5	0	55	45	30	Yes	Fair
JC-5	40	0	60	0	100	10	Yes	Poor
MB-1	33	33	33	100	0	30	Yes	Good
MB-2	35	25	40	60	40	5	Yes	Fair
JB-1	30	15	55	15	85	40	Yes	Fair
JB-2	5	5	90	10	90	40	Yes	Fair/ poor

Note: Sample sites are shown in Figure 2-10.
Source: Stephen M. Pescitelli and Robert C. Rung. September 2003. *Evaluation of Fish Communities and Stream Quality in the Jackson Creek Watershed (Des Plaines River Basin).* Illinois Department of Natural Resources.

Fish habitat can be partly addressed by instream measures that do not attempt to reshape the channel, but more extensive measures are in order that serve to reconnect the floodplain to the river (i.e., address the deepening of the channel and remove the high spoil piles on the banks) or add sinuosity back to a straightened channel (i.e., remeandering). The central point is that IBI and MBI scores, the biological for the plan, most likely will not improve significantly by reducing nutrient inputs alone. Direct habitat and hydrological improvements to the stream will have to be made to accomplish this.

Table 2-11. Stream conditions from IEPA

	Manhattan (GCA 01)	Jackson (GC 03)
Bottom substrate	Good	Good
Deposition	Excellent	Excellent
Substrate stability	Excellent	Excellent
Instream Cover (for fish)	Fair	Fair
Pool substrate	Poor	Excellent
Pool Quality	Poor	Excellent
Pool variability	Poor	Excellent
Canopy cover (shading)	Poor	Poor
Bank vegetative protection/stability	Excellent	Excellent
Immediate watershed land use	Poor	Poor
Flow-related refugia	Fair	Fair
Channel alteration	Good	Excellent
Channel sinuosity	Fair	Fair
Width/Depth ratio	Poor	Good
Hydrologic diversity	Fair	Fair
Overall	**Fair**	**Good**

Note: Sample sites are shown in Figure 2-9.
Source: Data for IEPA Stream Habitat Assessment Protocol (2003) provided via personal communication with Howard Essig

2.2.3 INSTREAM CHEMICAL PARAMETERS

The IEPA has identified total nitrogen and total phosphorus as potential causes of impairment in the stream segments it evaluated (Table 2-12). The Illinois Pollution Control Board has not set numeric or narrative standards for either parameter. In such cases, IEPA uses a statistical guideline, generally the 85th percentile of observed concentrations statewide, to determine whether a pollutant is a potential cause of impairment. For total nitrogen, the statistical guidelines are 7.8 mg/L nitrite/nitrate in the water column or 4,680 mg/kg Kjeldahl nitrogen in sediment. Ammonia nitrogen, which makes up part of total nitrogen,[16] does have a numeric standard of 15 mg/L.[17] For total

[16] Total nitrogen = nitrite/nitrate + ammonia/ammonium + organic nitrogen = nitrate/nitrite + Kjeldahl nitrogen

phosphorus, the guidelines are 0.61 mg/L in water and 2,800 mg/kg in sediment.[18] Based on the data in Table 2-13 from the Intensive Basin Survey in 2003, it can be seen that phosphorus was at 0.75 on one sample date in September in Jackson Creek above the Jackson Branch confluence. In Manhattan Creek the nitrate/nitrite concentration was over twice the statistical guideline for total nitrogen.

Table 2-12. Impairment information from 2006 303(d) list

Seg. ID	Name	Designated Use	Pollutant
GC 02	Jackson Creek	Unimpaired	N/A
GC 03	Jackson Creek	Aquatic Life	Total Phosphorus
GCA 01	Manhattan Creek	Aquatic Life	Total Nitrogen Total Phosphorus
GCB	Jackson Branch	Aquatic Life	Total Nitrogen Total Phosphorus

Table 2-13. Nitrogen and phosphorus in Manhattan and Jackson Creeks

Station	GC 03	GC 03	GCA 01
Date	6/11/2003	9/16/2003	6/11/2003
Constituent	**Concentration (mg/L)**		
Ammonia	0.08	0.01	0.07
Kjeldahl nitrogen	0.97		0.72
Nitrite + nitrate	6.84	4.35	15.7
Total nitrogen	7.81	4.35	16.42
Dissolved phosphorus	0.27	0.72	0.26
Total phosphorus	0.33	0.75	0.3

Source: IEPA

The causes of impairment in Jackson Branch were identified through a Facility-Related Stream Survey IEPA conducted in 2005. From the data collected then (Table 2-14) it can be seen that while ammonia nitrogen was well within the standard, nitrite/nitrate was almost twice the guideline more than a mile below the New Lenox discharge. Moreover, total phosphorus was five times the guideline at the same point. Neither nutrient was elevated above the outfall.

Table 2-14. Ammonia, nitrogen, and phosphorus levels in Jackson Branch

Station Location	Std	A1 Jackson Br. Drive Bridge	E Outfall	C1 0.1 mile d/s outfall	C2 1.3 mile d/s outfall
Ammonia	15*	<0.10	0.13	0.31	<0.10
Nitrite + Nitrate	—	0.04	28.2	23.5	17.2
Total P	—	0.049	5.144	4.176	3.272

CenterPoint has also collected data in the vicinity of Deer Run Industrial Park and Midewin National Tallgrass Prairie, taking samples from both the water column in the stream and undiluted stormwater from the industrial park (Tables 2-16 through 2-20). The focus was on the types of pollutants that could be expected from an industrial use. Hardness data were not collected, so to compare the zinc and copper data to the Illinois instream standards — which are increasing functions of hardness — a value of 285 mg/L hardness was assumed.[19] This appears reasonable, given that hardness varied between 264 and 381 in the 2003 IEPA samples. Given this, copper and zinc appear to be well below instream standards (Table 2-15). CenterPoint's contractor also collected data on total suspended solids, oil and grease, and chloride. Illinois has not set a standard for total suspended solids, but the statistical guideline IEPA uses is 116 mg/L. The oil and grease and chloride standards are 15 mg/L and 500 mg/L, respectively. In all cases measured concentrations are within these guidelines.

[17] The overall limit is 15 mg/L, but an additional standard applies from March to October; this standard varies with pH and water temperature. See Ilinois *Integrated Water Quality Report* and Section 303(d) List (2006), p. 17, Table B-3.
[18] Illinois *Integrated Water Quality Report* and Section 303(d) List (2006), p. 45.

[19] Carlson report, p. 7 : Carlson Environmental, Inc. and Christopher B. Burke Engineering, LTD. 2007. 2006 Stormwater, water quality and aquatic macro-invertebrate sampling report, U.S. Army Corps of Engineers Permit #199900519. Prepared for CenterPoint Intermodal, LLC.

Table 2-15. Copper and zinc standards as a function of hardness

Hardness (mg/L)	Cu standard (mg/L)	Zn standard (mg/L)
264	0.026	0.049
285	0.028	0.052
381	0.036	0.067

Source: Calculated from equations for chronic standards in Ilinois *Integrated Water Quality Report* and Section 303(d) List (2006), p. 17, Table B-3.

Sample values for stormwater, in contrast, were compared against USEPA benchmarks.[20] Here there were a number of exceedances, with zinc above the 0.117 mg/L guideline at one station and more or less equal to it at another station during a spring storm event in 2004. During the same storm event total suspended solids concentrations were elevated 3–4 times above benchmark. However, copper was well under the benchmark value.

Table 2-16. Copper in industrial stormwater and instream samples

	Station	2003	2004	2005	2006
Instream	CP/JC-1	ND	ND	ND	ND
	CP/JC-2	ND			
	CP/JC-3	ND			
	CP/JC-4	ND	ND	ND	ND
	Standard	0.028	0.028	0.028	0.028
SW spring	Station 1	ND	0.018	NA	ND
	Station 2	ND	0.017	NA	ND
	Benchmark	0.0636	0.0636	0.0636	0.0636
SW summer	Station 1			ND	
	Station 2			ND	
	Benchmark	0.0636	0.0636	0.0636	0.0636

ND: Not Detected, NA: Not Evaluated
Source: Carlson Environmental, Inc. and Christopher B. Burke Engineering, LTD. 2007. 2006 Stormwater, water quality and aquatic macro-invertebrate sampling report, U.S. Army Corps of Engineers Permit #199900519. Prepared for CenterPoint Intermodal, LLC.

[20] Final Reissuance of National Pollutant Discharge Elimination System (NPDES) Storm Water Multi-Sector General Permit for Industrial Activities; Notice. *Federal Register* 65(210), p. 64767.

Table 2-17. Zinc in industrial stormwater and instream samples

	Station	2003	2004	2005	2006
Instream	CP/JC-1	ND	ND	ND	0.023
	CP/JC-2	ND			
	CP/JC-3	ND			
	CP/JC-4	ND	ND	ND	0.024
	Standard	0.052	0.052	0.052	0.052
SW spring	Station 1	ND	0.11	NA	ND
	Station 4	ND	0.14	NA	0.02
	Benchmark	0.117	0.117	0.117	0.117
SW summer	Station 1			ND	
	Station 4			ND	
	Benchmark	0.117	0.117	0.117	0.117

Source: Ibid.
ND: Not Detected, NA: Not Evaluated

Table 2-18. Fats, oils, & greases in industrial stormwater and instream samples

	Station	2003	2004	2005	2006
Instream	CP/JC-1	ND	ND	11	ND
	CP/JC-2	ND			
	CP/JC-3	ND			
	CP/JC-4	ND	ND	19	ND
	Standard	NONE	NONE	NONE	NONE
SW spring	Station 1	ND	ND	NA	ND
	Station 4	ND	ND	NA	ND
	Benchmark	15	15	15	15
SW summer	Station 1			ND	
	Station 4			ND	
	Benchmark	15	15	15	15

Source: Ibid.
ND: Not Detected, NA: Not Evaluated

Table 2-19. TSS in industrial stormwater and instream samples

	Station	2003	2004	2005	2006
Instream	CP/JC-1	37	18	18	42
	CP/JC-2	42			
	CP/JC-3	26			
	CP/JC-4	34	6.6	24	40
	Guideline	116	116	116	116
SW spring	Station 1	32	430	NA	20
	Station 4	25	380	NA	20
	Benchmark	100	100	100	100
SW summer	Station 1			24	
	Station 4			26	
	Benchmark	100	100	100	100

Source: Ibid.
ND: Not Detected, NA: Not Evaluated

Table 2-20. Chloride in industrial stormwater and instream samples

	Station	2003	2004	2005	2006
Instream	CP/JC-1	100	140	94	74
	CP/JC-2	110			
	CP/JC-3	100			
	CP/JC-4	110	120	94	73
	Standard	500	500	500	500
SW spring	Station 1	98	44		110
	Station 4	95	43		110
	Benchmark	860	860	860	860
SW summer	Station 1			160	
	Station 4			160	
	Benchmark	860	860	860	860

Source: Ibid.
ND: Not Detected, NA: Not Evaluated

2.2.4 LAKE WATER QUALITY

No lakes within the watershed have been monitored for the *Integrated Water Quality Report* (305(b)). Furthermore, no lakes within the watershed have been enrolled in the IEPA Volunteer Lake Monitoring Program. It is not likely that water quality samples have been collected in any systematic way, if at all.

2.2.5 WASTEWATER

2.2.5.1 Wastewater Treatment Plants

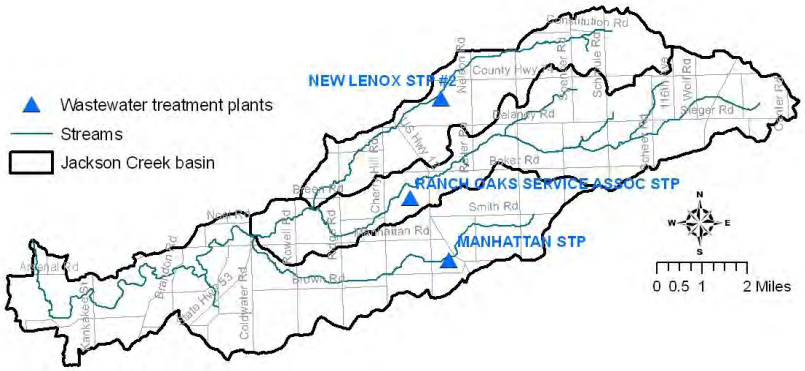
There are two municipal wastewater treatment plants (WWTP) in the watershed as well as a package plant for a subdivision just outside of Manhattan (Ranch Oaks). The New Lenox #2 plant was built in the 1970s and last expanded in 1995. It discharges into Jackson Branch, provides tertiary treatment through sand filters, and has a design average flow of 2.15 mgd. The Manhattan plant has been expanded in the last few years and has a design average flow of 1.35 mgd. However, the Manhattan plant's current average flow (0.69 mgd) is a bit higher than the current average flow from the New Lenox #2 plant (0.57 mgd). The Village of Elwood previously had a WWTP discharging to Jackson Creek but now discharges through the Joliet Army Training Area into the Des Plaines. The Gateway Mobile Home Park has been tied into the Frankfort sewer system.

The plants are not required to monitor total nitrogen or total phosphorus in plant effluent, as neither nutrient is regulated (neither of the plants are currently required to meet the 1 mg/L phosphorus effluent limit). Thus, in order to estimate loading from the plants to compare to loads from nonpoint sources, it is necessary to make certain assumptions about nutrients in wastewater. New Lenox provided data on concentrations of orthophosphate — the soluble, reactive form that is available for algal and plant uptake — in the effluent from the #2 plant.[21] Orthophosphate in final effluent varied from daily values of 1.2 to 7.4 mg/L, which is assumed to be reported as phosphorus. Total phosphorus will be slightly higher, although probably not much because final clarification removes organic phosphorus bound up with cellular material. The average phosphorus

[21] Personal communication from Ron Sly, Village of New Lenox, April 11, 2008

concentration in effluent from the New Lenox #2 plant is then estimated as 4.3 mg/L, which is within literature values for activated sludge plants with tertiary filtration. Effluent from the plants for which no data were available was assumed to contain 6 mg/L phosphorus, the midpoint of the literature range. [22]

Figure 2-11. Wastewater treatment plant locations



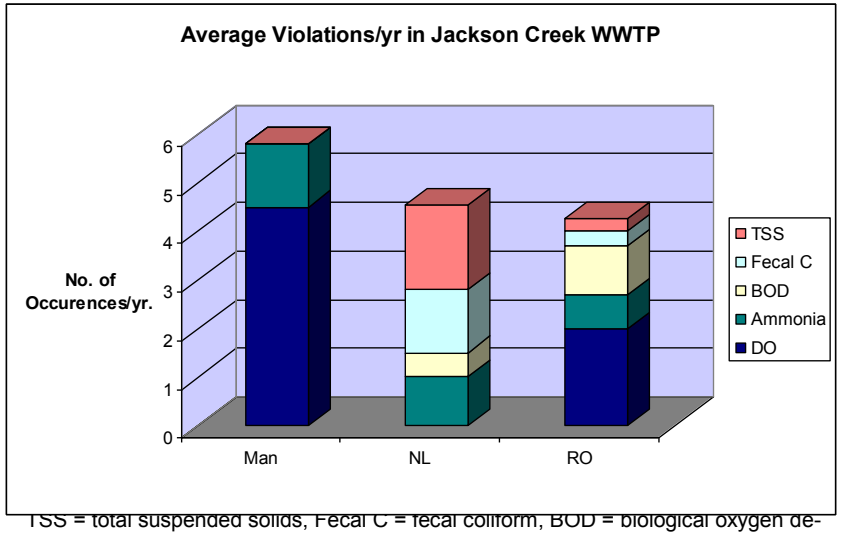
Source: USEPA Permit Compliance System

Table 2-21. Estimated nutrient loading from wastewater plants

	Flow	Concentration (mg/L)		Load (lb/y)	
	MGD	Total N	Total P	Total N	Total P
Manhattan	0.690	25	6.0	52,461	12,591
New Lenox #2	0.567	25	4.3	43,123	7,417
Ranch Oaks	0.020	25	6.0	1,539	369
Total	**1.28**			**97,122**	**20,377**

Source: U.S. EPA Permit Compliance System (data extracted December 20, 2007) for flow data; concentrations and loading as described in the text.

Neither plant monitors total nitrogen. Literature values were therefore consulted to average total nitrogen concentrations, which is estimated at 25 mg/L (from range of 15 – 35 mg/L) for activated sludge plants with or without filtration.[23] Estimates of annual nutrient loads from the WWTPs are shown in Table 2-21.[24]



TSS = total suspended solids, Fecal C = fecal coliform, BOD = biological oxygen demand, DO = dissolved oxygen

Violation frequencies for exceeding permit limits were assessed for each of the plants over the past few years. Figure 2-12 shows the average number of violations per year. Each of the plants has had some compliance problems for various parameters, most frequently dissolved oxygen and ammonia. It is not clear how much periodic exceedances may contribute to the aquatic life impairment.

[22] Asano, Takashi, Franklin Burton, Harold Leverenz, Ryujiro Tsuchihashi, and George Tchobanoglous. 2007. *Wastewater Reuse: Issues, Technologies, and Applications*. Metcalf and Eddy. Data are from Table 3-14.

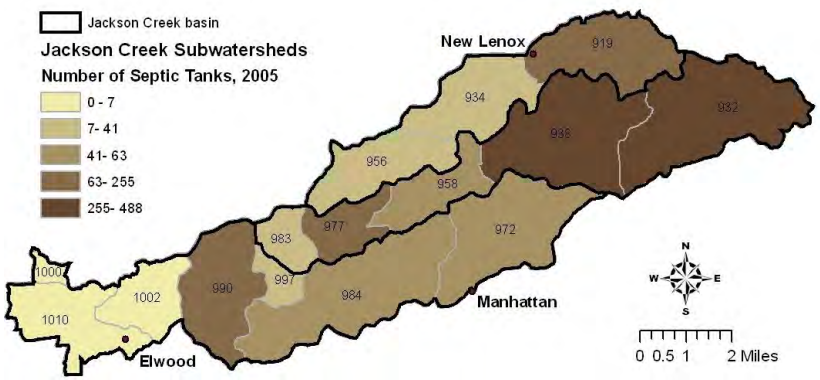
[23] *Ibid.*

[24] Average daily flow (mgd) × average concentration (mg/L) × 3,042 (L-d-lb/gal-y-mg) = average annual load (lb/y).

2.2.5.2 Septic Systems

A potential contributor to elevated nutrient concentrations in streams in the watershed is failing onsite sewage disposal systems. A study was therefore undertaken to estimate the number of septic systems by subwatershed. The results are shown in Figure 2-13 and Table 2-22. The U.S. Census most recently collected information on the type of sewage disposal systems serving housing units in 1990. This was retrieved for the block groups overlaying the watershed, as the block group is the smallest geographical unit for which the Census long form sample data are valid.

Figure 2-13. Estimated number of septic systems by subwatershed



The next step was to estimate how many new septic systems had been installed since 1990. To make the problem tractable, it was assumed that all new septic systems would be associated with residential land uses in unincorporated areas. Then, assuming that all septic systems from the 1990 Census were located within NIPC's 1990 unincorporated residential polygons, the number of septic systems installed up to 2005 could be estimated by calculating the number of septic systems by subwatershed in 1990 ÷ acreage of unincorporated residential land use in 1990 × acres of residential growth in unincorporated areas from 1990 to 2005. In order to verify the analysis, the results were compared to parcel data within the Jackson Creek watershed. Utilizing the assumption that there would be one septic tank per residential parcel located in an unincorporated area, the parcel data produced very similar results.

Table 2-22. Estimated number of septic systems by subwatershed

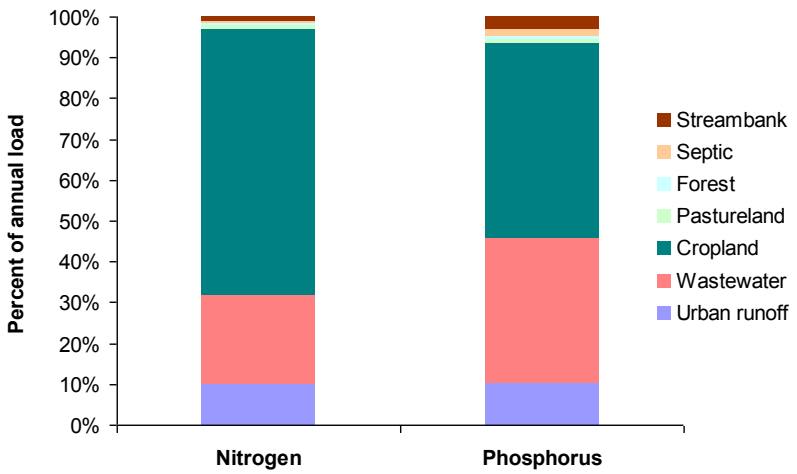
Subwatershed	Unincorp. Residential Acres, 1990	Septic Systems 1990	Septic Units per ac 1990	Unincorp. Residential Acres, 2005	Estimated Septic Systems 2005	Percent Change in Septic Units 1990-2005
919	181	190	1.05	243	255	34%
932	266	151	0.57	642	366	142%
934	67	43	0.64	64	41	0%
938	423	314	0.74	660	488	55%
956	75	35	0.47	75	35	0%
958	160	51	0.32	152	49	0%
972	192	75	0.39	158	62	0%
977	238	152	0.64	236	151	0%
983	21	14	0.64	31	20	47%
984	120	64	0.53	120	63	0%
990	294	160	0.54	393	212	33%
997	27	18	0.64	31	20	12%
1000	0	0	0	0	0	0%
1002	19	9	0.46	15	7	0%
1010	0	0	0	0	0	0%
	2083	**1275**	**0.59**	**2819**	**1768**	**25%**

Source: Census 1990, 1990 and 2005 CMAP land use inventories

No systematic data on septic failure rates are available, however. Inquiries to the Will County Health Department suggested that 2 – 5 percent of septic systems in the Jackson Creek area might be failing

at any given time, based on professional judgment.[25] When run in the watershed model STEPL (see Section 2.2.6 immediately below) with the number of septic systems by subwatershed and failure rate, the annual nutrient load from septic systems is estimated as 2,487 lb nitrogen and 974 lb phosphorus, or about 2.5 percent and 5 percent, respectively, of the nutrient load from the wastewater treatment plants.

Figure 2-14. Sources of long term average annual nutrient load



2.2.6 SOURCES OF POLLUTANT LOADS

In addition to identifying causes of impairment, IEPA also identifies potential sources of impairment, that is, the sources of pollutants or the historical origins of the causes of impairment. In the 2006 *Integrated Report*, these included crop production, municipal point source discharges, and site clearance. A sketch planning tool called STEPL (Spreadsheet Tool to Estimate Pollutant Loads[26]) was employed to estimate the existing nutrient load, break the load down by source area, and break it down by source type or contributor, e.g., crop production, urban runoff, etc. This section presents the results of the tool; further documentation of the data and assumptions employed is presented in the online appendix. The site clearance source of impairment was not evaluated using the STEPL analysis because of its episodic nature and the fact that it *should* be controlled by construction BMPs under the National Pollutant Discharge Elimination System (NPDES) Stormwater program and local ordinances.

Table 2-23. Long term average annual nutrient load (lb/y)

Sources	Nitrogen	Phosphorus
Urban runoff	45,327	5,897
Cropland	292,495	27,318
Pastureland	5,302	527
Forest	1,190	454
Septic	2,487	974
Streambank	5,202	1,717
Wastewater	97,122	20,377
Total	**449,125**	**57,265**

The primary inputs to STEPL are land cover and land use information. Land cover categories are grouped into urban, cropland, forest, grass or pastureland, and a user-defined category that in this implementation was wetlands and water (Figure 2-2). STEPL also allows the urban land cover classification to be broken down further, which was done by subcategorizing urban areas using the (draft, unreleased) CMAP land use inventory for 2005. This also permitted the land cover information from 2001 to be updated with more recent information. The model output from STEPL is average annual pollutant loads from non-point sources and is shown by source in Figure 2-14. First, the gross pollutant load from the landscape is computed, and second, the mitigating effects of existing best management practices (BMPs) are incorporated. Contributions from wastewater are calculated separately and added to the STEPL results as described in Section 4.3. It is important to understand that STEPL is not a comprehensive physical model. It computes only watershed loading, not

[25] Personal communication with Will County Health Department, March 18, 2008
[26] See http://it.tetratech-ffx.com/stepl/models$docs.htm.

water quality response, and makes use of highly generalized data at some points. Most importantly, however, it should be understood that STEPL is not calibrated. The available water quality and streamflow data — three ambient water quality data points for nutrients and no streamflow data — are insufficient to calibrate and validate a water quality model.

2.2.7 LOAD REDUCTIONS

The development of target loads to which nitrogen and phosphorus loading need to be reduced is a necessary step before identifying best management practices to achieve the reductions (see Nine Elements in Section 1). In the case of other pollutants the target load would be defined by the applicable water quality standard. This is not possible for total nitrogen and total phosphorus because Illinois has not set either numeric or narrative standards for streams and rivers.[27] As for other water quality constituents, the standard is set to protect a specific type of beneficial use. Some other states have set standards to protect aquatic life and recreational uses from eutrophication, most frequently setting standards for total phosphorus.[28] If standards are set for nitrate/nitrite, this typically is done to protect public water supply use, often with a standard of 10 mg/L (the Maximum Contaminant Level for drinking water). However, a few states have set standards for particular river reaches to protect against eutrophication. Nevada has average standards of 0.6–1.3 mg/L total nitrogen with single value standards of 0.8–1.7 mg/L. Arizona set total nitrogen standards of 0.3–0.7 on an average annual basis. North Dakota set an interim standard of 1.0 mg/L. No states in the central Great Lakes region (USEPA Region 5) have developed standards yet.

[27] With the exception that a stream feeding a reservoir ≥ 20 acres cannot have total phosphorus levels higher than 0.05 mg/L..
[28] **USEPA. 2003. *Survey Of States, Tribes And Territories Nutrient Standards*.** Retrieved from: http://www.dep.state.fl.us/water/wqssp/nutrients/nutr_link.htm

Table 2-24. Recommended nutrient load reductions

	GC 03		GCA	
Constituent	Conc (mg/L)	Reduction needed	Conc (mg/L)	Reduction needed
Total N	7.81	-68%	16.42	-85%
Total P	0.33	-78%	0.3	-76%

Nutrient loading targets in this plan were developed based on the nutrient criteria guidelines USEPA has produced. The states can either adopt these criteria or propose their own. USEPA assembled multi-decadal water quality samples for the Corn Belt and Northern Great Plains ecoregion of the U.S. ("Ecoregion VI") and aggregated the data to smaller Level III nutrient ecoregions. Most of northeastern Illinois, including Jackson Creek, falls into the Central Corn Belt Plains Level III ecoregion. USEPA has suggested that nutrient criteria can be developed by treating streams with nutrient concentrations below the 25th percentile of all streams as non-impacted,[29] and has published values for the 25th percentile for the Central Corn Belt Plains.[30] Concentrations above this value can then be taken as unacceptable, or states can develop a classification system ranging in quality from reference to acceptable to degraded. Since the latter approach has not been taken in Illinois,[31] values above the USEPA 25th

[29] USEPA. 2000. *Nutrient Criteria Technical Guidance Manual: Rivers and Streams*. EPA-822-B-00-002. Available at http://www.epa.gov/waterscience/criteria/nutrient/guidance/rivers/. The 25th percentile as USEPA calculates it is the median of the 25th percentiles of samples taken in each season of the year. The guidance manual also suggests criteria can be developed by establishing reference streams known to be in good condition and treating values above the 75th percentile in those streams as signaling degradation.
[30] USEPA. 2000. *Ambient Water Quality Criteria Recommendations: Information Supporting the Development of State and Tribal Nutrient Criteria for Rivers and Streams in Nutrient Ecoregion VI.* EPA 822-B-00-017. Data are from Table 3d. Available at http://www.epa.gov/waterscience/criteria/nutrient/ecoregions/rivers/rivers_6.pdf.
[31] USEPA (ibid.) provided three options for developing nutrient criteria: the reference stream approach, using predictive relationships, and using published nutrient thresholds or recommended algal limits. Illinois has opted to develop predictive relationships (see Illinois Council on Food and Agricultural Research at http://www.ilcfar.org/research/waterqualityforum.html), so it has not prepared a classification system based on percentiles in the frequency distribution of nutrient samples. It is not clear when nutrient criteria might be established in Illinois.

percentile cutoffs were treated as degraded. In this way the nutrient criteria define the load reduction target.[32]

The nutrient criteria are 2.461 mg/L total nitrogen and 0.0725 mg/L total phosphorus for the Central Corn Belt Plains. Comparison of these criteria values to the observations in Table 2-13 — averaging the two total phosphorus observations for GC 03 and ignoring the sample date for GC 03 for which there is no total nitrogen value — then leads to the percent reduction needed shown in Table 2-24. Using the modeled loads above, the load reductions needed are as shown in Table 2-25, where segment GC 03 is Jackson Creek upstream from the Manhattan Creek confluence and GCA is Manhattan Creek. Here the assumption is made that the percent decrease in sample concentration needed ≅ percent reduction in annual load needed.

Table 2-25. Load reductions needed in segment GC 03 and GCA

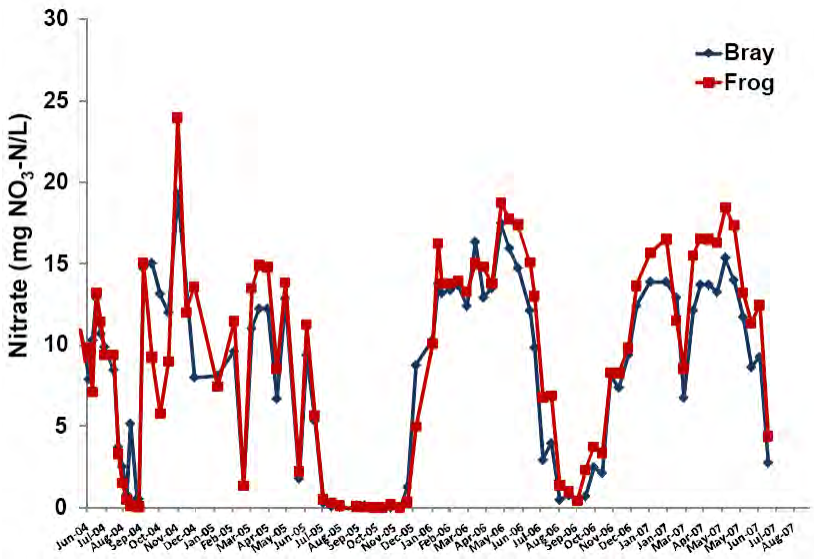
	Nitrogen (lb/y)		Phosphorus (lb/y)		
	GCA	GC 03	GCA	GC 03	GCB
Nonpoint	108,451	138,850	10,331	14,795	4,306
Point	52,461	1,539	12,591	369	7,417
Total	160,912	140,389	22,922	15,164	11,723
% reduction	-85%	-68%	-76%	-87%	-81%
Load reduction	136,795	95,464	17,383	13,193	9,544

Note: the load reduction for Manhattan Creek (GCA) is for only the subwatersheds draining to Manhattan Creek (972, 984, and 997 in Figure 1-2)

[32] In an interesting paper from the National Water Quality Assessment Program, the USGS has argued that USEPA's ~~a~~rbitrary quartile" approach is inappropriate. The argument is that the USEPA approach fails to take into account *natural* background concentrations, which are quite variable. However, examination of the USGS results suggests that predicted background concentrations are *lower* than the 25th percentile-based criteria in the Central Corn Belt Plains, i.e., that further load reductions may be needed. See Richard A. Smith, Richard B. Alexander, And Gregory E. Schwarz. 2003. *Natural Background Concentrations of Nutrients In Streams And Rivers Of The Conterminous United States.* Environmental Science & Technology 37(14): 3039—3047. Retrieved from: http://water.usgs.gov/nawqa/sparrow/intro/es&t.pdf

A load reduction was not directly calculated for Jackson Branch. In selecting sample sites in the Intensive Basin Survey, IEPA attempts to capture "ambient" conditions by identifying representative reaches that are not overwhelmingly influenced by point sources. But the samples taken for the Facility Related Stream Survey on Jackson Branch are meant to evaluate the impact of a specific discharge, not assess ambient conditions. It is recommended that a phosphorus load reduction for Jackson Branch be estimated as the average of the percent reductions for the other two drainages, resulting in a load reduction of 9,544 lb/y.

Figure 2-15. Example of nutrient concentration variability in agricultural watershed



Source: http://www.ilcfar.org/research/wqperry.pdf

It should be noted that the calculated load reductions are based on the three samples collected by IEPA in 2003. This is insufficient to capture the variability in nitrogen and phosphorus concentrations.

For example, researchers studying the Bray Creek and Frog Alley watersheds in McLean and Ford Counties as part of the Illinois Council on Food and Agriculture Research (C-FAR) effort (see footnote 30) found that nitrate concentrations varied from 0 ~ 25 mg/L in monthly monitoring over three years. Concentrations were positively related to streamflow, as one might expect for pollutants of nonpoint source origin (Figure 2-15). It is difficult to know whether the samples collected by IEPA in Jackson and Manhattan Creeks represent average conditions; presumably they could fall anywhere within a range of actual concentrations in the stream. Nutrient loading would tend to be relatively lower in late summer and fall when rainfall and potentially fertilizer application are lower, although this tendency is not enough to conclude that the available samples underestimate or overestimate general conditions. An obvious recommendation is that a more intensive sampling program be initiated in Jackson Creek. This is needed to validate the loading estimates made here as well as to track water quality improvement or decline given the expected land use changes described in Section 2.3.

2.3 Hydrology

2.3.1 WATER BALANCE

Based on average precipitation records Jackson Creek receives about 35 inches of rain per year. The Illinois State Water Survey estimates that regional evapotranspiration tends to be about 25 inches per year.[33] The remainder becomes streamflow if it is assumed that little subsurface storage occurs, which is a reasonable on an average annual basis (Table 2-26). Streamflow is made up partly of direct runoff and partly of baseflow, or flow originating from shallow groundwater. In the absence of withdrawals for irrigation or other uses, most recharge to shallow groundwater ultimately feeds surface water bodies. Relatively little percolates to deeper aquifer systems. The sketch planning tool STEPL used to estimate pollutant loading generates runoff estimates based on the SCS Curve Number Method[34] and annual rainfall records. It produces an estimate of runoff of 29,339 ac-ft/y, which is close to the estimate produced by the State Water Survey method.

Table 2-26. Simplified annual water balance

	Annual volume (ac-ft)	Percent of rainfall
Rainfall	98,215	100%
Annual stream discharge	28,081	29%
Evapotranspiration	70,133	71%

Source: Calculated from data in H. Vernon Knapp. 1988. *Fox River Basin Streamflow Assessment Model: Hydrologic Analysis.* ISWS Contract Report 454. See Figure 7, p. 14. Retrieved from: http://www.sws.uiuc.edu/pubdoc/CR/ISWSCR-454.pdf.

2.3.2 STREAMFLOW

There are no continuously operating stream gages on Jackson Creek. Most gage data were collected in the 1960s (Table 2-27), and even then data collection was limited mostly to annual peak gage heights. This is unfortunate for a number of reasons, but for the purpose of this plan it means that a hydrologic model cannot be calibrated without collecting more data. The lack of water quality data also means that a water quality response model could not be calibrated even if sufficient hydrologic data were available. For the purpose of a watershed overview, average annual streamflow at the mouth of the creek can be estimated, however. The average annual discharge given in Table 2-26 can be converted to an annual mean streamflow of 38.8 cfs at the mouth of the creek.

[33] H. Vernon Knapp. 1988. *Fox River Basin Streamflow Assessment Model: Hydrologic Analysis.* ISWS Contract Report 454. See Figure 7, p. 14. Retrieved from: http://www.sws.uiuc.edu/pubdoc/CR/ISWSCR-454.pdf. An adjustment can be made for soils with higher infiltration rates (generally above 1.2 in/h), as they tend to have lower evapotranspiration than the regional average, but infiltration rates in Jackson Creek are generally lower than this.

[34] For description, see http://www.ecn.purdue.edu/runoff/documentation/tr55.pdf.

Table 2-27. Available streamflow data

Gage location and ID	Parameter monitored	Record
JACKSON CREEK NEAR MANHATTAN, IL (05539550, Stream)	Annual peak gage heights	1962-70
JACKSON CREEK NEAR JOLIET, IL (05539560, Stream)	Annual peak gage heights	1966-70
JACKSON BRANCH AT NEW LENOX, IL (05539580, Stream)	Annual peak gage heights	1962-70
JACKSON BRANCH NEAR JOLIET, IL (05539590, Stream)	Annual peak gage heights	1966-70
JACKSON CREEK NEAR ELWOOD, IL (05539600, Stream)	Misc. discharge measurements	1961-62
MANHATTAN CREEK AT MANHATTAN, IL (05539610, Stream)	Annual peak gage heights	1966-70
MANHATTAN CREEK NEAR ELWOOD, IL (05539620, Stream)	Annual peak gage heights	1966-70
JACKSON CREEK NEAR ROCKDALE, IL (05539630, Stream)	Annual peak gage heights	1966-70
JACKSON CREEK AT MANHATTAN RD NR ELWOOD, IL (05539632, Stream, WQ)	Misc. discharge measurements, water quality, & Biology	2000
JACKSON CREEK AT ELWOOD, IL (05539635, Stream)	Annual peak gage heights	1966-70
JACKSON CREEK NEAR BLODGETT, IL (05539640,Stream)	Annual peak gage heights	1966-70
JACKSON CREEK NEAR CHANNAHON, IL (05539650, Stream)	Low flow discharge & peak gage heights	1961, 1966-70
Jackson Creek near New Lenox, IL (05539520)	Annual peak gage heights	1962-70

Source: Personal communication from John LaTour, US Geological Survey, April 4, 2007

Flood discharges have also been estimated at various points along the stream. The Illinois State Water Survey maintains a database[35] of flood discharge estimates and makes it available on the Survey website. In addition to the data shown in Table 2-28, the database includes the source, report from which the information was taken, additional location information, and Q_{60} and Q_{600} parameters. The Survey also maintains a floodplain model inventory, generally taken from Flood Insurance Studies, but the database does not include records for areas within the Jackson Creek watershed.

[35] Illinois State Water Survey Flood Discharge Database. Retrieved from: http://www.sws.uiuc.edu/fpi/cfd.asp

Table 2-28. Estimated flood discharges from ISWS database

Location	Creek	Source Date	Drainage (sq mi)	Q10 (cfs)	Q100 (cfs)
US 45 (d/s)	JC	5/10/05			2,281
Elsner Rd (d/s)	JC	2/8/05			1,518
Wolf Rd	JC	12/26/96	2.53	887	1,982
Delaney Rd	JC	12/26/96	3.18	1	2,556
Sheer Rd	JC	12/26/96	3.99	1,341	3,164
Schoolhouse Rd	JC	12/26/96	6.89	2,250	5,271
IL 53	JC	3/17/03	42.6	2,215	3,807
Brandon Rd	JC	3/17/03	46.6	2,368	4,068
Arsenal Rd	JC	6/12/98	Est. for several sites		
Confl Jxn Cr w/ D. Plaines	JC	6/12/98	52.7	2,343	4,064
Laraway Rd	JB	10/31/06	0.34		33
Townline Road	JB	12/26/96	1.38	533	1,240
Jxn Br Confl At Jxn Cr	JB	12/26/96	1.69	598	1,387
1600' E Of Spencer Rd	JB	11/28/95	0.97		315
Spencer Road U/S	JB	11/28/95	2.86		894
Norfolk & Western Rr	JB	3/17/03	3.68		1,320
Nelson St	JB	3/17/03	5.04		1,740
Appx 5600 Ft U/S US 52	JB	3/17/03	6.77		2,200
US 52	JB	3/17/03	8.44		2,300
Abandoned RR Bridge	JB	7/23/91	9		2,340
Confluence At Jxn Creek	JB	7/23/91	10.8		2,620
400 Ft U/S Of Confl	JB	11/28/95	1.53		568
Confl W/Main Stem	JB	11/28/95	1.78		634
U/S Confl. w/ Wilson Cr	MC	3/17/03	3.47	357	625
State Street	MC	3/17/03	4.71	451	788
Gougar Road	MC	3/17/03	5.28	467	814
Cherry Hill Road	MC	9/2/81	7.05		979
U/S N Tributary Confl	ST	2/8/05			252
D/S N Tributary Confl	ST	2/8/05			763
Elsner Road D/S	ST	2/8/05			202

Location	Creek	Source Date	Drainage (sq mi)	Q10 (cfs)	Q100 (cfs)
Mouth At South Tributary		2/8/05			511
Elsner Road D/S		2/8/05			427
Wabash Rr	WC	9/2/81	0.89		268

JC = Jackson Creek, JB = Jackson Branch, MC = Manhattan Creek, ST = South Tributary, WC = Wilson Creek

A GIS-based identification of structures in the 100-year floodplain was carried out to help quantify threats to property. As of spring 2005, there were 572 structures within the floodplain with an assessed value of $61million (Table 2-29). This contrasts with approximately $852 million in the entire watershed. It is not known whether the structures have been floodproofed or raised above the base flood elevation.

Table 2-29. Structures in SFHA (2005)

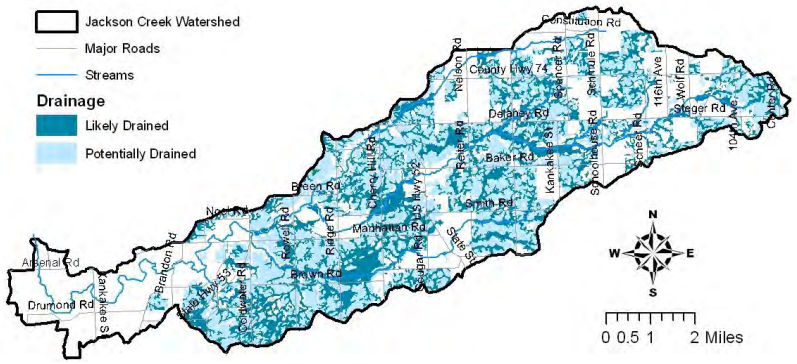
Property class	Count	Assessed value
Commercial	9	$665,234
Exempt	9	$0
Farm	21	$976,121
Industrial	33	$33,761,517
Residential	500	$25,719,780
Total	572	$61,263,652

Source: Will County parcel file, April 2008

2.3.3 TILE DRAINAGE

Tile drainage is thought to be extensive in the watershed. Since the Will County Stormwater Management Ordinance (WCSMO) requires special attention to tiles during development, and many watershed stakeholders were interested in their overall effects on hydrology, an attempt was made to estimate their prevalence and effects. Based on discussions with staff at the Natural Resources Conservation Service, soils that have tiles were identified based on whether they are considered poorly or very poorly drained (likely have tile drainage) or somewhat poorly drained (potentially have tile drainage). The results are shown in Figure 2-16 and indicate that essentially any part of the watershed used for row crops has tile drainage. Even soils generally unlikely to require drainage may have tiles to drain hillside seeps.

Figure 2-16. Soils in agricultural use expected to have tile drainage



Identifying actual tile locations is more difficult. Two main methods have been identified to do so: (1) on-site surveys, such as required in the WCSMO during development; and (2) remote sensing, using color infrared aerial imagery. On-site surveys are impractical for a 50-square-mile watershed. Drain tile alignments can be identified from color infrared imagery because reflectance is a function of soil moisture. There are generally only 2 – 3 times during the year when conditions are appropriate for acquiring the imagery and low altitude

image collection is generally needed.[36] Acquisition of the imagery is expensive and the method is prone to error.

It is also possible to locate tile outlets remotely on the assumption that grass waterways, which are easily identified in aerial photographs, will have a tile running beneath them as brome or fescue would not take root in a wet draw without drainage. However, this does not show the locations of main tiles and laterals, just the outlets. It would be necessary to walk the stream to verify the locations of outlets, especially because grass waterways do not always have clear confluences with ditches or streams.[37] The information available suggests that tile drainage is very widespread, which suggests in turn that agricultural BMPs designed to complement the tile system may be most appropriate for the watershed. Target areas can be defined for these BMPs without knowing the underground alignments of tiles, although actual BMP design will require site-level information.

The positive effect of drainage on farm productivity is well known, as is their negative effect on wetlands and what might be called a natural hydrologic regime. However, they also have direct effects on sediment and nutrient export, some positive and some negative. A review of studies comparing plots with tile drainage to those without tile systems found that drainage causes:[38]

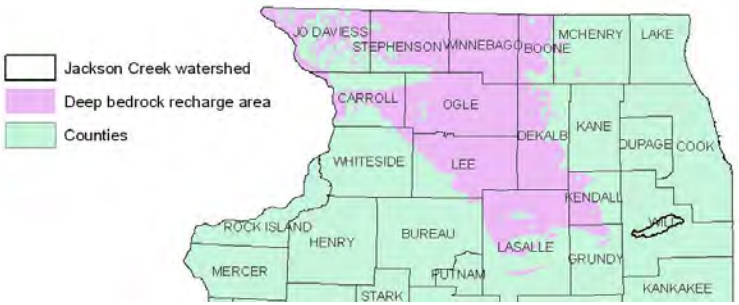
- A reduction of 29–65% in runoff leaving site as overland flow
- A reduction of 15–30% in peak runoff rate
- A reduction of 16–65% in sediment lost by water erosion
- Variable reduction in phosphorus loss, which tends to correlate with decrease in runoff and soil loss
- Increased nitrate/nitrite export

The STEPL tool does not account for these effects, which would tend to increase the relative contribution of cropland to total nitrogen and decrease its contribution to phosphorus.

2.3.4 GROUNDWATER AND AQUIFER RECHARGE PROTECTION

Productive aquifers in northeastern Illinois can be classified in a general typology of deep bedrock, shallow bedrock, and surficial sand and gravel. The deep bedrock aquifer (in rock from the Cambrian-Ordovician period and > 500 ft deep) is overlain with shale, limiting the general area that contributes recharge to that shown in Figure 2-17. The shallow bedrock (generally and sand/gravel aquifers receive recharge more locally and are extensively used for water supplies by communities in the watershed (Table 2-30). The sand and gravel aquifers are not used for public drinking water sources in the Jackson Creek watershed because of their limited yields.

Figure 2-17. Deep bedrock aquifer recharge area in Illinois



Source: Illinois State Water Survey

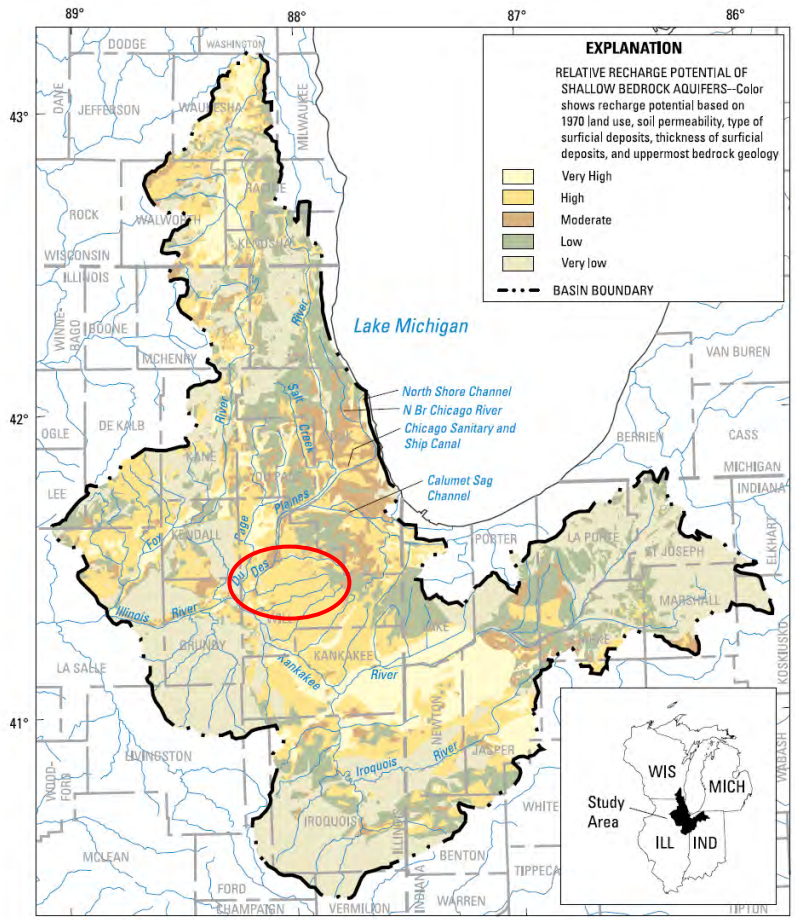
[36] A. Verma, R. Cooke, and R. Wendt. 1996. Mapping subsurface drainage systems with color infrared aerial photographs. *Applications in Remote Sensing.* Retrieved from: http://www.r-s-c-c.org/rscc/Volume4/verma/verma.html

[37] Examination of aerial photography suggests that in some cases these surface drainageways may run into inlets to the tile system.

[38] Fausey, N.R., L.C. Brown, H.W. Belcher, and R.S. Kanwar. 1995. Drainage and Water Quality in Great Lakes and Cornbelt States. *JASCE Journal of Irrigation and Drainage Engineering* 121(4):283-288.

While the infiltration rates of the soils in the watershed would seem to suggest low recharge, a model developed by the USGS for the Upper Illinois basin predicts the Jackson Creek area to have a high recharge potential for the shallow bedrock system (Figure 2-18) and high–moderate recharge potential for the surficial aquifers (not shown) relative to elsewhere in the basin.[39] Land use, soil permeability, type and thickness of surficial deposits, and uppermost bedrock geology were the inputs to the USGS model. If recharge potential is high in the watershed, development would tend to reduce recharge potential according to the model (unless newer development tends to make greater use of infiltration or volume reduction practices). The model in fact does suggest that recharge potential for the shallow bedrock system decreased between 1970 and 1990 in the neighborhood of Jackson Creek because of land use change. Because the model only shows relative changes rather than specific magnitudes, it is difficult to tell how important the change is, although examination of the data in the USGS study suggests that the impact of changing land use over 20 years in the whole Illinois River basin was quite small.

Figure 2-18. Relative recharge potential in Upper Illinois basin.



Source: USGS

Groundwater can also be viewed from the standpoint of protecting wells from contamination. As part of its Source Water Assessment Program,[40] IEPA has evaluated threats to groundwater supplies from overlying land uses for each public well (Community Water Supply

[39] Terri L. Arnold and Michael J. Friedel. 2000. *Effects of Land Use on Recharge Potential of Surficial and Shallow Bedrock Aquifers in the Upper Illinois River Basin*. U.S. GEOLOGICAL SURVEY Water-Resources Investigations Report 00–4027. Retrieved from: http://il.water.usgs.gov/nawqa/uirb/pubs/reports/WRIR_00-4027.pdf

[40] Required under the 1996 Amendments to the Safe Drinking Water Act

and Non-Community Water Supply wells)[41] in the state. The public wells serving populations in the Jackson Creek watershed are tabulated in Table 2-30. The primary requirement of the SWAP program in this watershed is the establishment of a 200-foot setback from the wellhead, which regulates certain existing and new activities.[42] The assessments for the wells serving watershed residents suggest that because of overlying land uses and geologic conditions the wells are not susceptible to contamination. However, the 200-foot radial setback is required in the absence of specific information about the actual capture zone of the well, i.e., the overlying area that contributes recharge when the well is pumping.[43]

Analysis of the available information suggests that additional wellhead protection is not a critical activity in the Jackson Creek watershed. Nevertheless, IEPA recommends that public water supply well operators:

- Consider enacting maximum setback zone ordinances up to 1,000 feet;
- Revisit contingency planning documents to ensure that, through emergency preparedness, a water supply will minimize its risk of being without safe and adequate water;
- Properly abandon inactive wells (inactive wells that are not properly abandoned can act as direct conduits for contaminants into aquifers); and
- Review cross connection control program to ensure it remains current and viable (cross connections to either the water treatment plant or in the distribution system may negate all source water protection initiatives provided by the community).[44]

Table 2-30. Community water supply wells in Jackson Creek watershed

Well ID	System	Aquifer	Status	Min Setback (ft)	Depth (ft)
01000	Elwood	DB	Active	200	1500
20382	Manhattan	SB	Active	200	156
20383	Manhattan	SB	Inactive	200	115
20384	Manhattan	SB	Active	200	115
00862	Manhattan	DB	Active	200	1655
00683	Gateway MHP	SB	Active	200	300
01114	Gateway MHP	SB	Active	200	300
20407	New Lenox*	SB	Inactive	200	303
00557	New Lenox*	SB	Aband.	200	325
01107	New Lenox*	SB	Inactive	200	301

DB = deep bedrock, SB = shallow bedrock
* New Lenox obtains water from a Lake Michigan wholesaler. Its wells are for a back-up supply.
Source: IEPA Source Water Assessment Program

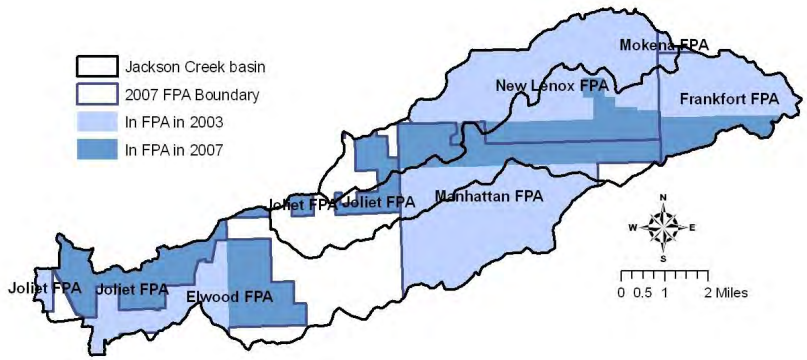
2.4 Developing Areas

Although the watershed is mainly agricultural, much of it is expected to eventually be developed. This is backed up by an examination of the Facility Planning Area boundaries, which have enclosed almost the entire watershed in the past few years, especially the eastern half (Figure 2-19). Inclusion within a FPA is a precursor to eventual development, generally speaking. Stakeholders in the watershed suggest that boundary agreements are largely in place between the municipalities as well. Interestingly, the Jackson Creek

[41] A public well is any well with 15 service connections or that serves 25 persons at least 60 days out of the year. Community wells serve residents year round; non-community wells serve businesses, institutions, etc.
[42] Title 35 Ill. Adm. Code, Part 615 and 616. The affected activities are on-site landfills, on-site land treatment units, on-site surface impoundments, on-site waste piles, underground storage tanks, pesticide storage and handling units, fertilizer storage and handling units, road oil storage and handling units, and de-icing agent storage and handling units. The effectiveness of enforcement is unknown.
[43] When delineated, this is referred to as a Phase II Wellhead Protection Area under the SWAP program.
[44] Source Water Assessment fact sheets for Community Water Supply wells serving Jackson Creek. Available at http://www.epa.state.il.us/cgi-bin/wp/swap-fact-sheets.pl

watershed was the HUC 10 watershed with the *highest* projected population change in the last population forecasts for 2030 published by the Northeastern Illinois Planning Commission.

Figure 2-19. Facility planning area boundaries



Source: IEPA

2.4.1 IMPERVIOUSNESS PROJECTION

To develop a sense of how much land use change is expected in the watershed, household and employment forecasts for 2030 generated by the Northeastern Illinois Planning Commission,[45] a predecessor to CMAP, were translated into acreages of residential and nonresidential (employee-generating) land uses in the watershed.[46] It was assumed that most new residential development would be at a density of three dwelling units per gross acre. New nonresidential acreage was estimated by first determining the most likely type of employee-generating land use (industrial, retail, etc.), then applying standard factors for the number of employees per square foot and the floor area ratio (FAR) for each land use type to translate the employment forecasts into acreages.[47] The forecasts are developed by quartersection and were aggregated to the subwatersheds.

Table 2-31. Current and projected development by subwatershed

	Developed in 2005 (ac)		Developed in 2030 (ac)	
Subwatershed	Nonres	Res	Nonres	Res
919	280	575	357	1,483
932	92	1,172	257	2,069
934	130	623	142	1,584
938	60	662	83	1,958
956	2	75	2	125
958	45	154	53	426
972	101	476	184	2,502
977	0	236	0	253
983	0	31	5	229
984	35	177	69	611
990	8	543	80	1,444
997	3	31	6	195
1000	175	0	175	1
1002	842	72	892	114
1010	1,164	0	1,613	14
Total	**2,936**	**4,826**	**3,918**	**13,007**

Source: 2005 CMAP land use inventory, CMAP household and employment forecasts (revised September 22, 2006)

The expected development will increase total imperviousness in Jackson Creek. To estimate the amount of increase, it was assumed that residential development would be 24 percent impervious (the average level for all residential land uses in the watershed in 2001) and that non-residential land uses would be 50 percent impervious. The latter assumption is a generalization of imperviousness for commercial, industrial, and distribution uses in the watershed in 2001 and may underestimate the imperviousness of new nonresidential developments. The results of this analysis suggest that imper-

[45] The forecasts were adopted on September 27, 2006.

[46] The preferred method is to use the comprehensive plans from the communities in the watershed to predict future land use. Northern Illinois University has developed a coverage of the land use categories from the future land use maps of a number of communities in Will County, a project funded by Nicor, but CMAP was unable to obtain permission to use these data.

[47] These values were taken from Nelson, Arthur. 2004. *Planner's Estimating Guide: Projecting Land-Use and Facility Needs.* Chicago: APA Planners Press.

viousness would increase substantially in each of the tributary drainages and in the watershed as a whole (Table 2-33), in all cases to greater than 10 percent.

Table 2-32. Projected new development for 2030 by municipality

Municipality	Residential (ac)	Nonresidential (ac)
Elwood	905	554
Frankfort	710	165
Joliet	172	18
Manhattan	2,652	126
Mokena	28	0
New Lenox	3,103	113
Unincorporated	610	6
Total	**8,180**	**982**

Table 2-33. Impervious surface forecast

		Imperviousness	
Tributary drainage	**Subwatershed**	**2001**	**2030**
Jackson Branch (GCB)	919	12%	22%
	934	14%	25%
	956	1%	2%
Subtotal		**9%**	**17%**
Jackson Cr upstream from Manhattan Cr (GC 03)	932	10%	17%
	938	6%	14%
	958	3%	8%
	977	2%	2%
	983	1%	7%
Subtotal		**6%**	**13%**
Jackson Cr + Manhattan Cr (GCA 01 + GC 02)	972	6%	22%
	984	2%	5%
	990	5%	15%
	997	2%	10%
	1000	2%	2%
	1002	3%	5%
	1010	10%	21%
Subtotal		**5%**	**13%**
Total		**6%**	**14%**

2.4.2 LOCAL ORDINANCES

As the previous section shows, continued urban growth is expected in the watershed. As of now most of the nutrient loading and perhaps most of the biological decline can be attributed to agriculture and wastewater, but this is expected to change.Two important means of controlling the impacts of urban growth are a commitment to protect significant concentrations of natural resources – the environmental corridors described in Section 6 – and the passage of protective development standards through local ordinances. Local ordinances are discussed here. Rather than review the stormwater ordinances of the communities in the watershed, which are presumed to have requirements at least as strong as the WCSMO, land use and subdivision standards were evaluated, as they can have either a relatively negative or relatively positive effect on runoff control by, for example, stipulating certain street widths or by encouraging or not encouraging flexible development. The ordinances of the larger municipalities were compared to a checklist from the Center for Watershed Protection (CWP) for guidance.[48] The results are shown in Table 2-34. The purpose of the CWP's checklist was to scan municipal ordinances to determine whether it would be valuable to hold a "site planning roundtable," in which officials from municipal engineering, planning, etc. departments go through ordinances in more detail. Using a facilitated process they would determine which ordinances the group would be willing to change and which they were not, and recommendations would be forwarded for action by elected officials. The value of the maximum score for each code element in the checklist is based on what the Center for Watershed Protection's stakeholder group felt was most important and has not been altered. While the CWP's exact guidelines may not be ideal for the communities in Jackson Creek, it would seem that there is room for establishing more protective zoning and subdivision standards.

[48] Center for Watershed Protection. 1998. *Better Site Design*. Retrieved from: http://www.cwp.org/PublicationStore/bsd.htm

Table 2-34. Comparison of municipal ordinances to Center for Watershed Protection checklist.

	New Lenox	Score	Manhattan	Score	Frankfort	Score	Elwood	Score	**Std**	Max score
Street width (local access)	>28'	0	31'	0	32'	0	***		**18-22'**	4
Queuing	Not mentioned	0	No	0	Implied no b/c of street width	0	***		**Yes**	3
Street length	Not mentioned	0	Not mentioned	0	Not mentioned	0	***		**Minimize**	1
ROW width for minor roads	66'	0	66'	1	66'	0	***		**<45'**	3
Allow utilities under paved part of ROW?	Unclear	0	Unclear	0	Implied yes	1	Unclear	0	**Yes**	1
Culs-de-sac radii	57'	0	31’	3	45'	3	***		**<35' or <45'**	3
Require landscaped island?	Yes	0	Yes	1	Encouraged	1	Yes*	1	**Yes**	1
Allow alternative turn-arounds?	Not mentioned	0	Not mentioned	0	Not mentioned	0	***		**Yes**	1
Curb and gutter required?	Yes	0	No	2	Yes	0	Yes	0	**No**	2
Established swale criteria?	Yes	2	Yes	2	Yes	2	***		**Yes**	2
Parking ratio, professional office[49]	4	0	4	0	5	0	4	0	**≤3**	1
Parking ratio, shopping ctr	5.5 (4 if >50K sf)	0.5	Not mentioned	0	4	1	5.5	0	**≤4.5**	1
Parking ratio, single family detached	2	1	2	1	2	1	2	1	**≤2**	1
Max rather than min?	No	0	No	0	No	0	No	0	**Yes**	2
Promote shared parking?	Allow	1	Allow	1	Allow	1	***		**Yes**	1
Provide model shared parking agreements?	No	0	No	0	No	0	***		**Yes**	1
Reduce parking ratios w/ shared parking?	No	0	No	0	Discretionary	1	***		**Yes**	1
Parking ratio reduced near transit?	No	0	No	0	Discretionary	1	***		**Yes**	1
Parking stall width	180 sf[50]	0.5	9’	1	9'	1	9'	1	**≤9'**	1

[49] Parking ratios in spaces per 1,000 square feet gross leasable area
[50] It is possible to have a width of 9' and an area of 180 sf

	New Lenox	Score	Manhattan	Score	Frankfort	Score	Elwood	Score	**Std**	Max score
Stall length	180 sf[50]	0.5	20’	0	18'	1	19'	0	**≤18'**	1
Smaller dimensions for compact cars?	No	0	No	0	Yes[51]	1	Yes	1	**Yes**	1
Pervious area for spillover parking?	Yes	2	No	0	No	0	No	0	**Yes**	2
Incentives for structured parking?	No	0	No	0	No	0	No	0	**Yes**	1
Minimum landscaping for parking lots?	Yes	2	No	0	Yes (1 island / 10 spaces)	2	Yes	2	**Yes**	2
Bioretention islands allowed?	Yes	2	No	0	Implied yes	2			**Yes**	2
Cluster development allowed?	Yes	3	Yes (PD)	3	Yes (PD)	3	Yes	3	**Yes**	3
Land conservation or impervious cover a major goal of open space design ordinance?	Yes	1	Yes	1	Yes (PD)	1	Yes	1	**Yes**	1
Additional submittal or review requirements for CD?	Yes	0	Yes	0	Yes (PD)	0			**No**	1
By-right form of development?	No	0	No	0	No	1	No	0	**Yes**	1
Flexible site design criteria?	Yes (PD)	2	No	0	Yes (PD)	2			**Yes**	2
Irregular lot shapes allowed?	Yes	1	Yes	1	Yes (PD)	1				1
Front setback for 0.5 ac residential lot	35'	0	30’	0	35'	0	30' [52]	0	**≤20'**	1
Rear setback for 0.5 ac residential lot	50'	0	30’	0	40'	0	40' [33]	0	**≤25'**	1
Min side setback for 0.5 ac residential lot	15'	0	10’	0	15'	0	10' [33]	0	**≤8'**	1
Frontage for 0.5 ac residential lot	100'	0	75’	2	100'	0	90' [33]	0	**≤80'**	2
Min sidewalk width	4'	2	4' (residential)	1	5'	0	***		**≤4'**	2
Required on both sides of street?	Yes	0	Yes	0	Yes	0	***		**No**	2
Sloped to drain to yard, not street?	Not mentioned	0	Not mentioned	0	Unclear	0	No	0	**Yes**	1

[51] Frankfort has allowed this on a limited basis although it is not specifically encouraged in the ordinance.
[52] For 15,000 sf lot, the minimum size for the General Residential district

	New Lenox	Score	Manhattan	Score	Frankfort	Score	Elwood	Score	**Std**	Max score
Substitute alternate pedestrian networks?	Not mentioned	0	Not mentioned	0	Not mentioned	0	Yes [53]	1	**Yes**	1
Minimum driveway width?	20'	0	9'	2	None (max 28')	2	10'	0	**≤9'**	2
Can pervious materials be used?	No	0	No	0	No	0	***		**Yes**	2
Use two-track design?	Not mentioned	0	Not mentioned	0	Not mentioned	0	***		**Yes**	1
Shared driveways permitted in residential developments?	Not mentioned	0	No	0	Yes[54]	0	***		**Yes**	1
Require association to manage common open space?	Yes	2	No	0	Yes [55]	2	***		**Yes**	2
Require consolidation of open space?	No	0	No	0	No	0	***		**Yes**	1
Keep percentage of open space in natural condition?	No	0	No	0	No	0	***		**Yes**	1
Uses defined for open space?	Yes	1	No	0	Yes	1	***		**Yes**	1
Allow management of open space by third party?	Not mentioned	0	No	0	Not mentioned	0	***		**Yes**	1
Discharge roof runoff to yard?	Not mentioned	0	No	0	Not mentioned	0	***		**Yes**	2
Allow temporary ponding on yard or roof?	Not mentioned	0	No	0	Not mentioned	0	***		**Yes**	2
Stream buffer ordinance?	Yes	2	Yes	2	Yes	2	***		**Yes**	2
Minimum buffer width?	75'	1	25'	0	25 - 75'	0	***		**≥75'**	1
Include wetlands, steep slope, and floodplain?	Just wetland	1	Just wetland	1	Just wetland [56]	1	***		**Yes**	1
Require native vegetation in buffer?	Yes	2	Yes	2	Yes	2	***		**Yes**	2
Ordinance outline allowable uses in buffer?	Yes	1	Yes	1	Yes	1	***			1

[53] In residential design guidelines
[54] Frankfort frequently allows these through PUD, but it is not written into the subdivision code.
[55] Frankfort's requirements are elaborated more thoroughly
[56] Frankfort has identified wetlands in its Water Resources Management Plan in addition to the NWI

	New Lenox	Score	Manhattan	Score	Frankfort	Score	Elwood	Score	**Std**	Max score
Buffer ordinance specifies education and enforcement?	No	0	No	0	No	0	***		**Yes**	1
Preserve natural vegetation on residential lots?	No[57]	0	Somewhat	1	Encouraged	2	***		**Yes**	2
Clear trees from septic field?	Not mentioned		No septic permit-ted	0	Not mentioned	1	***		**No**	1
Require tree conservation?	No	0	No	0	Yes	2	Yes	2	**Yes**	2
Limits of disturbance on con-struction plans adequate to prevent clearing?	Unclear	0	Unclear	0	Unclear	0	***		**Yes**	1
Incentives for conserving non-regulated land?	Yes (density bo-nus in PD)	2	No	0	Yes (density bonus in PD)	2	***		**Yes**	2
Flexibility to meet regulatory requirements?	Yes	2	Somewhat	1	Yes (PD)	2	***		**Yes**	2
Require water quality treat-ment for stormwater?	Yes	2	Yes (encouraged)	2	Yes (BMPs)	2	Yes	2	**Yes**	2
Effective design criteria for BMPs?	Yes	1	Yes	1	Yes	1	Yes	1	**Yes**	1
Discharge stormwater directly into wetland without pretreat-ment?	No	1	No	1	No	1	No	1	**No**	1
Restrict or prohibit develop-ment in 100 yr floodplain?	No[58]	0	Yes	2	Yes[59]	2	No	0	**Yes**	2
Total		38		36		52		—		100

*** While the Village of Elwood has a number of its ordinances online and mailed CMAP a package of ordinances, including a copy of the subdivision ordinance on CD, the project team was unable to locate standards and requirements in a these areas.

[57] Except in planned developments
[58] 1:1 compensation, no restriction on type of use
[59] 1.5 compensation, uses restricted

2.5 Local Government and Stakeholder Activities

This section briefly describes additional beneficial actions by local governments to protect water resources in the Jackson Creek watershed.

2.5.1 VILLAGE OF FRANKFORT

The Village of Frankfort has incorporated about 1,350 acres within the watershed. Land use is primarily newer single family residential with a density of 2 – 2.5 dwelling units per net acre. No areas of the Village within the watershed lack detention.

The Village has taken a comprehensive and forward-looking approach to the management of stormwater infrastructure. It developed a *Water Resource Management Plan*[60] to complement its water resource protection ordinances, such as the Lowland Conservancy Overlay District. As part of the plan, the Village has compiled a database of detention basins in the Village. The Public Works department has jurisdiction over control structures associated with the basins even if they are in private hands. The Village requires open space in subdivisions to be conveyed to a public agency if there are potential benefits from its public use or to be placed into a conservation easement. Density bonuses have also been granted in some cases for additional open space preservation beyond regulatory requirements. Elements of conservation design have been incorporated into developments, although there is a preference among elected officials for curb and gutter over swales. In Frankfort, conservation design would be most applicable in the area south of Steger Road which is expected to be developed in large lot subdivisions.

[60] http://www.villageoffrankfort.com/docs/2008-wrmp.pdf

Figure 2-20. Section of Jackson Creek in Frankfort to be remeandered (near intersection of 116th and Steger)

The Village does not have a wastewater discharge within the watershed. However, at one of its plants on Hickory Creek it undertakes tertiary treatment to remove additional nitrogen from the effluent stream and is doing so voluntarily. This is a significant environmental benefit and should be a model for other municipalities in the watershed and elsewhere in the county and larger region. The Village has also been active in multijurisdictional water resources projects, the most significant one in this watershed being the planned dechannelization of Jackson Creek where it runs in a roadside ditch south of Steger Road.[61] The land is part of the Forest Preserve District of Will County's Jackson Creek Headwaters preserve, but much of this is being provided by the Village. The stream work is being undertaken as part of a road project.

[61] For more information see November 27, 2008 *Southtown Star* article at http://www.southtownstar.com/neighborhoodstar/frankfort/1299598,112708restorecreek.article

2.5.2 VILLAGE OF MANHATTAN

Almost 2,900 acres of the watershed were incorporated within Manhattan in 2007. It includes a small part of the older downtown area as well as a much larger area with a small number of newer, post-ordinance subdivisions with densities of 4 – 5 units per net acre. Relatively little of this area has been developed thus far. Based on its Facility Planning Area and the growth area outlined in the Village's 2008 Comprehensive Plan, the majority of Manhattan's growth is expected to be medium density residential, although conservation development is encourage in the Prairie Creek District and in fact includes some areas along Jackson Creek. The Comprehensive Plan is laudable in that it places considerable emphasis on conservation design.

The Village has been actively promoting the protection of Manhattan Creek through its stream protection resolution.[62] One provision of the resolution is that detention ponds discharging to Manhattan Creek be deeper than usual (at least ten feet over 25 percent of the pool area) and draw water to the outfall from at least six feet below the pond surface. This provision is meant to prevent stream warming, as the fish study DNR performed in 2003 indicated the presence of southern redbelly dace, a cooler-water species, near the confluence with Jackson Creek. This provision appears to be the outcome of consultation with state biologists relating to the Manhattan Creek corridor's status as an Illinois Natural Areas Inventory site. Most significantly, the resolution requires developers to restore "surface and buried creeks existing in their property or in adjacent public right-of-way; restoration is defined as daylighting piped creeks and historic creek corridors, removing fish barriers, establishing buffers and planting native vegetation, including native trees." The resolution also prohibits stream modification except as part of a restoration project. One important outcome of these provisions is the daylighting of a section of creek that had been in a main drain, done as part of the Brookstone Springs Subdivision east of US 52 and completed in 2006 (Figure 2-21). The resolution also requires a 35-foot strip of native prairie vegetation along the banks of the creek. This has been interpreted to mean that trees need to be removed.

There is also a trail plan for Manhattan developed as a cooperative venture between the village, the township, and the park district. The latter has taken on other cooperative projects to promote preservation of natural and historic resources, the flagship being the Round Barn property managed by the park district and involving easements held by IDNR and FPDWC.

Figure 2-21. Recently completed daylighting and remeandering project on Manhattan Creek, Village of Manhattan, August 2006.

[62] Resolution No. 314 (A Resolution of Intent to Preserve and Improve the Natural Functions of Manhattan Creek Within the Village of Manhattan, County of Will, State of Illinois), passed November 4, 2003

2.5.3 VILLAGE OF ELWOOD

The Village of Elwood contains about 2,000 acres of land in the watershed. Much of this is either part of the CenterPoint Intermodal Center or BNSF Logistics Park. There is a small residential area consisting of two subdivisions and part of a third, as well as a much larger area projected for residential development east of the Union Pacific line. The Village has experimented with advanced best management practices in its village hall, the parking lot of which drains through breached curbs to a pervious area.

2.5.4 GREEN GARDEN TOWNSHIP

Only a small part of Green Garden Township (parts of Sections 4, 5, and 6) is within the watershed. However, the township government is quite active, producing and updating a comprehensive plan (townships with land use plans can make a formal objection to the county board over a zoning change if the township board feels it is incompatible with the township plan, which then forces a supermajority vote of the county board to approve the request). The township land use plan is strongly oriented toward natural resource protection and the preservation of rural character. A Green Garden Township Multi-Use Trail Plan[63] was also developed in August 2008, although the township rejected the plan's recommendations.

2.5.5 CITY OF JOLIET

A relatively small area (900 acres) within the watershed is incorporated within the City of Joliet. The City's South Side plan[64] (2007) suggests that it is planned for business park or industrial use. See Section 6.1.2 for further discussion of this industrial use. The City has drafted a Jackson Creek Watershed Protection Ordinance which was passed as Section 47-15G of the City's zoning code,[65] providing that development of a parcel within the Jackson Creek watershed protection area[66] (and several others) requires a special use permit. Among other things, the ordinance requires a 25-foot strip of natural vegetation from the ordinary high water mark (47-15G.12). Unlike the Manhattan resolution, Joliet's ordinance mentions a requirement to establish canopy cover.

2.5.6 CITIZEN GROUPS

The two main citizen environmental groups active in the watershed are the Prairie Parklands Ecosystem Partnership[67] and the Prairie Streams Watershed Planning Committee. Prairie Parklands is part of IDNR's Partners for Conservation (C2000) program and coordinates proposals for grant funding under that program; its past successes are shown in Table 2-35. The Prairie Streams group has been active in Jackson Creek and a number of nearby watersheds and also produced a high-level watershed plan for the stream in 2005.

Table 2-35. Prairie Parklands accomplishments

Acres Restored	2.330
Land Acquired (acres)	65
Feet of Stream Restored	7,300
Sites Monitored	99
Students Educated	5,488
Teachers Trained	75
Volunteers Enlisted	773
Other Citizens Contacted	2,245
C2000 Funding	$1,151,636.94
More Leveraged	$1,920,740.09

[63] http://www.greengardentownship.org/ProposedPlan.pdf
[64] http://www.cityofjoliet.info/City-Government/FINAL-SouthSideCompPlan_001.swf
[65] http://www.cityofjoliet.info/City-Government/ZOAPNDX080707_000.swf

[66] The watershed protection area is ~~the~~ the real property lying within one hundred (100) feet of an ordinary high water mark of Cedar Creek, Sugar Creek, Jackson Creek, and Jackson Branch, within twenty-five (25) feet of the upland edge of any wetland within the Cedar Creek, Sugar Creek, Jackson Creek, and Jackson Branch watershed or within one hundred (100) feet of the center thread of any tributary to Cedar Creek, Sugar Creek, Jackson Creek, and Jackson Branch actually located in the 100-year floodplain" (47-15G.3.b).
[67] http://dnr.state.il.us/orep/pfc/ecosystem/partnerships/partner.asp

3. URBAN NONPOINT SOURCE AND STREAM HABITAT PROJECT RECOMMENDATIONS

Four types of projects are recommended in this plan: (a) urban nonpoint source reduction, (b) stream habitat restoration, (c) improvements to wastewater treatment plants, and (d) agricultural best management practices. Project types (a) and (b) are discussed in this section, followed by a site-specific priority list of projects recommended for the medium term. Wastewater recommendations and a more general program of agricultural BMPs are recommended in the following two sections based on estimated pollution reduction benefits and attractiveness to the implementer.

3.1 Urban Nonpoint Source Overview

This section addresses techniques for reducing nonpoint nutrient loading from urban areas in the Jackson Creek watershed. The two types of techniques discussed are increased management and retrofits to existing stormwater management infrastructure. Because urban runoff is estimated to contribute only about 10 percent of the total watershed nutrient load, reduction from urban nonpoint sources is not a major focus of the plan.

3.1.1 STORMWATER RETROFITS

In already-urbanized watersheds, the main technique for reducing pollutant loading is the stormwater retrofit: re-engineering existing stormwater management infrastructure to improve pollutant removal. The Center for Watershed Protection (CWP) has advanced this field considerably in the past decade or two, and this section draws heavily from CWP's experience.[68] Generally speaking, the object of a stormwater retrofit should be to capture and treat the *water quality volume*, the amount of rainfall in the size of the storm that delivers most of the pollutant load during the year. This is generally taken to be the 90 percent exceedance storm, the event that is larger than 90 percent of the storms in a typical year. In northeastern Illinois, this would typically be equivalent to 1.4 inches in 24 hours.[69] An alternative definition simply takes the first inch of *runoff*, representative of the "first flush" of a heavy storm, to be the water quality volume. They are nearly equivalent and either way is acceptable for planning purposes. The detention basins in the watershed already control the two-year, 24-h storm (3.04 inches), which is meant to protect against channel enlargement, but in many cases do not store and treat the water quality volume. For instance, older dry bottom basins often route smaller events through a low flow channel.

The retrofits installed most typically are those shown in Table 3-1. Again, the design object of such projects is to store and treat the water quality volume. A relatively common project is the first one mentioned: to improve storage in existing dry bottom detention ponds and redesign them to enhance pollutant removal, such as adding wetland plantings, forebays, and lengthening the flow path within the pond. An example is shown in Figure 3-1. Another interesting project is to obtain treatment storage by modifying culverts to pond water from smaller storm events and treat it using wetlands (Figure 3-2). A second factor in considering retrofits is scale. The projects in Table 3-1 are subwatershed-wide in scale, meaning that they usually treat runoff from a number of different properties off-site. In contrast, on-site retrofits are smaller projects, such as the addition of swales in small parking lots, installation of sand filters or oil/grit traps on industrial sites, or rooftop disconnection. Subwatershed-

[68] Most recently summarized in the Center for Watershed Protection's Urban Subwatershed Restoration Manual. *Manual 3: Urban Stormwater Retrofit Practices*. August 2007.

[69] Based on local rainfall amounts for 24-hour duration storm events (Bulletin 70 rainfall data), group "D" soils and a curve number of 84. Engineering Resource Associates, Inc. *Watershed Management Ordinance Regulatory Recommendation Memorandum on Volume Control Provisions*. Prepared for Metropolitan Water Reclamation District. April 28, 2008.

wide treatments – or "storage retrofits" in CWP's terminology – are typically more cost-effective because of their larger scale.

Table 3-1. Typical opportunities for storage retrofit.

Type	Description
Add Storage to Existing Ponds	Add water quality treatment storage to an existing pond that lacks it by excavating new storage on the pond bottom, raising the height of the embankment, modifying riser elevations/dimensions, converting unneeded quantity control storage into water quality treatment storage and/or installing internal design features to improve performance.
Storage Above Roadway Culverts	Provide water quality storage immediately upstream of an existing road culvert that crosses a low gradient, non-perennial stream without wetlands. Free storage is created by adding wetland and/or extended detention treatment behind a new embankment just upstream of the existing roadway embankment.
New Storage Below Outfalls	Flows are split from an existing storm drain or ditch and are diverted to a stormwater treatment area on public land in the stream corridor. Works best for storm drain outfalls in the 12- to 36- inch diameter range that are located near large open spaces, such as parks, golf courses and floodplains.
Storage in Conveyance System	Investigate the upper portions of the existing stormwater conveyance system to look for opportunities to improve the performance of existing swales, ditches and non-perennial streams. This can be done either by creating in-line storage cells that filter runoff through swales and wetlands or by splitting flows to off-line treatment areas in the stream corridor.
Storage in Road Right of Ways	Direct runoff to a depression or excavated stormwater treatment area within the right of way of a road, highway, transport or power line corridor. Prominent examples include highway cloverleaf, median and wide right of way areas.
Storage Near Large Parking Lots	Provide stormwater treatment in open spaces near the downgradient outfall of large parking lots.

Source: Center for Watershed Protection

Figure 3-1. Schematic design for retrofit of dry detention basin to shallow marsh wetland.

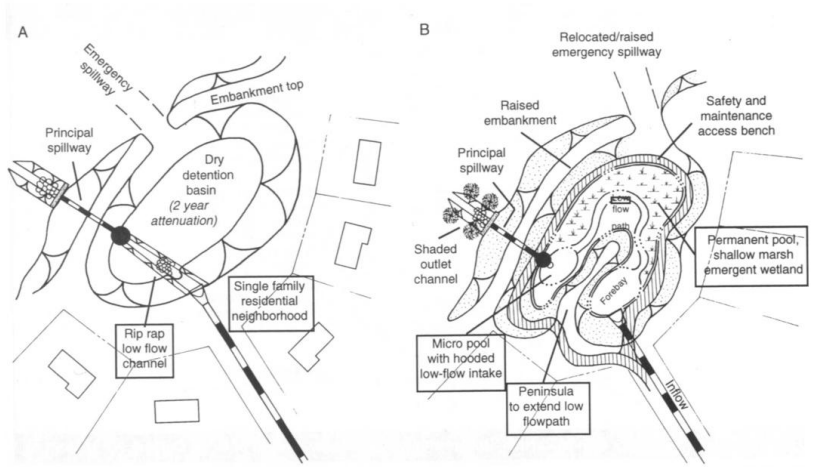
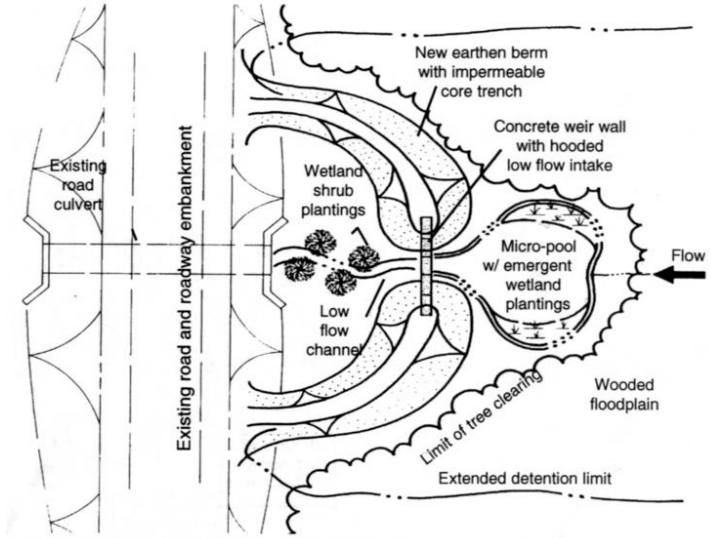


Figure 3-2. Modification of culvert to obtain upstream water quality storage.



Source: Watershed Protection Techniques 1(4): 188–191. Reprinted in *The Practice of Watershed Protection*, eds. T.R. Schueler and H.K. Holland; (Ellicott City, MD: Center for Watershed Protection)

Table 3-2. Technologies for urban stormwater retrofits.

Type	Description
Extended Detention	This option relies on 12 to 24 hour detention of stormwater runoff after each rain event within a pond, with portions of the pond drying out in between storm events. Extended detention (ED) allows pollutants to settle out and can also provide downstream channel protection.
Wet Ponds	Wet ponds consist of a permanent pool of standing water. Runoff from each new storm enters the pond and partially displaces pool water from previous storms. The pool also acts as a barrier to re-suspension of sediments and other pollutants removed during prior storms.
Constructed Wetlands	Constructed wetlands are shallow depressions that receive stormwater for treatment. Runoff from each new storm displaces runoff from previous storms, and long residence time increases pollutant removal.
Bioretention	Bioretention is an innovative urban stormwater practice that uses native forest ecosystems and landscape processes to enhance stormwater quality. Bioretention areas capture sheet flow from impervious areas and treat the stormwater using a combination of microbial soil processes, infiltration, evapotranspiration, and plants.
Filtering Practices	Filter practices function by filtering runoff through an engineered media and collecting treated runoff in an underdrain. The media may consist of sand, soil, compost, or a combination of these.
Infiltration Practices	An infiltration trench is a rock-filled chamber with no outlet that receives stormwater runoff. Stormwater runoff passes through some combination of pretreatment measures, such as a swale or sediment basin, before entering the trench where it infiltrates into the soil.
Swales	Swales are a series of engineered, vegetated, open channel practices that are designed to treat and attenuate stormwater runoff for a specified water quality volume.
Other Retrofit Treatment	These on-site practices provide treatment of roof runoff using rain gardens, rain barrels, green roofs, cisterns, stormwater planters, dry wells, or permeable pavers.

Source: Center for Watershed Protection

Stormwater retrofits are typically 1.5 – 4 times more expensive than installing comparable infrastructure during development. For this reason it is desirable to try to (1) undertake water quality retrofit projects on public land to avoid acquisition costs and (2) to bundle water quality benefits into municipal, county, and state construction projects. An example of bundling would be to obtain upstream storage during culvert replacement. Culvert replacement will have to be done in several places in the watershed in the upcoming years because of the need to expand road capacity to serve new development. The cost of retrofit also points up the need to institute adequate water quality protections during site development to avoid later (and higher) costs that would be borne by the public sector. A policy based on this principle is recommended in Section 6.

3.1.2 PROJECT OPPORTUNITIES

Discussions with local government officials in the watershed did not reveal many urban nonpoint source project opportunities or many water resource problems in general. Relatively little of the watershed is developed, and what has been built was constructed following the adoption of stormwater management ordinances. The urban projects identified are detention basin retrofits or streambank stabilization and revegetation. Perhaps the biggest need identified is the installation of storm sewers in the older part of the Village of Manhattan, which the Village is currently studying. It may be possible to add detention storage as part of the project as well as water quality treatment, which this plan recommends for funding.

3.1.3 MANAGEMENT OPTIONS

Besides structural projects, there are a number of management options that can reduce urban nonpoint source pollutant loading, such as increasing the frequency of street sweeping and using vacuum sweepers or reducing the use of phosphate fertilizers. Table 3-3 shows a sample of these options as well as an estimate of their effec-

tiveness at nutrient removal. Note that removal rates are defined differently for different management practices. The actual effectiveness of these practices at the watershed scale — in other words, the amount of the total watershed load they remove — depends primarily on urban density: they tend to be more effective the more densely developed the watershed is.

Table 3-3. Removal rates for selected management options.

	Removal rate		
	TSS	TP	TN
Street sweeping[70]			
Mechanical sweeping, monthly	9%	3%	3%
Regenerative air/vacuum, monthly	22%	4%	4%
Mechanical sweeping, weekly	13%	5%	6%
Regenerative air/vacuum, weekly	31%	8%	7%
Stormdrain cleanout program			
Annual	18%	<1%	3%
Semi-annual	35%	2%	6%
Use of phosphate-free fertilizer[71]	—	23%	—
Hotspot facility management			
Industrial good housekeeping practices	40%	49%	8%
Vehicle washing ordinances	Could approach 100%		

3.2 Stream and Riparian Restoration Overview

As discussed in Section 2, Manhattan Creek, Jackson Branch, and part of Jackson Creek are considered to be impaired for the aquatic life designated use. While important, it is unlikely that merely reducing nutrient loading to the streams will significantly improve biological conditions. This plan therefore attempts to identify instream and riparian habitat projects that would improve conditions for aquatic macroinvertebrates and fish. The need to do so largely stems from historic channelization, which was common throughout northeastern Illinois and dramatically reduced aquatic habitat. While major re-meandering projects such as the one the Village of Frankfort and the Forest Preserve District are undertaking will be relatively rare, smaller projects to recreate pool-riffle sequences, install rootwads, enhance buffers, and implement other devices to improve habitat can be effective in improving biological conditions and ultimately supporting the aquatic life use of the streams. Finally, wetland restoration is important both for nutrient removal and aquatic habitat.

The watershed has a number of characteristics that may make it a good candidate for stream restoration. It has low impervious cover and a relatively low gradient (<0.0015 ft/ft), both of which were shown in northeastern Illinois to improve stream restoration success rates for a variety of projects.[72] Impervious cover is expected to increase substantially in the next 30 years, as discussed in Section 2.4, which may make it harder for restored stretches of stream to withstand increased erosive forces, but again the watershed will be developing with detention release rates that help control those effects.

[70] Removal rates are the estimated fraction of the on-street load picked up by sweepers. Center for Watershed Protection. 2008. *Deriving Reliable Pollutant Removal Rates for Municipal Street Sweeping and Storm Drain Cleanout Programs in the Chesapeake Bay Basin.* Available from: http://www.cwp.org/Resource_Library/Center_Docs/municipal/CBStreetSweeping.pdf.

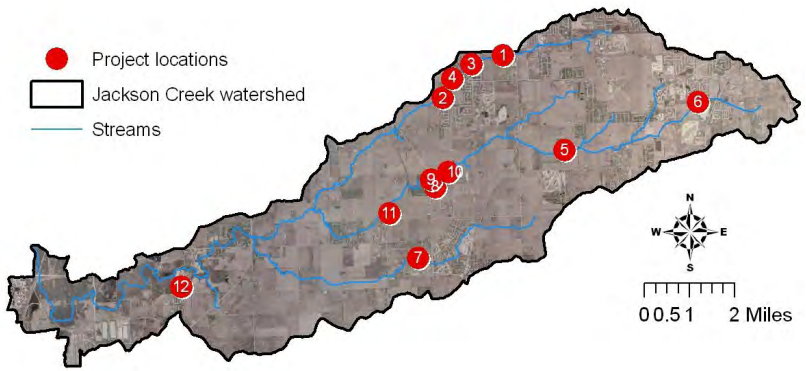
[71] The removal rate is an estimate of the reduction in annual phosphorus loading from medium-density residential areas (i.e., the event mean concentration in runoff is reduced by 23 percent).See research from Dane County, Wisconsin at http://www.danewaters.com/management/PhosphorusControlPresentation.aspx.

[72] Northeastern Illinois Planning Commission and U.S. Fish and Wildlife Service, Chicago Field Office. 2005. *Stream Restoration Inventory*.

3.3 Project Recommendations

Based on the preceding considerations, a short list of potential site-specific nonpoint source pollution reduction and habitat improvement projects has been developed for the watershed. The following projects under "project snapshots" are improvements recommended to be implemented within the next five years, subject to agency and landowner agreement. The list is based on professional judgment of the opportunities presented along the stream, concentrating mainly on publicly owned land. The short list is not exhaustive; there are many possibilities for projects that would improve conditions in the watershed. Project locations in the context of the watershed are shown in Figure 3-3. They are estimated to result in the annual nutrient load reductions shown in Table 3-15. Potential funding sources are provided at the end of the chapter.

Figure 3-3. Locations for proposed projects.



3.3.1 PROJECT SNAPSHOTS

(1) Creek reach north of Edison Drive, west of Cedar Road. Jackson Creek is a trapezoidal channel with a mud bottom in this reach. Debris deposits providing evidence of recent high flows demonstrate that the creek stays within its banks here and is cut off from its historic floodplain. Areas of currently vacant land of old field vegetation south of the creek, north of Edison Drive, provide opportunities to create adjacent wetland and re-connect the creek with the floodplain. Grading would be necessary to lower the elevation of this land.

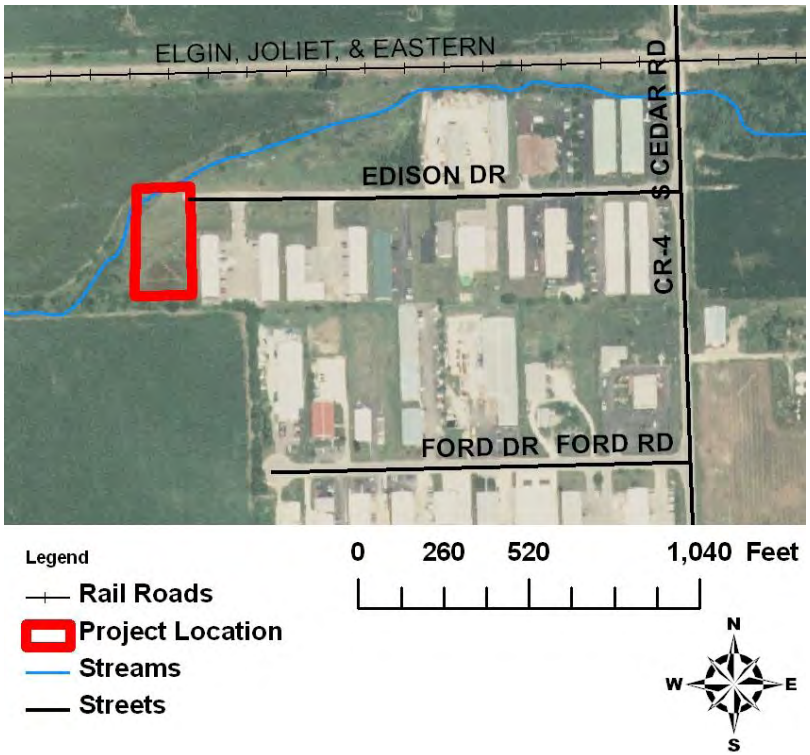
Figure 3-4. Project 1 site

Table 3-4. Conceptual cost estimate for project 1

Item	Unit	Quantity	Unit Price	Total
Construction Layout	LS	1.00	$1,000	$1,000
Earth Excavation and Hauloff	CY	6,050	$7	$42,350
Tree Removal	LS	1.00	$6,000	$6,000
6" Topsoil Re-Spread	SY	3,630	$1.50	$5,445
Seeding	AC	0.75	$6,000	$4,500
Subtotal				$59,295
Contingency 20%				$11,859
Construction Subtotal				$71,154
Design, permitting, etc.				$17,789
Project Total				**$88,943**

This project is expected to have a water quality benefit in that reestablished floodplain wetlands will be inundated periodically during high flow events and will be able to take up nutrients or promote denitrification. The amount removed depends on the frequency of inundation, the volume that enters the wetlands, residence time, and a number of other factors. The drainage area is about 2,700 acres. As a planning level estimate, with a bankfull flow depth of six feet the stream will overflow between the six and nine month storm events, and if the wetlands remove 25 percent of N and 50 percent of P, the average annual removal would be 3,189 lbs of N and 336 lbs of P. The Village of New Lenox is likely the most appropriate lead agency.

Figure 3-1. Project 1 location map



(2) Dry detention basin with concrete "racetrack" (west of the intersection of Daniel Lewis Drive and Kerry Winde Drive). Stormwater outfalls from the existing residential subdivision emerge into a mowed turf grass detention basin at this location. Flows within the basin are directed by a narrow concrete channel that encircles the perimeter of the bottom of the basin, presumably to direct low flows to the outlet at the southwest end of the basin (such a low flow can be seen in the channel in Figure 3-5). The basin in its current state does nothing for water quality. Low flows are confined to the concrete channel, with essentially no opportunity for filtration or pollutant assimilation by vegetation and invertebrates and with almost no ability to infiltrate into the ground.

Figure 3-2. Project 2 site

The basin could be effectively converted into a wetland complex with features such as forebays and level spreaders at the outfall structures to capture sediment and limit erosive forces within the wetland basin. A schematic design for such a retrofit is shown in

Figure 3-1. Water quality would be improved through the natural processes of the vegetation and infiltration into the ground would help with stormwater volume issues as well. The New Lenox Park District, the landowner, would be the appropriate lead agency.

Figure 3-3. Project 2 Location Map

Table 3-5. Conceptual cost estimate for project 2

Item	Unit	Quantity	Unit Price	Total
Construction Layout	LS	1.00	$1,000	$1,000
Earth Excavation and Hauloff	CY	1,160	$7	$8,120
Tree Removal	SY	3,500	$8	$28,000
6" Topsoil Re-Spread	SY	3,450	$1.50	$5,175
Seeding	AC	0.72	$6,000	$4,320
Subtotal				$46,615
Contingency 20%				$9,323
Construction Subtotal				$55,938
Design Engineering 7.5%				$4,195
Construction Oversight 7.5%				$4,195
Permitting 10%				$5,594
Project Total				**$69,923**

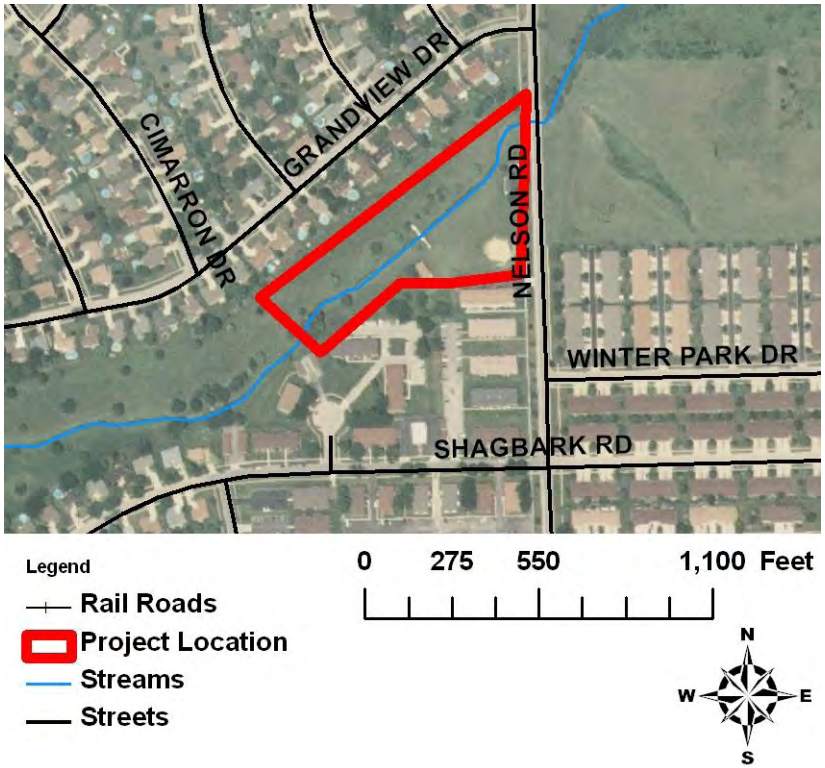
(3) Stonebridge Park – New Lenox Park District. The creek within Stonebridge Park has eroding side slopes and extensive algal blooms. The side slopes are generally turf grasses that are intensively managed by the New Lenox Park District. The banks of the creek within the entire reach are routinely mowed and weed-whipped all the way to the waterline. It is unclear if the turf grass is fertilized as well. In any event, the establishment of a sizeable buffer (50 – 75 feet) of non-mowed native vegetation on either side of the creek channel would benefit the creek, both in terms of water quality (reduction of algal blooms due to filtration of runoff from mowed turf grass) and bank erosion (native vegetation will have a deeper, more extensive root system than turf grass and will hold the soils better). The New Lenox Park District, the landowner, would be the appropriate lead agency.

Figure 3-4. Project 3 site

Table 3-6. Conceptual cost estimate for project 3

Item	Unit	Quantity	Unit Price	Total
Stripping Sod	SY	2,778	$2.50	$6,945
Seeding	AC	0.60	$6,000	$3,600
Erosion Control Blanket	SY	2,778	$1.25	$3,472
Subtotal				$14,017
Contingency 20%				$2,803
Construction Subtotal				$16,821
Construction Oversight 7.5%				$1,262
Permitting 10%				$1,682
Project Total				**$19,765**

Figure 3-5. Project 3 Location Map



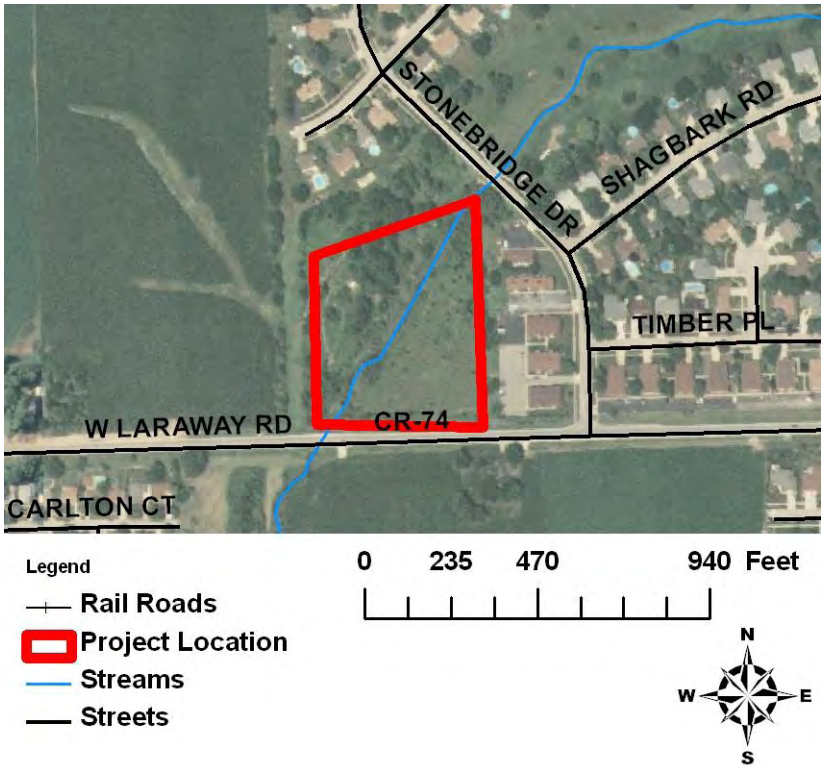
(4) Creek reach between Stonebridge Drive and Laraway Road. The creek bisects a currently vacant land parcel approximately 9 acres in size. The banks are in generally good condition in this reach as the surrounding property does not contain the mowed and maintained turf grass as noted within Stonebridge Park immediately upstream of this parcel. A project within this reach would involve conversion of weedy invasive vegetation species to deep rooted native prairie vegetation. The New Lenox Park District in cooperation with the landowner could be considered the agency lead.

Figure 3-6. Project 4 site

Table 3-7. Conceptual cost estimate for project 4

Item	Unit	Quantity	Unit Price	Total
Invasive Species Removal	AC	5	$4,000	$20,000
Overseeding north side	AC	5	$2,000	$10,000
Herbiciding	AC	4	$500	$2,000
Native Prairie Seeding	AC	4	$2,500	$10,000
Subtotal				$42,000
Contingency 20%				$8,400
Construction Subtotal				$50,400
Construction Oversight 7.5%				$3,780
Permitting 10%				$5,040
Project Total				**$59,220**

Figure 3-7. Project 4 Location Map



(5) Creek reach west of Kankakee Street between Baker Road and Delaney Road. The creek in this reach is a deep (channel bottom approximately 8 feet below surrounding ground elevation) trapezoidal channel that takes two artificial 90 degree bends to follow property boundaries. The banks of the channel and particularly at the right-angled bends are lined with concrete slabs for erosion control. There is nothing within this reach to address water quality and the existing erosion control measures will ultimately fail as channel flows increase due to development within the watershed upstream of this reach.

This channel section is a good candidate for complete relocation to create a more natural meandering channel without the harsh 90 degree bends. The channel bottom possibly could be raised and the side slopes of the channel could be cut back to a more gentle slope (perhaps 4:1) and bio-engineered forms of erosion protection could be installed. It may be feasible to install a series of riffle-pool complexes within the reach. The riffles would aerate the water and provide habitat for aquatic organisms. Cooperation between the landowner, the NRCS/SWCD, and potentially FPDWC would probably be needed for this project.

Figure 3-8. Project 5 site

Figure 3-9: Project 5 Location Map

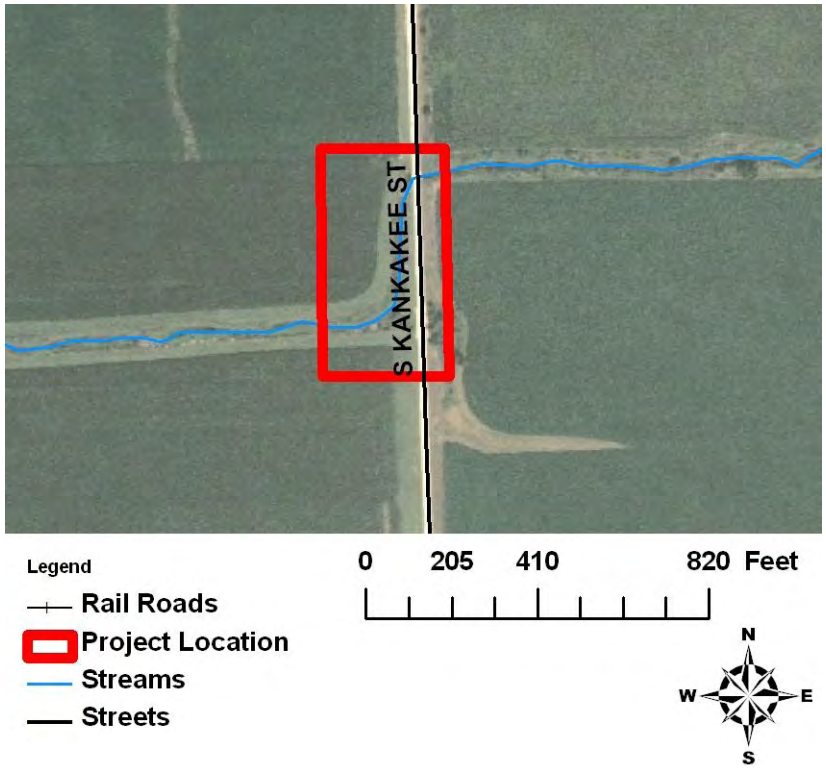


Table 3-8. Conceptual cost estimate for project 5

Item	Unit	Quantity	Unit Price	Total
Earth Excavation	CY	5,600	$7	$39,200
Fill Existing Creek	CY	2,500	$4	$10,000
Concrete Wall Removal	LF	50	$350	$17,500
Riffles	LS	1.00	$5,000	$5,000
Bank Seeding	AC	0.70	$6,000	$4,200
Erosion Control Blanket	SY	3,300	$3	$9,900
Fescue Blue Grass Seed	AC	0.25	$5,000	$1,250
Subtotal				$87,050

Item	Unit	Quantity	Unit Price	Total
Contingency 20%				$17,410
Construction Subtotal				$104,460
Design Engineering 7.5%				$7,835
Construction Oversight 7.5%				$7,835
Permitting 10%				$10,446
Project Total				**$130,575**

(6) Frankfort Park District – Wolf Road Conspan Bridge and east. This reach is surrounded to the north and south by publicly-owned land (Frankfort Park District), affording opportunities for establishment of native buffers and installation of signage to promote educational outreach. Base flows appear to be low as this reach is "high" in the watershed. However, surrounding residential development in the Frankfort area appear to yield high post-storm event flows as bank erosion is evident in this reach.

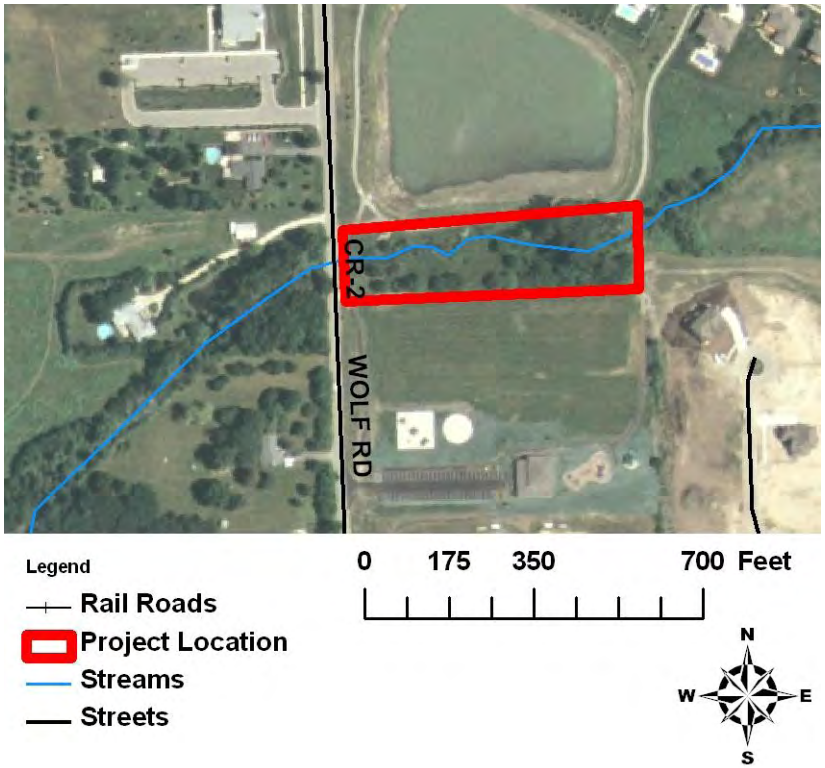
A series of riffle-pool complexes (3 or 4 maximum) could be installed in the channel to help dissipate some of the energy generated by the storm-event flows. The riffles are designed such that the base flow can pass through relatively unimpeded while the higher storm flows are directed through the riffle and scour-pool complexes. Properly installed rock riffles can increase habitat diversity in channelized stream reaches by increasing pool depth for fish, enhancing particle size distribution of substrate for macroinvertebrates to survive and feed, and increasing dissolved oxygen concentration in the steam. The Frankfort Park District is the recommended agency lead.

Figure 3-10. Project 6 site

Table 3-9. Conceptual cost estimate for project 6

Item	Unit	Quantity	Unit Price	Total
Sediment Removal	CY	180	$7	$1,260
Riffles	LS	1	$3,000	$3,000
Tree Protection	LS	1	$10,000	$10,000
Subtotal				$14,260
Contingency 20%				$2,852
Construction Subtotal				$17,112
Construction Oversight 7.5%				$1,283
Permitting 10%				$1,711
Project Total				**$20,107**

Figure 3-11: Project 6 Location Map



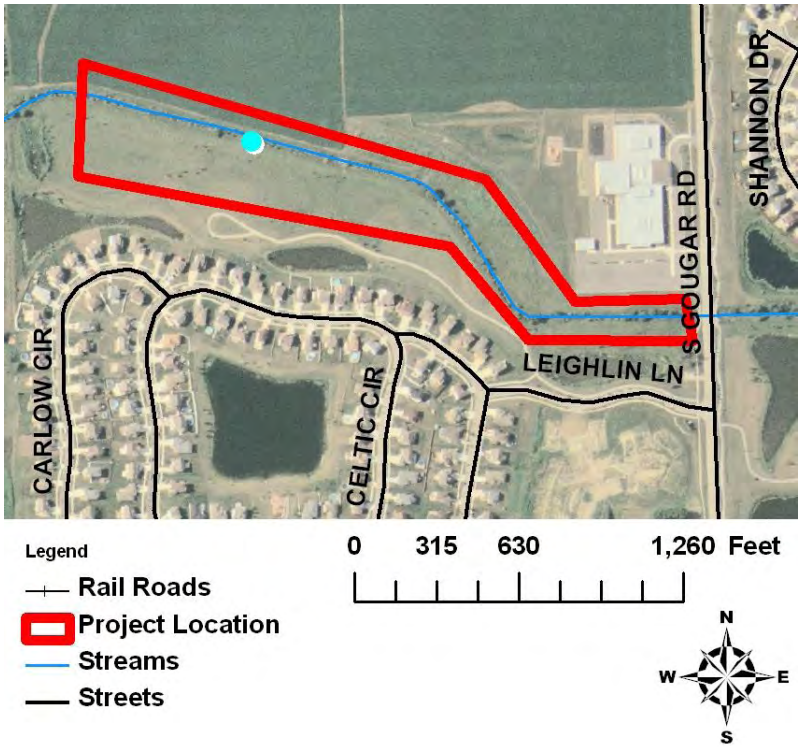
(7) Manhattan Park District property north of residential subdivision (Estates of Leighlinbridge), south of Wilson Creek School. In this reach, the creek is a linear trapezoidal channel with nearly vertical, eroding side slopes. There is very limited woody vegetation within this reach. With park district property adjacent to the south of the creek, this reach would be an excellent candidate for channel bank restoration. The side slopes of the channel could be cut back to a gentler slope (4:1 or even 6:1) and bio-engineered forms of erosion protection could be installed. It may be feasible to install a series of riffle-pool complexes within the reach. The riffles would aerate the water and provide habitat for aquatic organisms. The lack of woody vegetation could also be addressed through native tree plantings on the restored side slopes, providing additional wildlife habitat and shading effects, helping maintain cooler stream temperatures that favor many aquatic macroinvertebrates. Agency lead: Manhattan Park District.

Figure 3-12. Project 7 site

Table 3-10. Conceptual cost estimate for project 7

Item	Unit	Quantity	Unit Price	Total
Earth Excavation and Hauloff	CY	7,100	$9	$63,900
Clearing (shrubs/brush)	LS	1.00	$5,000	$5,000
Earthwork for Riffle-Pool creation	LS	1.00	$25,000	$25,000
Seeding	AC	4.40	$6,000	$26,400
Erosion Control Blanket	SY	21,000	$1.50	$31,500
Subtotal				$151,800
Contingency 20%				$30,360
Construction Subtotal				$182,160
Design Engineering 7.5%				$13,662
Construction Oversight 7.5%				$13,662
Permitting 10%				$18,216
Project Total				**$227,700**

Figure 3-13: Project 7 Location Map



(8) Round Barn Site – Native Buffer Establishment. The Manhattan Park District controls property at near the southeast corner of IL Route 52 and Baker Road ("Round Barn Farm"). On the south side of Jackson Creek, there is a picnic area with mowed turf and large oak trees. A narrow fringe of weedy vegetation, mainly reed canary grass, separates the mowed turf of the parkland from the waters of Jackson Creek. An enhancement to improve water quality in Jackson Creek could be made by increasing the size of the existing buffer of non-mowed vegetation from 30 feet to 100 feet and converting the existing weedy vegetation to a diverse array of native deep-rooted prairie vegetation. The native vegetation buffer could extend all the

way to the toe of the embankment of Route 52, allowing for filtration of road runoff prior to discharge into the river. Currently, the grassed ditch along Route 52 appears to be mowed as well. The Manhattan Park District would likely be the lead agency for this project, which has previously applied for a C2000 grant for a project very similar.

Figure 3-14. Project 8 site

Figure 3-15. Project 8 Location Map

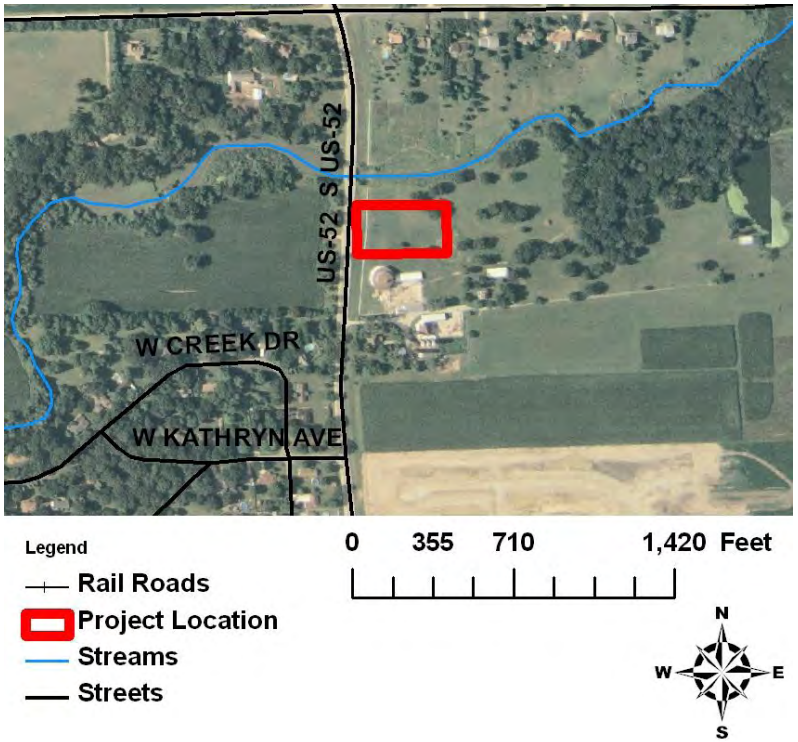


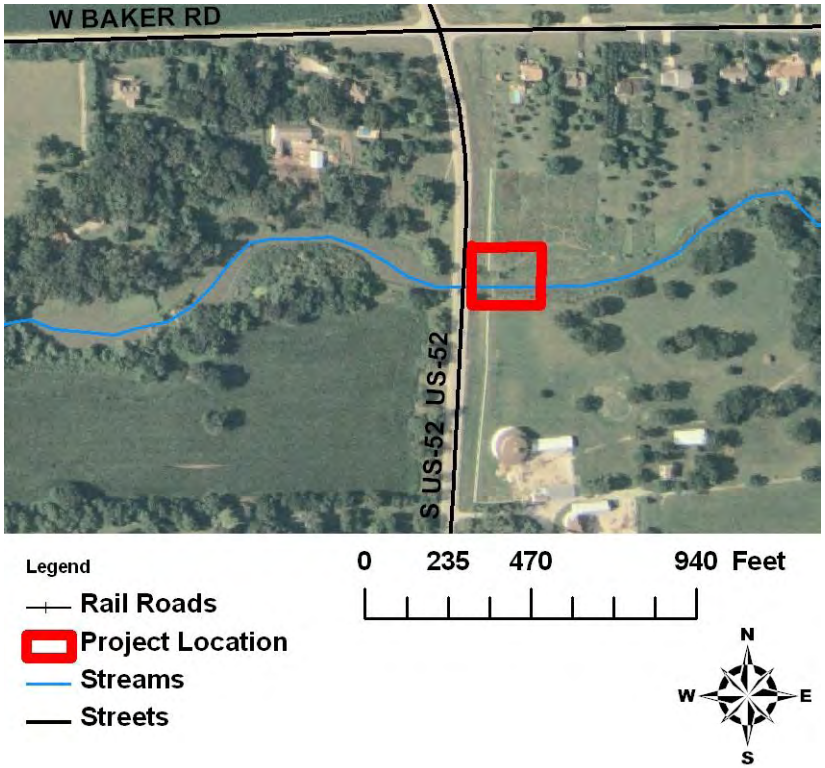
Table 3-11. Conceptual cost estimate for project 8

Item	Unit	Quantity	Unit Price	Total
Stripping Sod	SY	10,300	$2.50	$25,750
Seeding	AC	2.10	$4,500	$9,450
Erosion Control Blanket	SY	10,300	$1.25	$12,875
Subtotal				$48,075
Contingency 20%				$9,615
Construction Subtotal				$57,690
Construction Oversight 7.5%				$4,327
Permitting 10%				$5,769
Project Total				**$67,786**

(9) Round Barn Site – Dam Removal. There is a small concrete dam structure spanning the Jackson Creek channel east of the IL Route 52 bridge over Jackson Creek. The dam impedes the passage of fish and results in sediment accumulation, disturbing the natural balance of erosion/accretion and sediment transport within this stretch of Jackson Creek. The dam serves no apparent purpose, provides no wildlife habitat enhancement and ideally should be removed, allowing the creek to flow naturally.

Figure 3-16. Project 9 site

Figure 3-17. Project 9 Location Map



Dam removal is typically fairly complex, but considerable experience in these projects has been gained in northeastern Illinois over the past decade or so. For instance, there is extensive information from the Brewster Creek dam removal project from the NIPC *Implementation of the Fox River Watershed Management Plan* Phase I document. The IDNR Office of Water Resources has also produced a list of 25 potential dam removal projects (*Evaluation of Public Safety at Run-of-River Dams*, 2007), although this proposed project is not among them (it focused on larger rivers such as the Fox and Kankakee). The Manhattan Park District and potentially Openlands (since Openlands has previously investigated such a project) are the likely lead

agencies/facilitators for the project. The Army Corps of Engineers and IDNR Office of Water Resources would be extensively involved.

Table 3-12. Conceptual cost estimate for project 9

Item	Unit	Quantity	Unit Price	Total
Dam Removal	LS	1.00	$45,000	$45,000
Sediment Removal	LS	1.00	$2,000	$2,000
Subtotal				$47,000
Contingency 20%				$9,400
Construction Subtotal				$56,400
Construction Oversight 7.5%				$4,230
Permitting 15%				$8,460
Project Total				**$69,090**

(10) Baker Road north bank stabilization. Approximately 200 linear feet of severely eroded channel bank exists immediately north of the Baker Road bridge over Jackson Creek. The erosion is affecting the western bank only as the creek makes a gentle turn at this location. The upland area above the channel bank is a residential lawn of mowed turf grass. The proposed enhancement would involve reshaping the existing, near vertical west channel bank, pulling it back to a 4:1 slope. The new channel bank will be stabilized by heavily seeding deep-rooted native vegetation species. The seeded area will be blanketed to limit erosion prior to vegetation establishment and to promote seed germination and dense coverage. The streambank stabilization will reduce loading from nutrients associated with soils.

Figure 3-18. Project 10 site

Figure 3-19. Project 10 Location Map

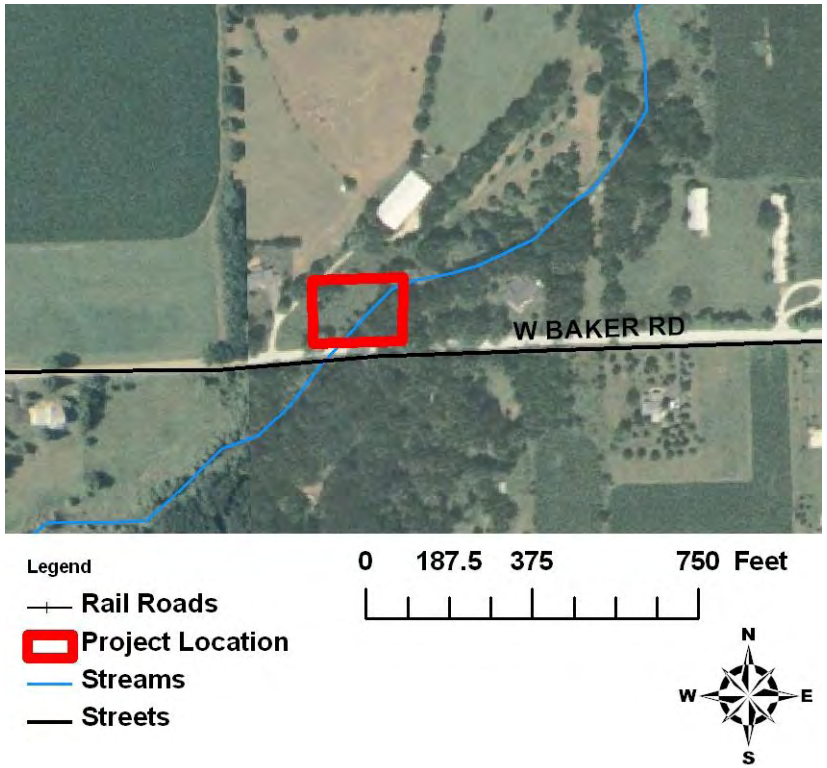


Table 3-13. Conceptual cost estimate for project 10

Item	Unit	Quantity	Unit Price	Total
Earth Excavation and hauloff	CY	120	$15	$1,800
Seeding	AC	0.07	$10,000	$700
Erosion Control Blanket	SY	355	$3	$1,065
Subtotal				$3,565
Contingency 20%				$713
Construction Subtotal				$4,278
Permitting 10%				$428
Project Total				**$4,706**

(11) Jackson Creek between Cherry Hill Road and Bike Path

A moderately eroded section of Jackson creek exists between Cherry Hill Road and the Wauponsee trail. Under the current conditions, a narrow band (approximately 5 feet in average width) of reed canary grass lines the nearly vertical creek channel banks. Upland area above the banks appears to be agricultural pasture grasses for the production of hay. An excellent opportunity exists to reshape the existing eroded channel banks, creating a stable 6:1 channel slope that will be vegetated by deep-rooted native vegetation.

Figure 3-20. Project 11 site

Additionally, a native buffer zone will be created on both sides of the channel, allowing surface stormwater runoff from the adjacent farm fields an opportunity to filter out sediment and other pollutants prior to reaching the waters of Jackson Creek. Reduction in erosion

will limit the loss of nutrients associated with bank soil, but nutrient load reduction will come from improved filtering of runoff prior to entering the stream. To calculate removal it is assumed that the buffer will treat the area ≤300 feet from the stream as this is assumed to be the limit of sheet flow. The NRCS/SWCD in cooperation with the land owner is the most appropriate lead agency for this project. Much of this area has been considered a candidate for use as a private wetland mitigation bank because of its extensive hydric soils and is also noted in the plan as a priority area for mitigation banking (see Section 6.2.2.1).

Figure 3-21. Project 11 Location Map

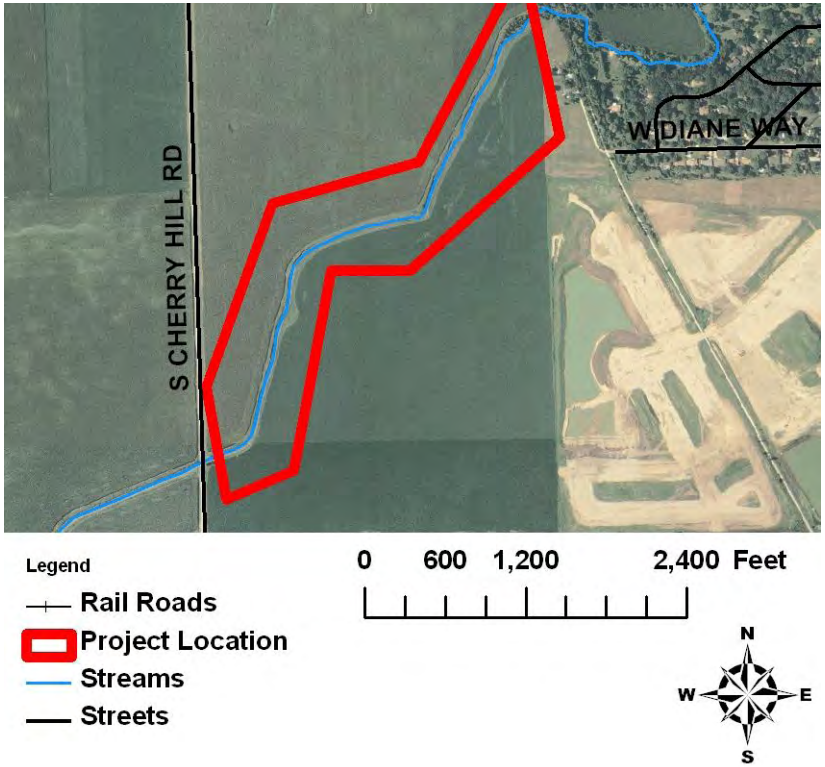


Table 3-14. Conceptual cost estimate for project 11

Item	Unit	Quantity	Unit Price	Total
Topsoil Strip	SY	1,400	$2.50	$3,500
Earth Excavation and hauloff	CY	1,000	$9.00	$9,000
Seeding	AC	0.30	$6,000	$1,800
Erosion Control Blanket	SY	1,400	$2.00	$2,800
Subtotal				$17,100
Contingency 20%				$3,420
Construction Subtotal				$20,520
Permitting 10%				$2,052
Project Total				**$22,572**

(12) Detention ponds in Elwood subdivisions between Brandon Road and Union Pacific line. These detention areas for the most part at the very edge of the property next to the railroad right of way. These detention ponds are dry bottom with mowed grass and have a straight concrete low flow channel. The dry detention basins could be retrofitted to a shallow marsh design by altering control structures to create a permanent pool, replanting with native vegetation, creating a forebay to settle out solids and dissipate energy, and creating a longer, more meandering flow path (see example in Figure 3-2). However, the basins are owned by the homeowners association, which typically makes it more difficult to undertake such projects. The ponds are also quite close to homes, and residents may not wish to replace a turf area with a wetland. The Village of Elwood is the most appropriate lead agency for this project.

Figure 3-26. Project 12 site

3.3.2 LOAD REDUCTIONS

Table 3-15. Estimated annual load reductions by site-specific projects

Site	Treatment size (ac)	Removal (lb/yr) N	Removal (lb/yr) P	Estimated Cost
1	2,700	3,189	336	$88,943
2	30	0	6.7	$69,923
3	18	14.5	8.7	$19,765
4	***	***	***	$59,220
5	ND	ND	ND	$130,575
6	***	27.7	9.1	$20,107
7	***	510.7	168.5	$227,700
8	10	8.1	4.8	$67,786
9	ND	ND	ND	$69,090
10	***	27.2	9.0	$4,706
11	33	458.9	170.1	$22,572
	2,791	**4,236**	**713**	**$780,385**

ND = not determined, *** = not purpose of project

3.3.3 FUNDING AND IMPLEMENTATION

A number of different funding sources can be accessed to implement the projects recommended in this plan (Table 3-16). A number of organizations can also be tapped to provide technical assistance (Table 3-17).

Table 3-16. Selected funding sources for potential projects identified in this plan.

Program	Funding Agency	Type	Funding Amount	Eligibility	Activities Funded	Website
Water Quality						
Capitalization Grants for Clean Water State Revolving Funds	US EPA/Office of Wastewater Management	Loan revolving fund	No limit on wastewater funds Drinking water up to 25% of available funds	Local government, Individuals Citizen groups Not-for-profit groups	Wastewater treatment Nonpoint source pollution control Watershed management Restoration & protection of groundwater, wetlands/riparian zones, and habitat	http://www.epa.gov/owm/cwfinance/index.htm
Non-point Source Management Program (319 grants)	Ilinois EPA	Matching Grant (60% funded)	No set limit on awards	Local government Businesses Individuals Citizen & environment groups	Controlling or eliminating non-point pollution sources Stream bank restoration Pesticide and fertilizer control	http://www.epa.state.il.us/water/financial-assistance/non-point.html
Conservation 2000 Ecosystem Program (Partners in Conservation)	Illinois DNR Office of Realty & Environmental Planning	Grant		Local government and landowners joined in an ecosystem partnership	Habitat Research Outreach/Education Resource Economics Planning Land Acquisition/ Conservation Easement	http://dnr.state.il.us/orep/c2000/ecosystem/
Strambank Stablilization and Restoration Program	Illinois Department of Agriculture	Matching grant (up to 80% funded)		Landowners, Citizen groups, Not-for-profit groups	Naturalized streambank stablization in rural and urban communities, work with SWCD	http://www.agr.state.il.us/Environment/conserv/index.html
Habitat						
Partners for Fish and Wildlife Habitat Restoration Program	Department of Interior, US Fish and Wildlife Service	Cost-share (50% funded)	up to $5,000	Private landowners	Voluntary restoration or improvements of native habitats for fish and wildlife Restoration of former wetlands, native prairie stream and riparian areas and other habitats.	http://partners.fws.gov/
Bring back the Natives Grant Program	National Fish and Wildlife Foundation	Matching Grant (33% funded)	Varies with project ($50,000-$75,000)	Not-for-profit groups, Universities Local governments	Restoration of damaged or degraded riverine habitats and native aquatic species through watershed restoration and improved land management.	

Program	Funding Agency	Type	Funding Amount	Eligibility	Activities Funded	Website
Wildlife Habitat Incentives Program	US Department of Agriculture	Grant, Matching Grant (at least 75% funded)		Private landowners, Not-for-profit groups	Establishment and improvement of fish and wildlife habitat on private land	http://www.nrcs.usda.gov/programs/whip/
Native Plant Conservation Initiative	National Fish and Wildlife Foundation	Matching Grant (50% funded)	$10,000-$50,000	Community and watershed groups Nonprofit groups Educ. institutions Conservation districts Local governments	—On-the-Ground" projects that involve local communities and citizen volunteers in the restoration of native plant communities.	http://www.nfwf.org/programs/npci.htm
NFWF General Challenge Grant	National Fish and Wildlife Foundation	Challenge Grant (30% funded)	$10,000 to $150,000	Community and watershed groups Nonprofit groups Educ. institutions Conservation districts Local governments	Promoting fish and wildlife conservation and the habitats on which they depend, working to involve other conservation and community interests	
Wetlands						
Wetlands Reserve Program	USDA NRCS	Direct contracts with landowners Easement (100%) Cost Share and 30 year easements (75%)	No set limit on awards	Individual Citizen groups, Not-for-profit groups	Wetlands restoration or protection through easement and restoration agreement	http://www.nrcs.usda.gov/programs/wrp/states/il.html
Wetlands Program Development Grants	US EPA	Matching Grant (75% funded)	No set limit on awards	Not-for-profit groups Local government	Developing a comprehensive monitoring and assessment program, Improving the effectiveness of compensatory mitigation, Refining the protection of vulnerable wetlands and aquatic resources	http://www.epa.gov/owow/wetlands/grantguidelines
Northeastern Ilinois Wetlands Conser-	US Fish and Wildlife Service	Grant/Matching Grant	$5,000-$150,000	A partnership of: Governmental agencies Not-for-profit conservation	Restoration of former wetlands Enhancement and preservation of existing wetlands	http://homepage.interaccess.com/~niwca/

Program	Funding Agency	Type	Funding Amount	Eligibility	Activities Funded	Website
vation Account				groups Private landowners	Creation of new wetlands Wetlands education and stewardship	
Small Grants Program	North American Wetlands Conservation Council	Matching Grant	Up to $50,000	A partnership of: Governmental agencies Not-for-profit conservation groups Private landowners	Long-term acquisition, restoration, enhancement of natural wetlands	http://northamerican.fws.gov/NAWCA/USsmallgrants.html
Wetland Restoration Fund	Openlands	Grant	$5,000-$100,000	Local government Not-for-profit groups Citizen groups Other organizations	Wetlands and other aquatic ecosystem restorations within the six-county Chicago region on land under conservation easement or owned by a government agency	
State Wetlands Protection Grants	US EPA	Matching Grant (75% funded)		Local governments Not-for-profit groups, Conservation districts	Development of new wetlands protection programs Refinement of existing programs Wetland/watershed protection demo projects Wetland and river corridor restoration Wetland conservation, monitoring & assessment Wetland month activities	http://www.epa.gov/Region5/business/fs-swpg.htm
Private						
Tellabs	Tellabs Foundation	Grant	At least $10,000	Not-for-profit groups	Environmental protection and improvement programs; Organizations which protect the environment	http://www.ivp.tellabs.com/about/foundation.shtml
GVF Core Program	Grand Victoria Foundation	Grant/Matching Grant	Varies with scope of project, size of organization, other funding	Not-for-profit groups	Preservation and restoration of natural lands and waterways	www.grandvictoriafdn.org

Table 3-17. Selected public and nonprofit technical assistance resources by project category.

Water Quality	Habitat	Wetlands
Illinois Environmental Protection Agency	Openlands	Ducks Unlimited
Natural Resources Conservation Service	US Fish and Wildlife	Wetlands Initiative
Will – South Cook Soil and Water Conservation District	Natural Land Institute	The Conservation Fund
Center for Neighborhood Technology	The Nature Conservancy	
The Conservation Foundation	Isaak Walton League	

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4. WASTEWATER TREATMENT RECOMMENDATIONS

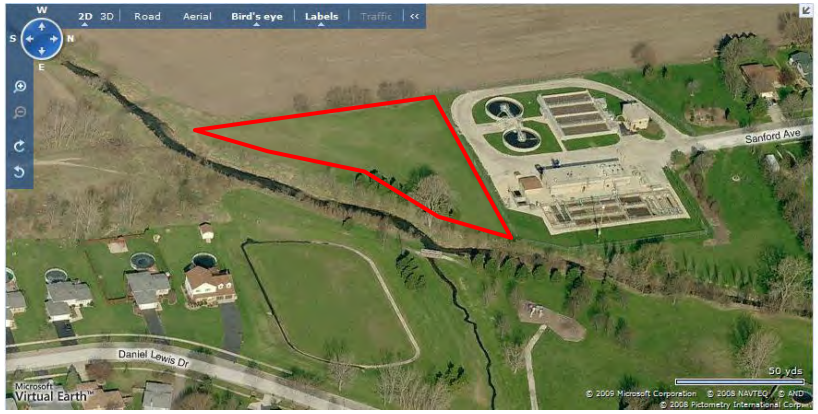
Wastewater treatment plants are estimated to contribute a substantial portion of the nutrient loading in Jackson Creek, Jackson Branch, and Manhattan Creek, amounting to approximately 22 percent of nitrogen and 36 percent of phosphorus loading. This is because nutrient removal is not practiced at the plants: the plants are not required to meet the 1 mg/L phosphorus effluent limit (although they will be upon expansion) and there appear to be no total nitrogen limits on plants in the state except at the Algonquin, Antioch, Monmouth, and Wonder Lake facilities.[73]

There are a number of ways of reducing the nutrient load from wastewater. First, the plants could install biological nutrient removal technology, the most effective of the options being considered. This likely would not be financially feasible except as part of an expansion. Because it is anticipated that the plants will eventually have to be expanded to serve the expected growth in the watershed (see discussion of expected growth in Section 2), there will eventually be an opportunity to install nutrient removal technology. It is the recommendation of this plan that the plants include nitrogen removal in addition to phosphorus removal when they expand.

Another option, albeit indirect, is to practice partial reuse of treated effluent, utilizing it for landscape or crop irrigation or for industrial cooling water. No large water users have been identified near the plants, however. As a final option, polishing wetlands could be constructed at the plant outfalls. It is probably the third option that is best in the medium term for the plants in the watershed. At both WWTPs publicly-owned land is available, and wetlands will provide reasonable final polishing during the summer months, although nutrient removal or reuse of a substantial part of the effluent stream would remove much more. Such a polishing wetland is used at one of the Frankfort plants discharging into Hickory Creek.

In brief, this plan's medium-term recommendation is that polishing wetlands be constructed at each plant within five-year timeframe for plan implementation. Over a longer timeframe, when the plants expand, nutrient removal should be included in their facilities plans.

Figure 4-1. Aerial view of New Lenox WWTP #2



Note: red line shows area proposed for polishing wetland construction

4.1 New Lenox WWTP #2

The New Lenox #2 plant is on Jackson Branch. Site investigations on the stream in this reach generally showed clear water flow, but areas of filamentous algae downstream of the WWTP outfall suggest that the discharge water likely contains elevated levels of nutrients. An area of mowed turf grass immediately south of the plant's mechanical facilities, owned by the Village, provides a potentially suitable area for a tertiary treatment wetland. The outfall could be routed into a treatment wetland to allow the wetland time and opportunity to

[73] A November 2008 search of the USEPA Permit Compliance System found only these facilities in Illinois whose permits listed total nitrogen.

assimilate the elevated nutrient levels prior to discharge into the stream.

Table 4-1. Conceptual cost estimate for recommended project at New Lenox WWTP #2

Item	Unit	Quantity	Unit Price	Total
Construction Layout	LS	1	$1,000	$1,000
Earth Excavation and Hauloff	CY	4,840	$7	$33,880
Tree Removal	LS	1	$3,000	$3,000
Clearing (Shrubs/Brush)	LS	1	$2,000	$2,000
Headwall Removal	EA	1	$1,500	$1,500
Storm Sewer	LF	25	$30	$750
6" Topsoil Re-Spread	SY	2,900	$1.50	$4,350
Seeding	AC	0.60	$6,000	$3,600
Subtotal				$50,080
Contingency 20%				$10,016
Construction Subtotal				$60,096
Design Engineering 7.5%				$4,507
Construction Oversight 7.5%				$4,507
Permitting 10%				$6,010
Project Total				**$75,120**

The total area from the south boundary of plant to the creek bank is about 1.2 acres. For planning and cost estimation purposes it is assumed about half of the area, or 0.6 acres, would be available for wetland construction. This flat area is Ashkum silty clay loam and hydric. Using case study information gathered by USEPA for treatment wetlands,[74] the effectiveness of the proposed wetland was estimated at a planning level. At the mass loading rates considered in the USEPA case studies, polishing wetlands generally remove 33 percent of nitrogen and 50 percent of phosphorus. With 0.6 acres available, 146 – 647 pounds of total nitrogen (TN) and 110 – 438 pounds of total phosphorous (TP) potentially could be removed from the proposed wetland. With 1.2 acres available, 292 – 1,314 pounds of nitrogen and 219 – 876 pounds of phosphorus could be removed. A conceptual cost estimate for this project is shown in Table 4-1.

[74] USEPA. 2000. *Free Water Surface Wetlands*. Wastewater Technology Fact Sheet. EPA 832-F-00-024. Available at http://www.epa.gov/owm/mtb/free_water_surface_wetlands.pdf

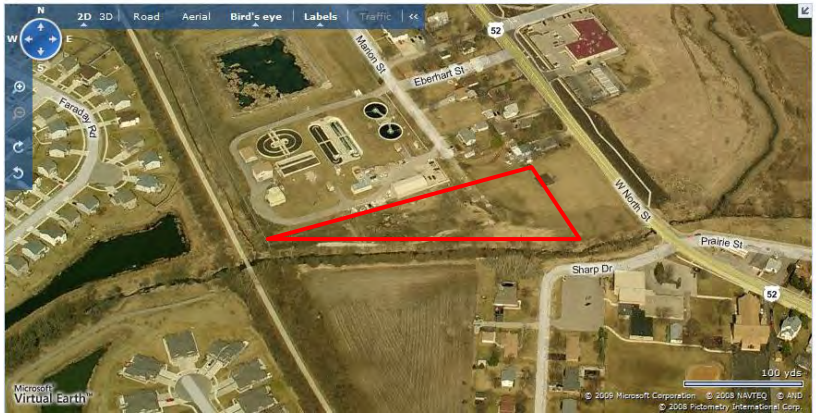
Figure 4-2. New Lenox WWTP #2 outfall

4.2 Manhattan WWTP

There is a sizeable area (~3.3 acres) of mowed turf grass floodplain adjacent to Manhattan Creek to the south and southeast of the existing plant that is mainly owned by the Village (Figures 4-3 and 4-4). This appears to be an excellent location for a tertiary treatment wetland for final polishing of the WWTP release water. In addition, a

created wetland in this area can provide additional flood storage capacity due to the minor amount of grading that would be needed to lower this field to an elevation where wetlands can be supported by both the hydrology of the WWTP release water as well as by frequent bank overflows by the creek itself.

Figure 4-3. Aerial view of Manhattan WWTP



Note: red line shows area proposed for polishing wetland construction

The bottom of the wetland would be set at the elevation of the 3 or 6 month storm event. Through the use of a flap gate or other designed water control structure, additional compensatory storage volume could be captured within the wetland basin. The soil in the area in question is Ashkum silty clay loam and hydric. Using the same technique described for the New Lenox WWTP, 803 – 3,613 pounds of nitrogen and 602 – 2,409 pounds of phosphorus could potentially be removed. A conceptual cost estimate is provided in Table 4-2.

Table 4-2. Conceptual cost estimate for recommended project at Manhattan WWTP

Item	Unit	Quantity	Unit Price	Total
Construction Layout	LS	1.0	$1,000	$1,000
Earth Excavation and Hauloff	CY	16,000	$7.00	$112,000
Tree Removal	LS	1.0	$5,000	$5,000
Storm Sewer Removal	LF	175	$10	$1,750
New FES	EA	1.0	$750	$750
6" Topsoil Re-Spread	SY	16,000	$1.50	$24,000
Seeding	AC	3.3	$6,000	$19,800
Erosion Control Blanket	SY	16,000	$1.00	$16,000
Subtotal				$180,300
Contingency 20%				$36,060
Construction Subtotal				$216,360
Design Engineering 7.5%				$16,227
Construction Oversight 7.5%				$16,227
Permitting 10%				$21,636
Project Total				**$270,450**

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5. AGRICULTURAL BEST MANAGEMENT PRACTICES

5.1 Overview

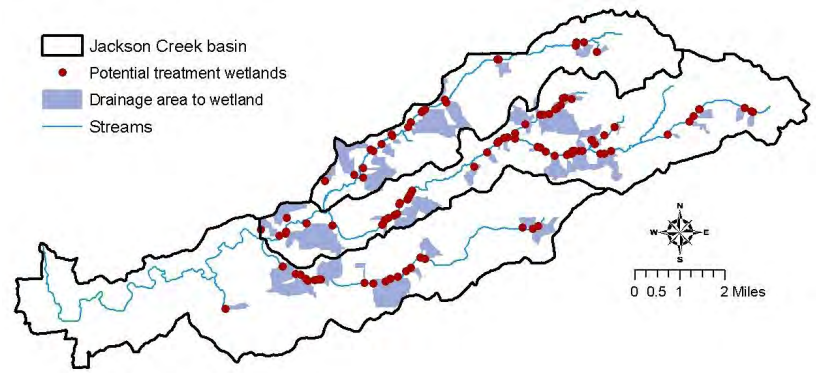
The majority of nutrient loading in the Jackson Creek watershed is estimated to come from agricultural nonpoint sources, followed by wastewater treatment plants. This section develops recommendations for controlling nutrient loading from farmland. The means of doing so is a suite of agricultural best management practices (BMPs) to be paid for through voluntary programs offered through the U.S. Department of Agriculture and the state. The BMPs in this section are all recommended for implementation because of their positive effect on nutrient loading. The section tries to provide a workable general program for targeting and implementing the BMPs, with the understanding that implementation may depart from the details provided here.

The discussion begins with several BMPs that are uncommon in northeastern Illinois but that hold promise based on their use in other parts of Illinois. These BMPs presume an existing tile drain system and are designed to complement it. The discussion then moves to better known practices for which there may be room for improvement as well as new sources of financing. The various nutrient management techniques — increased attention to fertilizer application rates and timing, use of nitrification inhibitors, etc.[75] — are not considered here because it is assumed that nitrogen prices are already driving farmers to make use of them. Therefore this plan concentrates on nitrogen removal rather than source reduction. It has been argued previously that source reduction alone cannot achieve the 10 mg/L nitrate drinking water standard in the tile-drained Midwest, much less the lower nitrogen criterion recommended by USEPA and used in this plan (Section 2.2.7).[76]

5.1.1 TREATMENT WETLANDS

Small wetlands can be used to treat nutrient enriched runoff from cropland by constructing them down slope from farm fields and intercepting tile drain or grass waterway flow. This practice seems to have been used very little in Illinois, although Iowa has used it extensively through the Conservation Reserve Enhancement Program. Research done on the practice in Iowa suggests it can be quite cost-effective and would tend to take only a small area of marginal farmland (wet soils at the edge of a field near a stream) out of production.

Figure 5-1. Potential wetland locations and treatment areas.



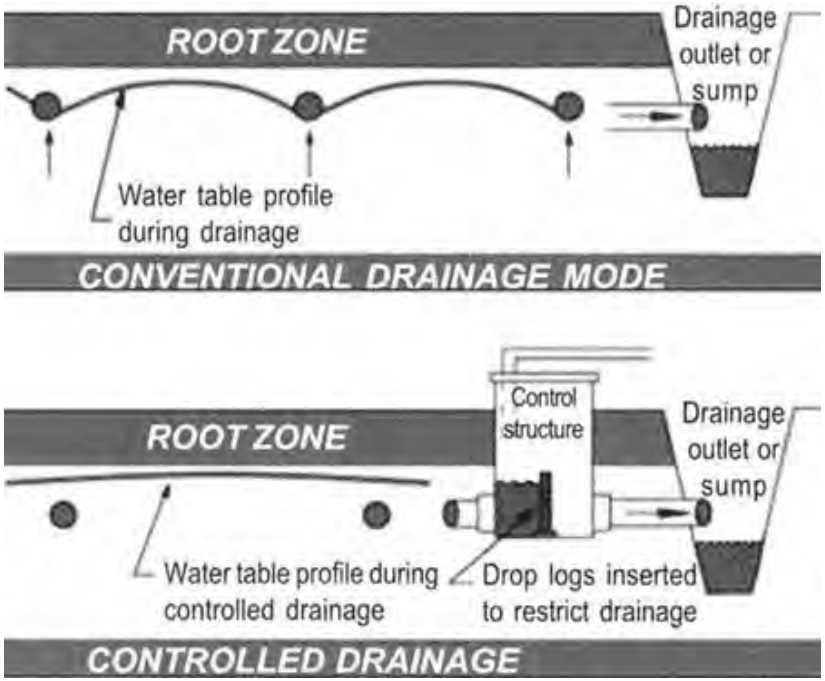
Effective use of treatment wetlands depends on siting them to capture a significant nitrate and phosphate load. Thus, this plan tried to identify the potential wetland locations that would receive a maximum amount of flow from farm fields. To do so, the predicted locations of accumulated flow, which approximate drain tile alignments and first order streams, were followed to the point where they inter-

[75] Dana L. Dinnes, Douglas L. Karlen, Dan B. Jaynes, Thomas C. Kaspar, Jerry L. Hatfield, Thomas S. Colvin, and Cynthia A. Cambardella. 2002. Nitrogen Management Strategies to Reduce Nitrate Leaching in Tile-Drained Midwestern Soils. *Agron. J.* 94:153–171. Available from: http://agron.scijournals.org/cgi/reprint/94/1/153.pdf

[76] Dan B. Jaynes, Tom C. Kaspar, Tom B. Moorman and Tim B. Parkin. 2008. In Situ Bioreactors and Deep Drain-Pipe Installation to Reduce Nitrate Losses in Artificially Drained Fields. *J Environ Qual* 37:429-436.

sect delineated streams. In some cases a location was chosen further from the stream because of a lack of hydric soils along the stream, or more commonly, because another type of use was between the agricultural field and the stream. Using the rule of thumb that a 1:100 ratio of wetland area to drainage area[77] is required for effective treatment, the resulting target acreage of wetland construction can be estimated at 39 acres, treating 3,985 acres of mostly cropland.

Figure 5-2. Controlled drainage diagram



Source: United Nations Food and Agriculture Organization. 2002. *Agricultural Drainage Water Management in Arid and Semi-Arid Areas.* Available from: http://www.fao.org/docrep/005/y4263e/y4263e00.HTM

[77] This 1% value is chosen for planning purposes. The Iowa Conservation Reserve Enhancement Program, for example, allows ratios between 0.5% and 2% (see http://www.agriculture.state.ia.us/waterResources/pdf/LandownerGuide.pdf). The actual wetland size will be determined by site conditions.

5.1.2 CONTROLLED DRAINAGE

Most of the cropland in the watershed has a tile drainage system in place. As discussed in Section 2, tile systems tend to reduce phosphorus export but increase nitrate export relative to undrained fields. One potential means of reducing nitrate in subsurface flow is to practice water table management or controlled drainage (Figure 5-2). Controlled drainage restricts the discharge from a subsurface drain outlet by using a control structure: sliding panels ("drop logs" or "flashboards") are raised and lowered to manage the water table to drain only as much water as needed for healthy crop growth (Figure 5-3). The water table is allowed to rise after planting and early crop germination, and again after harvest. During planting and harvesting the water table is lowered to facilitate field operations.

Controlled drainage decreases nitrate export through two main mechanisms: reducing the average annual volume of drainage water leaving a field, and providing a higher field water table level, promoting denitrification within the soil profile. Research from North Carolina suggests a 45 percent average annual nitrate export reduction from controlled drainage,[78] and experiments in Illinois have shown about the same removal.[79] A conservative planning estimate from researchers in the field is that controlled drainage can reduce annual average nitrate loss by 30 percent.[80] It is not clear how much phosphorus they remove, with some estimates higher and some lower than for nitrate. Here it is assumed that the removal efficiency

[78] Gilliam, J.W., D.L. Osmond, and R.O. Evans. 1997. *Selected Agricultural Best Management Practices to Control Nitrogen in the Neuse River Basin.* North Carolina Agricultural Research Service Technical Bulletin 311, North Carolina State University. Available from: http://www.soil.ncsu.edu/publications/BMPs/

[79] "Conservation Drainage" chapter in *Illinois Drainage Guide*, available at http://www.wq.uiuc.edu/dg/conservation.htm.

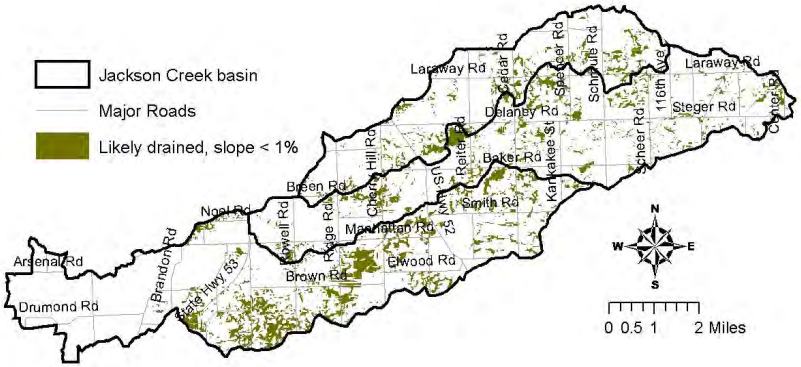
[80] R.A. Cooke, G.R. Sands, L.C. Brown. *Drainage water management: a practice for reducing nitrate loads from subsurface drainage systems.* Presentation at Gulf Hypoxia and Local Water Quality Concerns Workshop, September 26-28, 2005, Ames, IA. Available from: http://www.epa.gov/msbasin/pdf/symposia_ia_session2.pdf

is the same as for nitrate, although professional judgment suggests phosphate is typically bound to sediment and so would not tend to enter the tile system.

Figure 5-3. Image of control structure installed at tile outlet.

A major advantage of controlled drainage is that it does not take land out of production. The use of controlled drainage may also improve yields by ~5 percent by making more water available to plants during the growing season.[81] Controlled drainage can be implemented on fields that already have a tile system in place, and generally works best on land with a slope of less than 1 percent because this minimizes the number of control structures needed. In this situation, where one control structure can be used for every 20 acres, the cost range can be expected to be $20 – 110 per acre,[82] or about $65 per acre on average. EQIP covers the practice at a 60 percent cost-share and pays a $5 incentive per acre.[83] Also, it needs to be implemented carefully based on on-site conditions to avoid having a negative effect on adjacent fields — for example, the practice should not be used on a tile main shared by more than one farm.

Figure 5-4. Potential locations for pilot controlled drainage projects



Since controlled drainage has not been widely used in northeastern Illinois — although it has been implemented in Kankakee County[84] and several counties further south — a pilot project would probably be needed to demonstrate the feasibility of the practice. This is the primary recommendation, and would be best carried out by a conservation-oriented producer with the assistance of the NRCS and/or SWCD. If successful, there would be many opportunities to implement the practice more widely. Excluding land proposed for wetland treatment in Section 5.1.1, there are 3,600 acres of poorly or very poorly drained agricultural land in the watershed — which almost always has a tile system in place — that have a slope below 1 percent (Figure 5-4). It can be conservatively assumed that only half that acreage will actually have characteristics (besides flatness) that make

[81] Jane Frankenberger, Eileen Kladivko, Gary Sands, Dan Jaynes, Norm Fausey, Matt Helmers, Richard Cooke, Jeff Strock, Kelly Nelson, and Larry Brown. 2007. *Questions and Answers about Drainage Water Management for the Midwest.* Purdue Extension, WQ-44. Available from: http://www.admcoalition.com/WQ44.pdf.
[82] *Ibid.*

[83] This is NRCS practice 554 (–Drainage Water Management Implementation Incentive") and NRCS (–Structure for Water Control").
[84] http://www.spipipe.com/PDF/DWMTourBrochure.pdf

controlled drainage feasible. If pilot projects go well, this plan proposes a target of trying to implement either controlled drainage or bioreactors (discussed below) to treat 1,800 acres in the watershed.

5.1.3 BIOREACTORS

Another means of reducing nitrate in agricultural runoff is the bioreactor or biofilter, a trench filled with cellulosic material through which tile flow is routed just before discharging to the surface. Woodchips, cornstalks or cobs, cardboard fiber, a sand-sawdust mixture, or other can be used for the purpose. The method works by promoting denitrification: in this low-oxygen environment, soil microorganisms use the wood chips as a carbon source and reduce nitrate to nitrogen gas. In Iowa, wood chips surrounding a newly installed tile line reduced nitrate concentrations in subsurface drainage by 55–65 percent compared to a tile line with no wood chips.[85,86] The practice can also be implemented as a retrofit by installing an in-line bioreactor on the tile main near the outlet with a bypass for high flows.

There are many potential advantages to bioreactors. For one, they do not take land out of production. Unlike controlled drainage, they do not require changing management practices once they are installed. They also require little or no maintenance and are thought to last upwards of twenty years,[87] although research into the rate of carbon loss is still underway.

Again, because this practice has been used little in northeastern Illinois, it is recommended that the NRCS and SWCD work with a conservation-oriented landowner to install bioreactors as a demonstration project. There is little information available that would indicate where this practice works best or whether it is more or less effective than wetlands and controlled drainage, but it does appear reasonable that it could be used on fields in the watershed with slopes higher than 1 percent. About 10 feet of trench is needed per acre of drained land, and can be estimated to cost about $240 per acre.[88] One significant disadvantage of bioreactors is that EQIP does not currently cover the practice. EQIP policies will probably be revised eventually, but the relatively low usage of bioreactors proposed in this plan — treating 400 acres with them — reflects the lack of financing and the cost of the practice. It is recommended that the NRCS in Will County support the use of EQIP funding for bioreactors.

Figure 5-5. Installation of a woodchip bioreactor.

Source: http://www.admcoalition.com/Woodbio.pdf

[85] T. Kaspar, D. Jaynes, T. Moorman, and T. Parkin. 2003. *Reducing Nitrate Levels in Subsurface Drain Water with Organic Matter Incorporation.* Report to the American Farm Bureau Foundation for Agriculture. USDA-ARS National Soil Tilth Laboratory. Available from: http://www.agfoundation.org/projects/docs/ReducingNitrateLevels.pdf

[86] Dan B. Jaynes, Tom C. Kaspar, Tom B. Moorman and Tim B. Parkin. 2008. In Situ Bioreactors and Deep Drain-Pipe Installation to Reduce Nitrate Losses in Artificially Drained Fields. *J Environ Qual* 37:429-436.

[87] "Conservation Drainage" chapter in *Illinois Drainage Guide*, available at http://www.wq.uiuc.edu/dg/conservation.htm.

[88] http://www.admcoalition.com/Woodbio.pdf

5.1.4 CONSERVATION TILLAGE

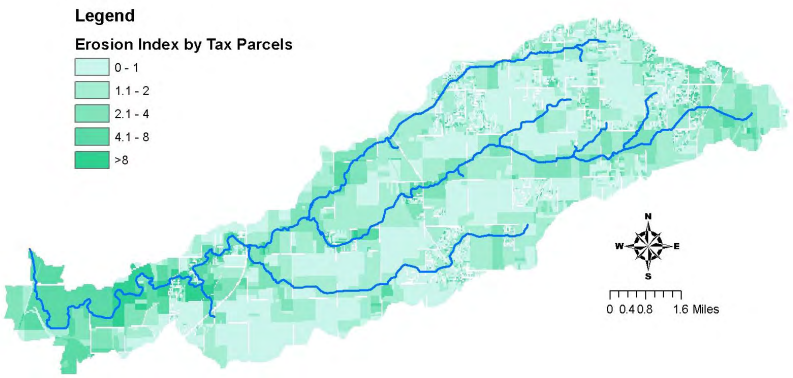
Better known and more widely implemented than the preceding three practices, conservation tillage involves leaving fields partially covered with crop residue — generally speaking at least 30 percent of the field would remain covered with residue — between growing seasons to protect the soil underneath from erosion. Higher priority locations for conservation tillage were considered to be areas with higher erosion index values.[89] In general these higher priority locations are along the main stems of Jackson Creek, Jackson Branch, and Manhattan Creek.

Table 5-1. Conservation tillage targets

Erosion Index	*Acres*	*No. Parcels*	*Target Year*	*Cost*[90]
<1	8,149	891	-	16,298
1-2	8,602	314	4-5	172,040
2-4	3,352	186	2-4	67,040
4-6	383	49	1-2	7,660
6-8	47	30	1-2	940
>8	35	28	-	750
Total	**20,568**	**1498**		**264,728**

There are 12,419 acres of agricultural land with an erosion index (EI) greater than 1, i.e., more than the tolerable rate of erosion (Figure 5-6). The erosion index was calculated on the basis of a 30-m grid and then averaged by tax parcel for clearer presentation. These would be the target areas for conservation tillage provided none is already practiced on the identified parcels. Regarding timelines for implementation of this BMP, parcels that may contribute the most nutrients to the watershed should have priority action. These are parcels with the highest erosion index and should be targeted in the first two years of project implementation. Parcels with lower EI can be scheduled for later years in the implementation program.

Figure 5-6. Erosion index values by tax parcel.



It is important to note that conservation tillage may already be practiced on some of the identified parcels. The only systematic information available on current tillage practices is provided at a geography no smaller than the county. Of the corn fields in Will County, 38 percent were in some form of conservation tillage in 2006 while 74 percent of the soybean fields were in a form of conservation tillage.[91] However, NRCS and Farm Bureau agents suggest conservation tillage in the watershed is practiced on 50 – 60 percent of fields. This would leave 5,000 – 6,000 acres in conventional tillage. During project implementation, it will be important to identify these fields

[89] The erosion index = $R \times K \times LS \div T$, where T is tolerable soil loss and the other factors are those in the RUSLE equation (R = erosivity of rainfall, K = erodibility of soil, and LS is a combination of slope and the length of the slope). The erosion index gives the potential for soil loss without regard to land cover, the type of crop planted, or management measures. An erosion index value < 1 indicates that soil loss is less than the tolerable rate, while in order to maintain eligibility for Farm Bill programs farmers are required to implement certain conservation measures if they farm highly erodible lands (erosion index > 8, with additional conditions).

[90] Average cost for no-till is considered to be equal to $20/ac. This appears to cover costs and perhaps yield a slight incentive according to statistics in USEPA 1993 *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters.* EPA 840-B-92-002.

[91] Illinois Department of Agriculture. 2006. *Illinois Soil Transect Survey.*

and target them with conservation tillage practices. In general, conservation tillage is an attractive soil conservation option for farmers because it does not take land out of production and it reduces the fuel and maintenance costs associated with tillage. On the other hand, corn yields generally increase with conventional tillage.

The main lever for increasing the use of conservation tillage in the watershed is targeted outreach to producers farming erodible soils by the NRCS and the Will-South Cook County SWCD along with technical assistance. Also, the direct costs of implementing conservation tillage may be offset through the state Conservation Practices Program and through the federal Environmental Quality Incentives Program, either of which pay $20 per acre for no-till, capped at an $800 total payment.

There is an additional incentive for conservation tillage available through the Illinois Climate Change Initiative (ICCI) and the Chicago Climate Exchange (CCX). CCX is group of businesses and other organizations that voluntarily agree to reduce their greenhouse gas emissions (GHG) by 6 percent and do so by either changing their operations to emit less GHG or by purchasing credits equivalent to a reduction in GHG. Some of these credits (called "Exchange Soil Offsets" or XSOs) come from farmers who practice conservation tillage or who install filter strips. Conservation tillage is eligible as a credit because it decreases the rate of carbon loss from farm fields. The monetary value of a credit is determined by its availability and the demand for it on the CCX, much like any other traded commodity. Because each of the XSOs is generally small, they are purchased by the Delta Institute and aggregated into larger credits for resale on the CCX. The price of a metric ton of carbon has varied between about $1.00 and over $7.00 on the CCX historically. As of October 2008 its value is quite low – probably a reflection of depressed conditions in many markets, not just for carbon -- leading to a value of the credit itself of only about $0.76 per acre of conservation tillage after program costs.

The producer contracts directly with the Delta Institute,[92] but the SWCD can assist by helping farmers understand the program and fill out the forms. As of August 14, 2008, no contracts had been signed in Will County. It is recommended that the Will – South Cook SWCD market the ICCI program in addition to the more familiar federal programs. A question and answer document for Illinois SWCDs has also been provided by the Illinois Climate Change Initiative.[93] While the value of an XSO is low as of 2008, it is expected to rise in value in future years as the importance of climate change mitigation strategies becomes more evident.

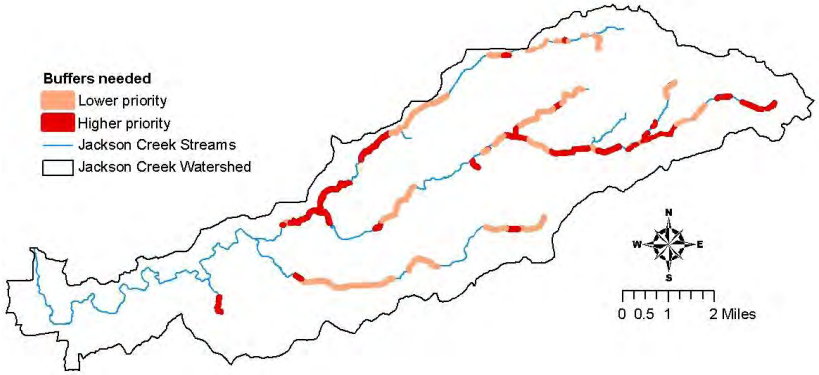
5.1.5 AGRICULTURAL BUFFER STRIPS

Buffer strips slow surface water flow from cropland into streams, trapping sediment and associated nutrients. They are most effective in controlling phosphorus and sedimentation, as phosphorus tends to bind to soil particles, while nitrogen tends to leach through the soil and be exported by the tile drain system. The tile system tends to short-circuit buffer strips, making them less effective.

Buffer strips can be grass plantings or forest vegetation. Federal programs provide a number of incentive payments and a signing bonus for filter strips in addition to cost-share payments and soil rental, which may offset the farmer's cost of taking land out of production. Under most conditions, it can be shown (Section 5.2 below) that farmers would pay nothing or make a modest bonus for enrolling in conservation programs to install filter strips. Also, the Illinois Climate Exchange Initiative accepts filter strips as carbon credits, with a value in mid-October 2008 of $1.26 per acre after program costs.

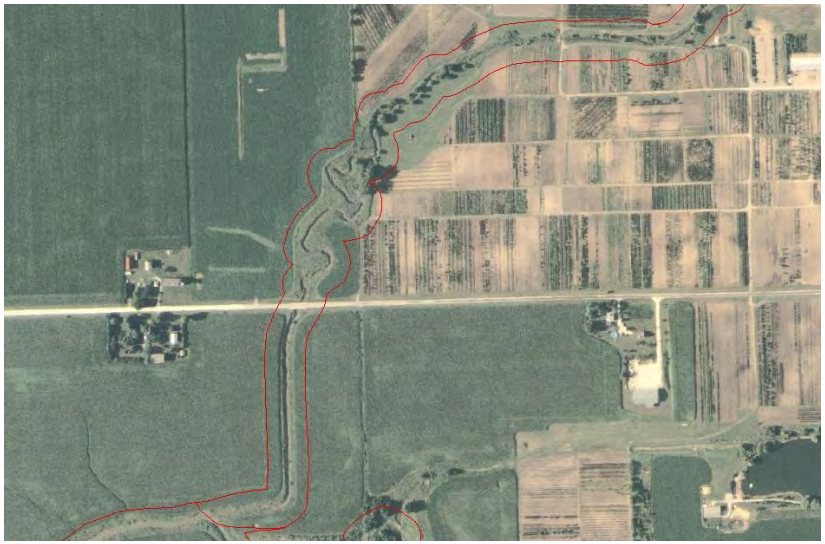
[92] The documents are at http://illinoisclimate.org/contracts.php
[93] See http://illinoisclimate.org/documents/SWCDFAQ.pdf

Figure 5-7. Agricultural areas lacking vegetated 100-ft buffer.



To determine target acreage for agricultural buffer strips, the area within 100 ft of the stream was examined to estimate whether an adequate grass or forested buffer was present. Areas lacking sufficient vegetation were identified for a potential buffer program implementation. Approximately 470 acres of buffer could be installed on cropland based on a 100-foot buffer standard (Figure 5-7). About 188 of these could be considered higher priority, located on parcels with an average erosion index greater than 3.

Figure 5-8. Example of wide buffer, meandering stream north of road; channelized stream and narrow buffer south of road (Jackson Creek)



Note: red line is 100-foot buffer of stream

5.2 Pollutant Removal and Costs

Table 5-2. Costs of recommended agricultural BMPs

Conservation Practice	Acres	Program	Avg cost / Acre [94]	Cost share	Incentive /ac	Soil rental /ac[95]	XSO /ac[96]	Total incentive payments to farmers	Total cost to farmers or (savings)	Capital **cost**
Filter strips[97]	188	CRP, CCX	$260	90%	$100	$95	$1.26	$40,469	($35,581)	$48,880
Treatment wetlands[98]	39	CRP	$4,100	90%	$100	$95	—	$8,346	$7,644	$159,900
Controlled drainage	1,400	EQIP	$65	60%	$5	—	—	$7,000	$29,400	$91,000
Bioreactor	400		$240	—	—	—	—	—	$96,000	$96,000
No till	5,000	CPP, CCX	$20	—	—	—	$0.76	$103,800	($3,800)	$100,000
Total	14,977	—	—	—	—	—	—	$159,615	$93,663	$495,780

Notes: CPP - Conservation Practices Program - State Dept. of Agriculture; EQIP - Environmental Quality Incentives Program – USDA; CRP - Conservation Reserve Program – USDA.

Table 5-3. Estimated annual load reductions from agricultural BMPs

	Treatment wetland	Controlled drainage	Bioreactors	No till	[99]Filter strips	Total
Installed	39	70	4,000	7,700	188	
units	ac	ea	ft	ac	ac	
Acres treated	3,985	1,400	400	7,700	564	14,049
Removal efficiency						
Nitrogen	24%	30%	60%	55%	10%	
Phosphorus	48%	30%	30%	45%	75%	
Load reduction						
Nitrogen (lb/y)	14,573	6,400	5,486	64,532	859	91,850
Phosphorus (lb/y)	2,722	598	256	4,931	602	9,109

Source: removal efficiencies for strip-till and filter strips from STEPL; treatment wetland from National Pollutant Removal Performance Database, v3; nutrient management from USEPA *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. Drainage practices discussed in Sections 6.1.2 and 6.1.3.

[94] Average cost for no-till and nutrient management planning is considered to be equal to the payment of $20 /ac, capped at $800. This appears to cover costs and perhaps yield a slight incentive according to statistics in USEPA. 1993. *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters.* EPA 840-B-92-002. Retrieved from: http://www.epa.gov/nps/MMGI/Chapter2/ch2-2c.html

[95] Average soil rental rate not specific to Will County

[96] XSO = Exchange Soil Offset from Illinois Climate Change Initiative/Chicago Climate Exchange. Calculated from http://illinoisclimate.org/conservationcalculator.php (October 2008)

[97] Notes: the following incentives apply to filter strips, grass waterways, and wetland construction: SIP -Stewardship Incentive Payment - 20% bonus on average Soil rental rate; PIP - Practice Incentive Payment - 90% cost share to establish practice; SP - Signing Bonus - One time Payment of $100 × the number of acres enrolled.

[98] Shallow water wetland estimated 5 acre area with 1 ft soil removed at $2.35/yard and 100 per acre seeding.

[99] It is assumed that filter strips treat the area 300 feet on either side of a stream, the approximate limit of sheet flow. It is also assumed that their nitrate removal is poor because of short-circuiting by the tile system.

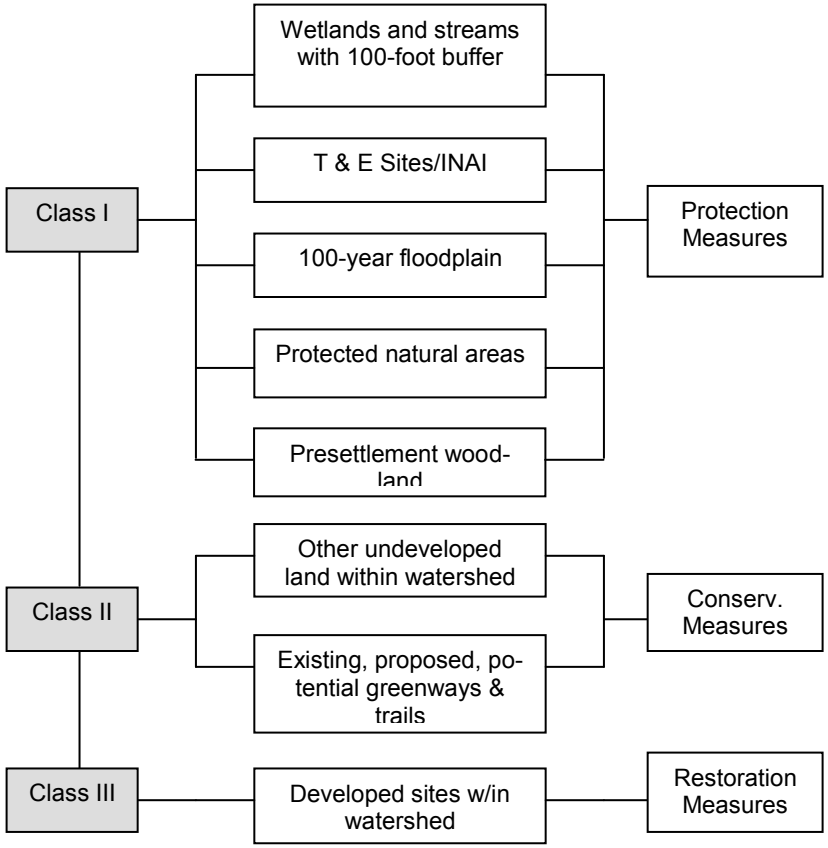
6. WATER RESOURCE POLICY RECOMMENDATIONS

6.1 Environmental Corridors

Environmental corridors — sometimes called *green infrastructure* — are landscape features that contain and connect natural areas and other natural resources. In other words, they are a network that preserves natural functions while permitting other areas to be put to other uses, such as agriculture or urban uses. They are also the areas where natural resource protection efforts should be concentrated, either by acquisition/easement by a public agency or land conservancy or by encouraging more sensitive design during development.[100] The basic concept for the delineation of environmental corridors is the establishment of hubs, blocks of protected areas to be restored to natural conditions, and linkages, which are linear strips that connect the hubs. This plan recommends a three-class system of environmental corridors, as shown in Figure 6-1, where Class I is that network of hubs and corridors. The overall principle for Class I is to establish legal protection through acquisition or easement for as much of it as is possible and realistic, as well as to preserve or restore its natural land cover. Class II represents developable land, on the other hand, where measures such as advanced best management practices may be appropriate. Finally, Class III represents developed land where watershed restoration measures may be appropriate, although as discussed in Section 3 there are few opportunities at present.

[100] This is different than developing an open space plan based on prioritizing parcels for protection, such as was done to good effect in the *North Branch of the Chicago River Open Space (Green Infrastructure) Plan* (Lake County Stormwater Management Commission, 2005, http://www.co.lake.il.us/smc/planning/nbos/default.asp). Stakeholders in the Jackson Creek watershed indicated that they sought a guidance framework rather than recommending specific parcels for protection because, among other reasons, each organization involved in land protection may have different priorities.

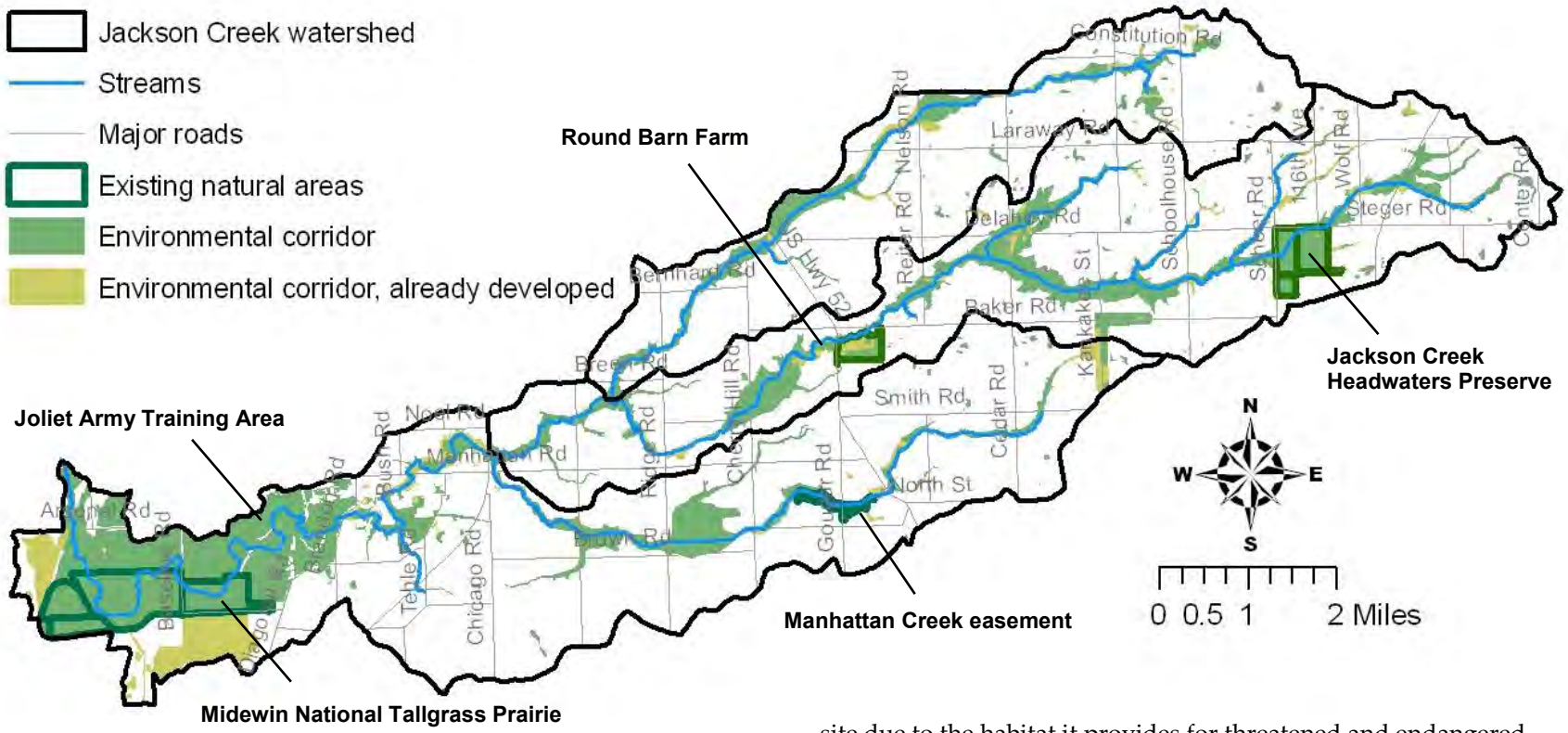
Figure 6-1. Environmental corridors diagram



6.1.1 CLASS I DESCRIPTION

The following describes the natural resources proposed to be Class I environmental corridors, shown in Figure 6-2. In some areas the corridors have already been developed (in other words, contain structures), as shown in a lighter color.

Figure 6-2. Environmental corridors



Illinois Natural Areas Inventory Sites are locations of significant natural resources identified by the Illinois Department of Natural Resources that would qualify for formal protection. These sites may contain natural communities, specific habitat for state-listed species, geological features, unusual concentrations of flora and fauna and high quality streams.[101] The INAI identified two sites in the Jackson Creek watershed: the Joliet Army Ammunition Plant and Manhattan Creek. The ammunition plant was listed in the INAI as a Category II site due to the habitat it provides for threatened and endangered species, and it is now partly within the CenterPoint development. Manhattan Creek has been designated as a Class A stream by IDNR in an earlier inventory due to the fish and aquatic habitat in it, although it has probably since declined from that classification. Threatened and endangered species have also been identified in at least one area outside of INAI sites.

The 100-year floodplain is derived from the Q3 file from the Federal Emergency Management Agency, digitized from Flood Insurance Rate Maps. Wetlands were taken from U.S. Fish and Wildlife Service

[101] Illinois Nature Preserves Commission, 2008.

in the National Wetlands Inventory. These water bodies should be considered part of the stream system and thus insuring their connectivity and protection would ensure better water quality and habitat preservation. The stream network itself is within a 100 foot buffer.

Protected natural areas are the hubs that the corridors connect. This conservation oriented open space includes the Jackson Creek Headwaters Preserve, the streamside area of the Round Barn property, the protected riparian area downstream from the Manhattan wastewater treatment plant, and of course the Midewin National Tallgrass Prairie. Finally, a relatively large area in the lower watershed as the stream enters the Des Plaines valley is still in a state close to its presettlement land cover of woodland. Numerous studies in the eastern U.S. have shown that forest cover in a watershed correlates strongly with aquatic community health.[102]

6.1.2 CLASS I RECOMMENDATIONS

From a water resources standpoint, the lands within Class I are the most important in the watershed. As much land as possible within the Class I corridor should be legally protected and managed for conservation purposes. This could either be through (1) acquisition/easement or through (2) what is called low-impact development or conservation design.

The ultimate goal is a continuous greenway along each major stream in the watershed. In 2006, FPDWC undertook an open space planning effort with the park districts in the watershed. This resulted in the following consensus goal: "We, as governmental agencies along Jackson Creek, intend to work toward the protection of a continuous greenway of open space along the creek (including the north and south branches and Manhattan Creek) to preserve the floodplain, provide outdoor recreational and educational opportunities, and maintain aesthetic and rural elements in a rapidly urbanizing landscape." The Jackson Creek Open Space Planning Resolutions of Support offer a unique opportunity for future planning and project partnerships.

Acquisition would generally be carried out by the Forest Preserve District of Will County or the park districts. In some cases they may receive land by developer donations. Exactly when and where acquisition/donation would take place cannot readily be said ahead of time, but the point of the Class I corridor is to show the areas where it is most important to preserve land from the perspective of this plan. It is also important to note that public sector agencies need to serve the public: the sites donated to them need to have adequate access and generally should be able to supply recreational opportunities in addition to satisfying conservation objectives.

Furthermore, the Joliet Arsenal Training Area (JATA) is considered part of the environmental corridor by virtue of its large, relatively unaltered, and mostly wooded area. The Army intends to divest ownership of this property, and there are efforts underway, supported by several organizations, to have it become part of an expansion of Midewin. The firm CenterPoint Properties is seeking a permit from the Army Corps of Engineers for wetlands impacts in a proposal to build a road and rail spur through JATA as part of the CenterPoint Intermodal North Center. A group of eight organizations submitted comments to the Corps recommending denial of the permit, arguing among other things that the Army would violate Illinois law by transferring rights to CenterPoint to build in JATA.[103] While the resolution of this specific debate is outside the scope of this plan, the broader issue of the disposition of JATA is not. From the stand-

[102] Center for Watershed Protection. *The Impacts of Impervious Cover on Aquatic Systems*. March 2003. Watershed Protection Research Monograph No. 1. This publication is available from the CWP website.

[103] Comments on Draft Section 404 permit requested by CenterPoint Properties for Phase I of the CenterPoint Intermodal Center North (LRC-2007-688), submitted by Openlands, January 9, 2009.

point of this plan, permanent protection and restoration of JATA, with protection from degradation by nearby development, is important and is recommended.

By contrast, with conservation design the preserved open space will generally remain in private hands, under easement, with an agreement to perform management and a financing mechanism to do so. The main principles of conservation design are: (1) flexibility in site design and lot size, (2) protection and management of natural areas, (3) reduction of impervious surface areas, and (4) sustainable stormwater management.[104] More information on conservation design and example site plans can be found in a number of references. The Village of Manhattan has recently prepared a comprehensive plan that contains an extensive discussion of this development practice. CMAP has also prepared a summary of conservation design in the region.[105]

One of the virtues of conservation design is that sensitive natural resources are preserved as part of the development – floodplains, wetlands, significant woodlots, etc. The philosophical underpinning of the technique is that by allowing flexible lot design standards that are density-neutral, such as implementing standards for the overall density on a site without minimum lot size requirements, it is possible to meet the business objectives of developers while conserving natural areas and systems. An equivalent number of residences can be clustered, potentially yielding an added benefit to developers by reducing site infrastructure costs (roads, sewer, streetlights, water, etc.), as well as reducing the long-term infrastructure maintenance costs borne by the public sector.

[104] *Conservation Design Resource Manual*. http://www.nipc.org/environment/sustainable/content.htm
[105] http://goto2040.org/ideazone/forum.aspx?id=748

6.1.3 CLASS II RECOMMENDATIONS

Population forecasts prepared by NIPC/CMAP in 2006 with extensive input from local officials suggest that a large area within the watershed will develop by 2030, although the current slump in the housing market may modify these expectations. It is recommended that development be channeled into the Class II corridors, protecting Class I. The normal suite of construction and post-construction BMPs are applicable here, along with further recommendations contained in the next section.

6.2 Water Quality and BMP Recommendations

6.2.1 BUFFERS

A buffer is an area along the stream where development is restricted, planted with native or natural vegetation, and whose primary function is to physically protect and separate the stream from future disturbance or encroachment. The buffer can provide stormwater management and act as a right-of-way during floods, thus sustaining the integrity of stream ecosystems and habitats. Buffers are especially useful to establish in new developments by waterways or by establishing conservation easements in existing developments.

There is no universally accepted minimum buffer width. It depends to some extent on the objectives (Table 6-1) and in many cases it is appropriate to have buffers that vary based on site conditions but meet an average width standard (buffer averaging). USEPA's model ordinance[106] recommends a minimum width of 100 feet to provide adequate stream protection and specifies a three-zone system where the zone closest to the stream (25 feet from top of bank) is in a natural or native land cover, the second zone is 50 feet from the first and is targeted for natural/native vegetation but permits very limited uses such as trails and stormwater management facilities, and the third extends an additional 25 feet to the nearest permanent struc-

[106] http://www.epa.gov/owow/nps/ordinance/mol1.htm

ture. The third zone is recommended for natural/native vegetation as well but could be turf.

Table 6-1. Sample buffer widths

Objective	Width (ft)	Considerations
Nutrient removal	15-200	Depends on hydrology, soils, loadings.
Sediment control	30-300	Depends on slope, soil type, sediment loadings.
Streambank stabilization	25-55	Choose deep-rooted species that readily resprout.
Flood control	25-200	Depends on stream order and flood patterns. Select sturdy flood-tolerant species.
Wildlife habitat	25-300	Depends on species of concern. Select native plant species for revegetation, particularly those that provide high value for food and shelter.
Aquatic habitat	60-110	Select native species for seasonal inputs of leaf litter and inputs of large woody debris.
Water temperature moderation	50-110	Depends on stream size and aspect, and the height, density, and crown size of the vegetation

Source: Virginia Cooperative Extension http://www.ext.vt.edu/pubs/forestry/420-155/table2.html

Local ordinances in the watershed generally call for a 75 – 100 foot setback in which development is restricted and a much smaller strip of natural/native vegetation (in other words, a buffer) within the setback that ranges from 25 to 35 feet. (The countywide ordinance does not contain buffer performance standards except for on agricultural land.) The ordinance requirements come in at the low end of the ranges described in Table 6-1, but they are very similar in performance to the USEPA model ordinance. Most are based on the Northeastern Illinois Planning Commission model ordinance from the early 1990s.

It is worth pointing out that preservation of aquatic habitat — which is closely related to improvement of biological conditions in the stream, i.e., supporting the aquatic life use, the ultimate purpose of this plan — tends to require a substantially wider buffer than for other purposes. This is in line with the requirement of other countywide ordinances (Lake, McHenry) to install wider buffers when developing near streams with higher Index of Biotic Integrity (IBI) scores. For instance, a 100-foot buffer is required by the McHenry ordinance for streams with IBI > 35, with no apparent zone system (i.e., the entire buffer would be devoted to native/natural plantings, with allowances for trails, docks, etc.). On Jackson Creek, this would tend to protect the lower watershed more than it currently is. Nevertheless, buffer requirements in local ordinances appear essentially appropriate and, if enforced correctly, protective of Jackson Creek.

6.2.2 WETLANDS

For reasons discussed in Section 2, protecting wetlands is an important policy goal. The primary protection on wetlands in the watershed is the Clean Water Act Section 404 program carried out by the Army Corps of Engineers to regulate wetland filling, with additional oversight by IEPA under Section 401. These programs do not protect wetlands that are not connected to "waters of the United States," the so-called isolated wetlands. Such wetlands may seem to have little relevance to this plan as it is primarily concerned with nutrient loadings to surface waters. However, researchers have found that isolated wetlands rarely are isolated from a water quality perspective. Most have a connection to groundwater or are periodically inundated. Since most wetlands act as nutrient sinks, altering or filling them generally results in the export of nutrients downstream, in this case to Jackson Creek.[107]

[107] Dennis F. Whigham and Thomas E. Jordan. 2003. Isolated wetlands and water quality. *Wetlands* 23(3): 541–549

There are other protections that may tend to prevent the destruction of isolated wetlands. At the local level, municipal ordinances as well as the stream and wetland protection ordinance applying to the unincorporated county generally limit the activities that can take place in wetlands as well as near them by specifying buffer distances. Damage caused to wetlands by allowable uses would be mitigated by an equal area of improvement. In some cases these ordinances, such as that of Joliet, define wetlands not only in physical–biological terms but also legally as those that are under the jurisdiction of a federal or state agency. In such a case a local ordinance would not appear to do much beyond the Corps' regulations. In other ordinances, such as that of Frankfort, local protections explicitly extend to all wetlands, whether or not they are under the Corp's jurisdiction. The WCSMO's or local ordinances' protection of depressional storage could also tend to decrease impacts to isolated wetlands, as some depressional areas are isolated wetlands. When depressional storage is removed it must be compensated in the site runoff storage facility at a 1:1 ratio. Offsite areas that were tributary to the depression also have to be routed through the site runoff storage facility. If it is significantly more expensive or difficult to provide compensatory storage than to work the depression into the site plan, this requirement could tend to preserve isolated wetlands.

These protections are not very certain or uniform across the watershed (or county) and would not tend to prevent the net loss of isolated wetlands, although the latter is not a stated goal of the 1998 Will County Stormwater Management Plan. It is recommended that the county and municipalities, as part of the countywide ordinance, consider instituting such a goal and implementing an isolated wetlands protection program with defined mitigation ratios of greater than 1:1.

6.2.2.1 Wetland Banking

Off-site wetland mitigation, especially through mitigation banking, has become more common in recent years. It is worth pointing out that the market for mitigation credits will increase if mitigation is required for isolated wetlands. A simple evaluation of potential wetland restoration sites in the watershed was undertaken with an eye toward possible locations for wetland banks. Potential restoration areas were considered to be any hydric soil that (a) was not considered a wetland in the National Wetland Inventory, (b) was not in a developed land use in the draft 2005 CMAP land use inventory, and (c) was on private land. These potential restoration areas were then prioritized by considering the objectives of nutrient load reduction, habitat restoration, and flood storage. The objectives were weighted equally.

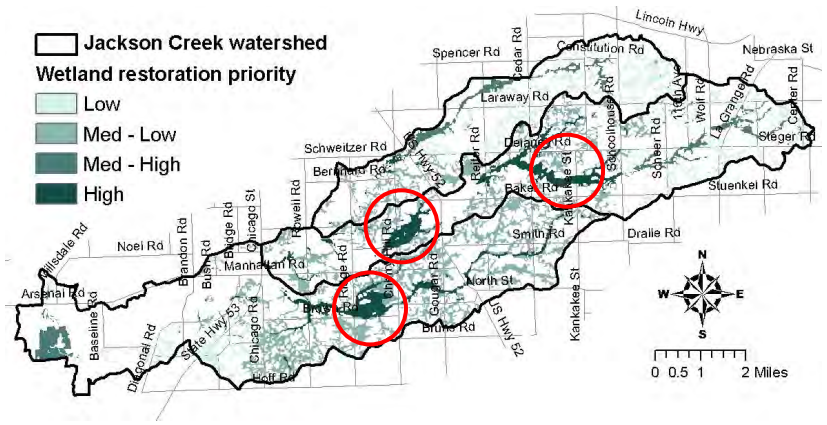
Table 6-2. Summary of wetland restoration criteria

Objective	Location priority	Cell Value
Water quality	"Hotspot" subwatersheds	0 – 10 based on rank of unit area load
Habitat	Chicago Wilderness bird and herp wetland models	0 – 10 depending on underlying model
Flood storage	100-year floodplains	10 if in SFHA, 0 otherwise

The potential for nutrient removal was treated on a subwatershed basis. For each subwatershed, a unit area nitrogen load was calculated (pounds per acre per year). These unit area loads were rank ordered and assigned a value of 1 – 10 to represent their magnitude. Hydric soils within a subwatershed with a higher unit area load would be rated more highly to represent the potential for greater nutrient load reductions by wetland restoration in those subwatersheds. The value of restored wetlands as habitat for birds and amphibians/reptiles (herps) was estimated by the Chicago Wilderness

"basin marsh" GIS model.[108] The basin marsh model calculates wetland habitat value based partly on the proximity of other wetlands. Thus, if used to target restoration efforts, the model weights locations near existing wetlands on the principle that it is better to recreate wetlands as complexes rather than in fragmented patches. The basin marsh model output was scaled to values of 0 – 10. Finally, the potential for flood storage as part of wetland restoration was simply represented as location within the 100-year floodplain, with a value of 10 if located in the Special Flood Hazard Area and 0 otherwise.

Figure 6-3. Relative wetland restoration priority



The results (Figure 6-3) indicate that there are higher-priority restoration locations within each of the major tributary drainages. The larger areas, circled in red, are generally in agricultural land uses and include:

(a) Approximately Spangler Road to the Wauponsee Trail along Jackson Creek (Section 7 of Manhattan Township, Section 14 of Jackson)
(b) An area mainly between Ridge, Brown, Cherry Hill, and Manhattan Roads (Sections 13 and 24, Jackson Township). This area was also specifically called out for wetland restoration in the Village of Manhattan's 2003 Manhattan Creek protection resolution.
(c) An area mainly between Baker, Reiter, Delaney, and Schoolhouse Roads (Sections 2, 3, and 4 in Manhattan Township)

6.2.3 BMP EFFECTIVENESS

Wet ponds are the norm in new development in the watershed, with more and more of them "naturalized," i.e., fringed with wetland vegetation. While they are quite effective at removing total suspended solids (TSS), they are less effective at nutrient removal (Table 6-2). In general, different BMPs have different removal rates for various pollutants. It can be seen that, in general, infiltration practices (e.g., infiltration basins) tend to have the highest removal rates for phosphorus while open channel practices like wet swales have the highest removal rates for nitrogen. There is also variability in the performance of the BMPs, as shown by the difference between median and 75th percentile removal rates. While some of this can be attributed to local conditions, different loading rates, and different study methodologies, much of it is due to design.

It is recommended that the county and municipalities consider adopting ordinance provisions to encourage in new development a combination of BMPs whose installation in series would generally result in the removal of 75 percent of nitrogen and 80 percent of phosphorus on an annual basis. These removal efficiencies represent averages of the nutrient loading targets described in Section 2. Because a wet pond or an extended detention pond (the latter being required in some cases by the countywide ordinance) already removes

[108] More information can be found in: Northeastern Illinois Planning Commission. June 2005. *Wetland Conservation Strategy Model Development*. Final report to Chicago Wilderness Consortium.

significant amounts of nutrients, it may only be necessary to provide a wet swale, for example, or a sand filter to pre-treat all or a portion of the runoff from a site. Guidelines on how to design such treatment trains and estimate their removal efficiency would be need to be provided in the Technical Guidance Manual.[109]

Table 6-1. Removal efficiency of BMPs for selected pollutants

	TSS		Total N		Total P	
	Med	Q3	Med	Q3	Med	Q3
Dry pond	49%	71%	24%	31%	20%	25%
Wet pond	80%	88%	31%	41%	52%	76%
Wetland	72%	86%	24%	55%	25%	53%
Filtering practices	86%	92%	32%	47%	59%	66%
Bioretention	59%	74%	46%	55%	5%	30%
Infiltration	89%	96%	42%	65%	65%	96%
Open channel	81%	87%	56%	76%	24%	46%

Med = median and Q3 = 75th percentile removal rate for BMPs studied
Source: National Pollutant Removal Performance Database, v3. September 2007. Center for Watershed Protection.

6.3 Retrofit Opportunities in Infrastructure Projects

It is recommended that local governments institute a policy to examine future infrastructure projects for the potential to bundle in water quality benefits at little additional cost. This was discussed in Section 3.1.1. For example:

- During roadway resurfacing or sidewalk/curb work, it might be relatively inexpensive to install improved catchbasins or to utilize newer treatment methods like absorptive media to remove dissolved constituents like phosphate.[110] Work on roads with open drainage may present an opportunity to shunt runoff into a small wetland treatment area within the right of way.
- As part of bridge or culvert work, it may be possible to add wetland or extended detention treatment behind the embankment. This is *only* recommended in areas where the stream is intermittent (the upper watershed) as the weir needed for ponding will tend to prevent fish passage. Permitting may be an issue with this type of project, and certainly must be designed to prevent increases in flood stage.
- Publicly owned detention basins that require significant maintenance may be candidates for retrofits that would improve their pollutant removal performance.
- Parking lot resurfacing/reconstruction may provide an opportunity to direct runoff to pervious areas rather than into the stormsewer system or to a bioretention area.

Such a policy could be implemented as part of the formal capital improvement program for the larger municipalities or informally during project planning by the smaller ones.

[109] http://www.willcountylanduse.com/SubEng/SubEngDocs/Stormwater TGM_071304draft.pdf
[110] For example, see http://www.imbriumsystems.com/en/products/sorbtive.html

7. PLAN IMPLEMENTATION AND MONITORING

7.1 Schedule and Milestones

This plan recommends four kinds of projects — (1) stream habitat restoration, (2) urban stormwater retrofits, (3) agricultural BMPs, and (4) wastewater treatment plant upgrades — and several policies. The project implementation part of the plan is assumed to be on a five-year timeline, which is consistent with typical capital improvement programming. Furthermore, the plan proposes a water quality monitoring program which should help reveal the extent to which more or fewer investments in water quality improvement are needed. If started a year after the plan is finished, new information would be available to guide project planning. Finally, it is possible that stakeholders may want to update the plan so as to include, potentially, additional objectives, providing an opportunity to review the project recommendations in the present plan.

The bullet list below identifies the project category, proposed project lead, and a basic schedule with milestones:

- Treatment wetlands
  - Task Lead: SWCD and/or NRCS or Farm Bureau initiate contact with landowners in opportunity areas, supply technical and financing information
  - Milestones: 2 pilots by 2010, 5 wetland projects by 2012, 10 wetlands by 2014
- Controlled drainage
  - Task Lead: SWCD and/or NRCS or Farm Bureau initiate contact with landowners in opportunity areas, supply technical and financing information
  - Milestones: 1 pilot by 2011, 2 projects by 2013, 3 projects by 2014
- Bioreactors
  - Task Lead: SWCD and/or NRCS or Farm Bureau initiate contact with landowners in opportunity areas, supply technical and financing information
  - Milestones: 1 pilot by 2011, 2 projects by 2013, 3 projects by 2014
- Conservation tillage
  - Task Lead: SWCD and/or NRCS market EQIP/ICCI payments to farmers in Jackson Creek
  - Milestones: 200 new acres enrolled by 2010, 500 by 2012, 1,000 by 2014
- Filter strips
  - Task Lead: SWCD and/or NRCS market CRP/ICCI payments to farmers in Jackson Creek
  - Milestones: 5 acres of filter strips per year
- Urban retrofits and stream habitat projects
  - Task Lead: Agency identified in project snapshot
  - Milestones: Apply for funding for at least one project each year of plan implementation, with the object of starting one project per year
- Wastewater treatment plant upgrades
  - Task Lead: Villages of New Lenox and Manhattan
  - Milestones: complete upgrades by 2014 or include nitrogen removal during expansion

7.2 Monitoring

7.2.1 INSTREAM SAMPLING

As discussed in Section 2.2.7, the available data are inadequate to calculate watershed loading or water quality response with acceptable accuracy. Because of this the loads and targets described in Section 2 should be considered provisional. It is recommended that IEPA and potentially other parties commit funds to collect additional data and develop such a water quality model. The study objectives are as follows. First, additional samples of total nitrogen and total phosphorus, and total suspended solids should be collected with op-

timal spatial resolution. Second, a water quality model such as HSPF, QUAL2K, etc. should be calibrated and validated using the data, so the frequency of sampling, additional constituents monitored, and length of the sample program should be adequate to do so. It may be necessary to provide a weather station as well. Third, the study should determine monthly and annual loads of total nitrogen and total phosphorus as well as the frequency and amount by which concentrations exceed criteria and determine more precisely the reduction in loading necessary to meet the criteria.[111]

Approximately 18 ~ 24 samples per year for about four years are recommended for nutrients. In situ measurements of temperature, pH, and dissolved oxygen should also be taken for use in modeling. The sample design should include sampling during both high and low flows to get an adequate representation of the distribution of flow and concentration. Flow measurements are also needed from a stream gaging station. Ideally samples from several points would be collected to improve spatial resolution, but whole-watershed loads can be computed based on one sample point. Since additional sample points will mainly affect lab analysis, one of the smaller cost items, and will not increase the other items very much, it may be worth establishing additional sample points. Planning-level cost information has developed by the Illinois State Water Survey for such a sampling program (Table 7-1) in another watershed in the region were scaled to estimate costs for Jackson Creek.

7.2.2 EFFLUENT MONITORING

Neither of the main wastewater treatment plants in the watershed monitor total nitrogen. New Lenox monitors orthosphosphate concentrations in effluent, but it is not known whether Manhattan does so (data was not made available from the Village of Manhattan). Because of this it is difficult to estimate accurately the relative contribution of the treatment plants to nutrient loading. It is recommended that both plants monitor and report total nitrogen and phosphorus as part of a study partnership with IEPA and the State Water Survey. In this case the municipalities' contributions could also be considered local match.

Table 7-1. Estimated cost of monitoring program for Jackson Creek

	Year				
	1	2	3	4	Total
Personnel					
Field Staff	$11,667	$12,017	$12,377	$12,748	$48,809
Data Mgmt	$3,611	$3,719	$3,831	$3,946	$15,107
Project Mgr	$2,314	$1,589	$1,636	$1,685	$7,224
Totals	$17,591	$17,325	$17,845	$18,380	$71,140
Fringe	$6,263	$6,168	$6,353	$6,543	$25,326
Equipment*	$13,300	$500	$525	$551	$14,876
Supplies	$667	$167	$175	$184	$1,192
Travel	$333	$67	$67	$67	$533
Op Auto	$1,449	$758	$796	$836	$3,839
Lab Anal	$2,567	$2,695	$2,830	$2,971	$11,063
Telecomm	$200	$200	$200	$200	$800
Subtotal	$42,370	$27,879	$28,790	$29,731	$128,769
F&A	$8,474	$5,576	$5,758	$5,946	$25,754
Total	$50,844	$33,454	$34,548	$35,677	$154,523

*Gage and pump sampler @ $7,600 and Campbell Scientific, Inc. weather station @ $5,700
Note: based on estimates from Illinois State Water Survey for three other watersheds

7.3 Information and Education

An information and education campaign in the context of watershed planning is meant to help implement the plan. The two primary means of educating watershed residents about water quality and

[111] By this time the Illinois Pollution Control Board may have adopted nutrient standards. It should be evident from the discussion in Section 2.2.7 that nutrient control is an emerging area of water quality regulation in Illinois and in many other states.

natural resource issues in Jackson Creek are through the meetings held over 1.5 years as part of the planning process and through the poster being produced to accompany this plan. The poster contains an overview of Jackson Creek as well as the main recommendations from the plan. The County will distribute these posters through its offices to interested watershed residents and those on business with the County.

The recommendations in this plan are mainly geared toward local officials, including County staff and elected officials, and institutional property owners in the watershed rather than the general public. They can best be reached through professional contacts and "leave-behinds" like the poster and the executive summary accompanying this plan rather than through a broad outreach strategy. The exception to this generalization is the agricultural BMPs recommended in Section 5. In this case, the plan recommends that the NRCS and/or SWCD, in addition to their technical and financial assistance to farmers implementing well known BMPs, actively pitch the more-novel BMPs discussed in Section 5.

Nevertheless, public education is ultimately an important part of protecting stream quality. There are two priority public education elements that are recommended. First, phosphate fertilizer used on residential and commercial landscapes will, as the watershed undergoes growth, become a more significant source of phosphorus. It is recommended that municipalities and the county begin to educate residents to purchase and use phosphate-free fertilizer or pay more attention to appropriate application rates. This can be done as part of normal village newsletters or enclosures in utility bills. Similar activities are often undertaken already as part of the NPDES Phase II Stormwater program. Second, volunteer stream cleanups can be an important way of engaging watershed residents in activities that directly improve stream conditions. There are several long-running, successful volunteer stream cleanup programs in the region, with the Thorn Creek Restoration Coalition the best nearby example. The County/Stormwater Committee might consider building a volunteer component into the stream maintenance program it is developing.

7.4 Goal Achievement

As noted in Section 2, the targets chosen in this plan are marked by uncertainty because of the insufficiency of water quality monitoring and streamflow data. They require high load reductions, and as a result, it was difficult to develop recommendations this plan that would result in meeting the targets. Table 7-2 provides a comparison of the targets to the reductions expected from the projects recommended in this plan.

Table 7-2. Load reduction target and BMP summary

	Total N	Total P
Reduction needed	232,259	40,120
Identified opportunities		
Agricultural BMPs	91,850	9,109
Urban/stream habitat	**4,236**	**713**
Wastewater	4,260	2,847
Total	100,346	12,669
Gap	131,913	27,451

The goals in Section 1 include flood damage reduction, with the specific objectives for this plan of identifying water resource problems for further study, including stormwater management infrastructure in need of retrofit, and characterizing buildings in the floodplain. The latter objective is addressed in Section 2. Conversations with municipal officials did not reveal significant flooding issues resulting in property damage, even following heavy rain in September 2008. Furthermore, most of the stormwater management infrastructure in the watershed is fairly new and was installed after the passage of local stormwater management ordinances. Retrofit needs appear limited. However, stakeholders may wish to investigate flood damage

reduction and other flood-related issues further as part of a plan update.

7.5 Summary of Recommendations

- The municipalities and the county should undertake "site planning roundtables" as described in Section 2.4.2 to identify changes to zoning and subdivision ordinances to promote natural resource protection.
- For the urban retrofit and stream habitat restoration projects, it is recommended that the lead agencies identified in the project snapshots in Section 3.3.1 seek undertake to implement the projects or similar projects within five years of plan publication, making use of available grant funds.
- The Villages of New Lenox and Manhattan should install polishing wetlands at their wastewater treatment plants in the watershed within the five-year timeframe for plan implementation. When the villages expand their plants, they should include nitrogen and phosphorus removal.
- The Will – South Cook SWCD, the NRCS, and the Will County Farm Bureau, perhaps working with the Resource Committee, should attempt to identify conservation oriented farmers to conduct pilot wetland treatment, controlled drainage, and bioreactor projects. The milestones in Section 7.1 should be used to guide these efforts.
- As much land as possible within the Class I environmental corridor should be legally protected and managed for conservation purposes, either through acquisition/easement or through conservation design during development.
    - The FPDWC, park districts, and land conservancies should use the Class I environmental corridor identified in this plan to guide and support their land protection activities.
    - The municipalities and the county should promote protection and restoration of areas in the environmental corridors by channeling development to Class II environmental corridors through zoning and annexation policies and by encouraging sensitive site design in those areas if they are developed.
- It is recommended that local governments and land management agencies make available the analysis of wetland banking opportunities in Section 6.2.2.1 to interested parties as the topic arises and support efforts to develop a mitigation bank within the watershed.
- The Stormwater Committee should consider amending the WCSMO to include protections for isolated wetlands.
- The county and municipalities should consider adopting ordinance provisions to encourage in new development a combination of BMPs whose installation in series would generally result in the removal of 75 percent of nitrogen and 80 percent of phosphorus on an annual basis. The Stormwater Committee should provide guidelines on how to design such treatment trains and estimate their removal efficiency the Technical Guidance Manual.
- The municipalities and the county should institute policies to examine future infrastructure projects for the potential to bundle in water quality benefits at little additional cost (Section 6.3).
- Undertake an ADID study for Will County to identify wetlands and characterize their functional values.
- Support efforts to transfer ownership of the Joliet Arsenal Training Area to the U.S. Forest Service to expand Midewin with the ultimate goal of restoring JATA.
- Undertake a more intensive monitoring/modeling program for nutrients, such as that described in Section 7.2, including:
    - Additional sample collection;
    - Effluent monitoring;
    - Stream gaging; and

  - Calibration of a more sophisticated watershed model and simulation of nutrient loading.
- The County should distribute the watershed posters through its offices to interested watershed residents and those on business with the County.
- The municipalities and the county should include recommendations on fertilizer use in newsletters to residents or enclosures in utility bills. The County/Stormwater Committee should consider building a volunteer component into the stream maintenance program it is developing.

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APPENDIX: MAP EXHIBITS

Figure 1-1. Municipal boundaries (2007)

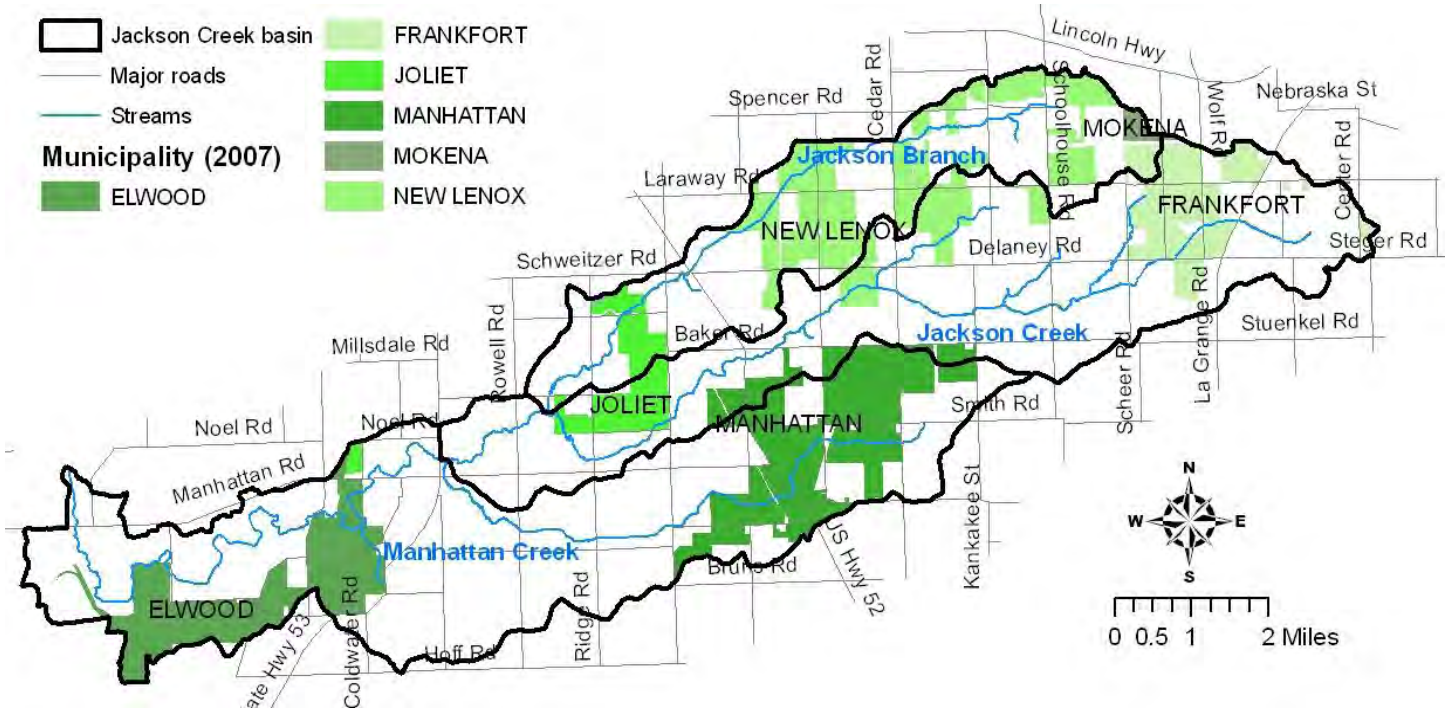


Figure 1-2. Subwatersheds

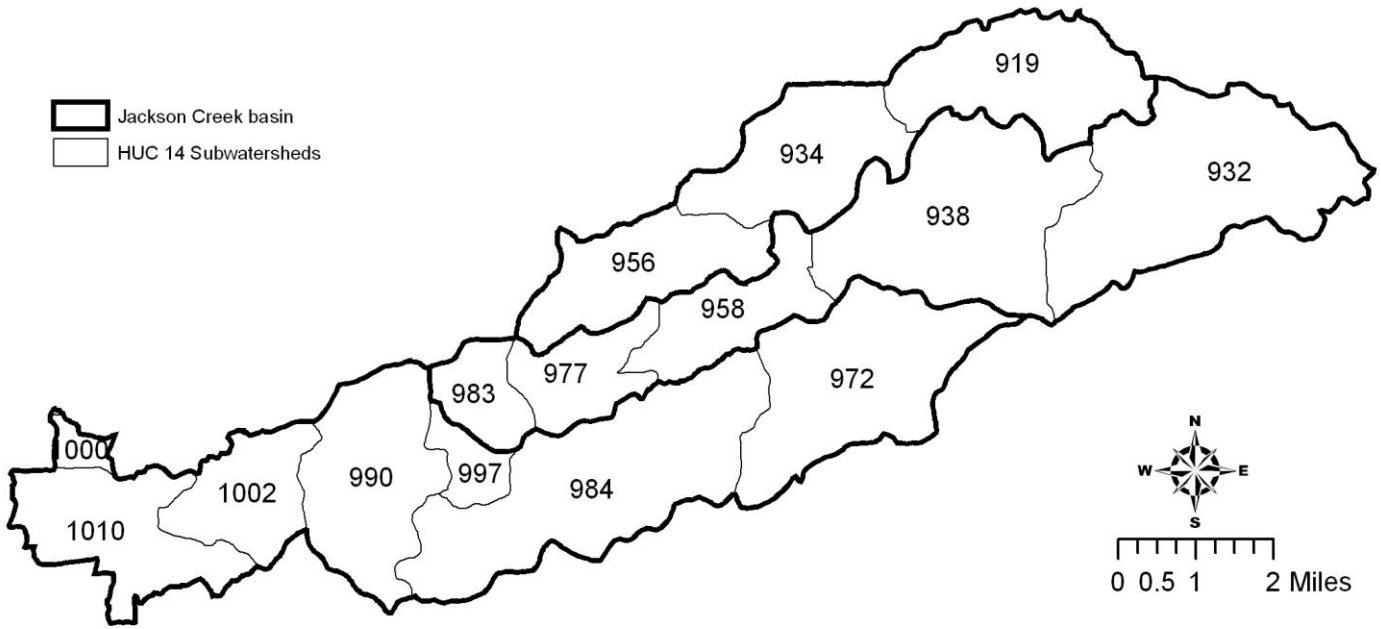


Figure 2-1. Land Use in 2005

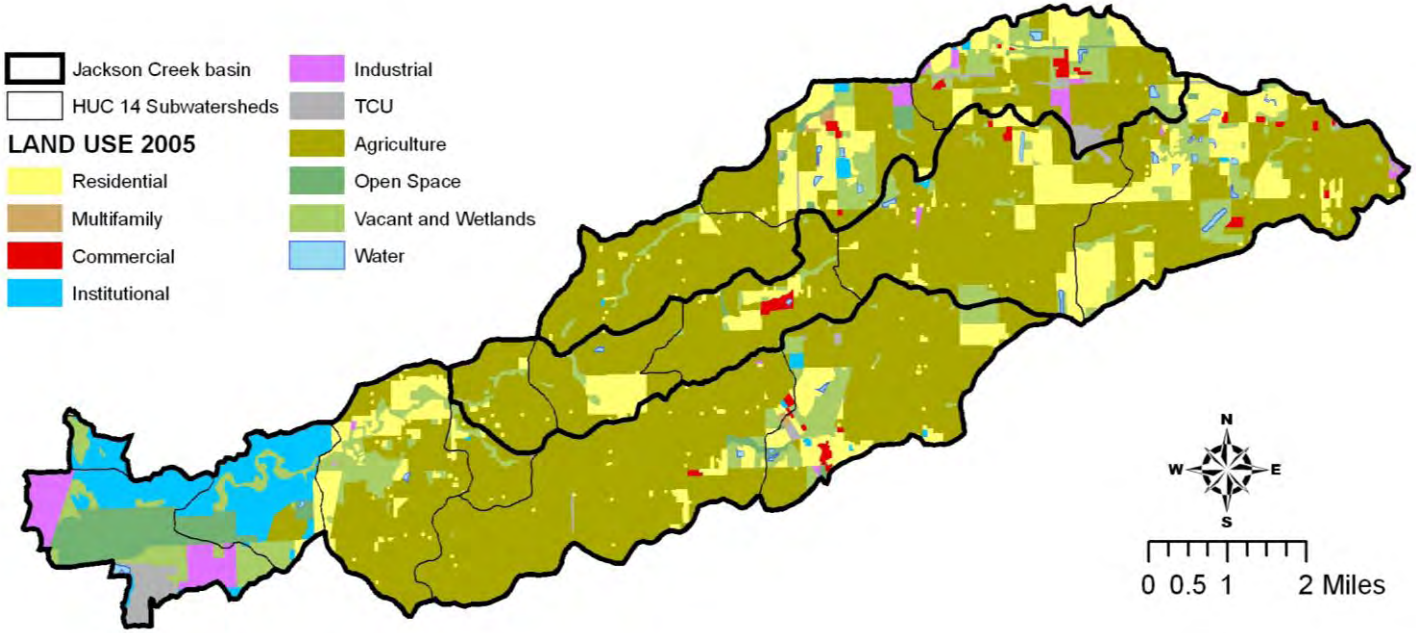


Figure 2-2. Land Cover in 2001

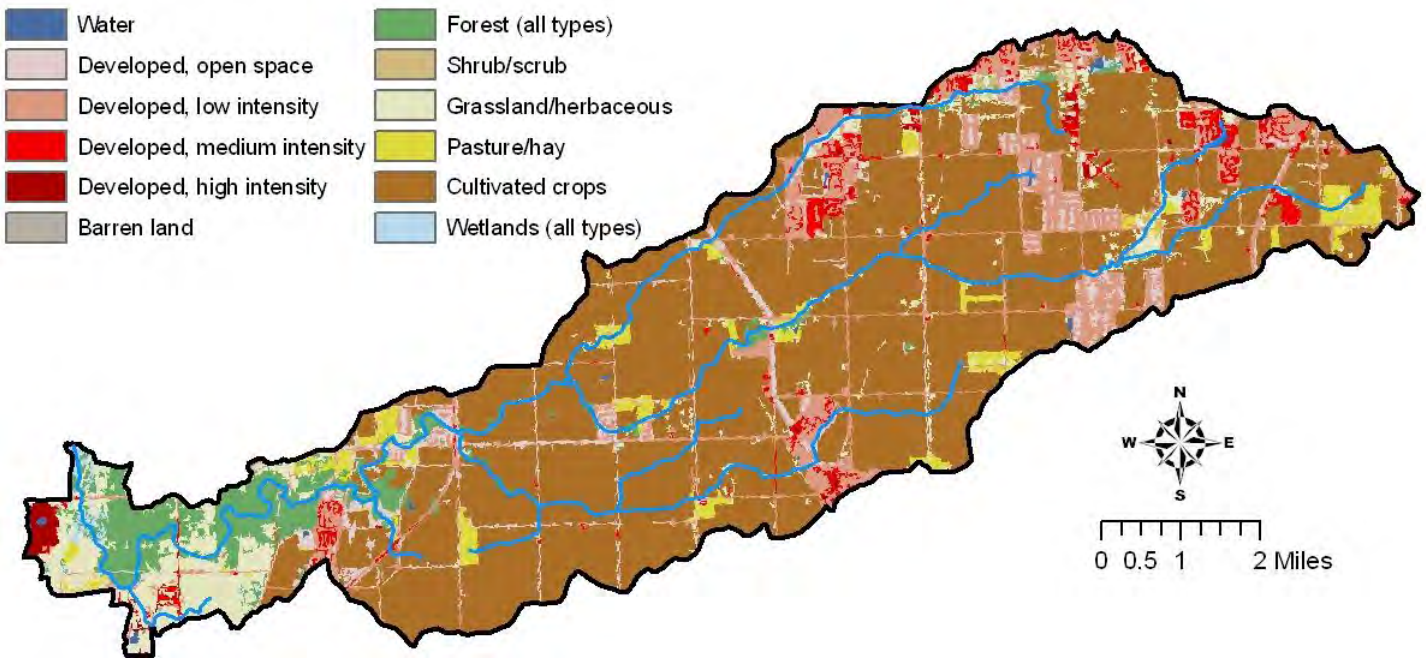


Figure 2-3. Slope

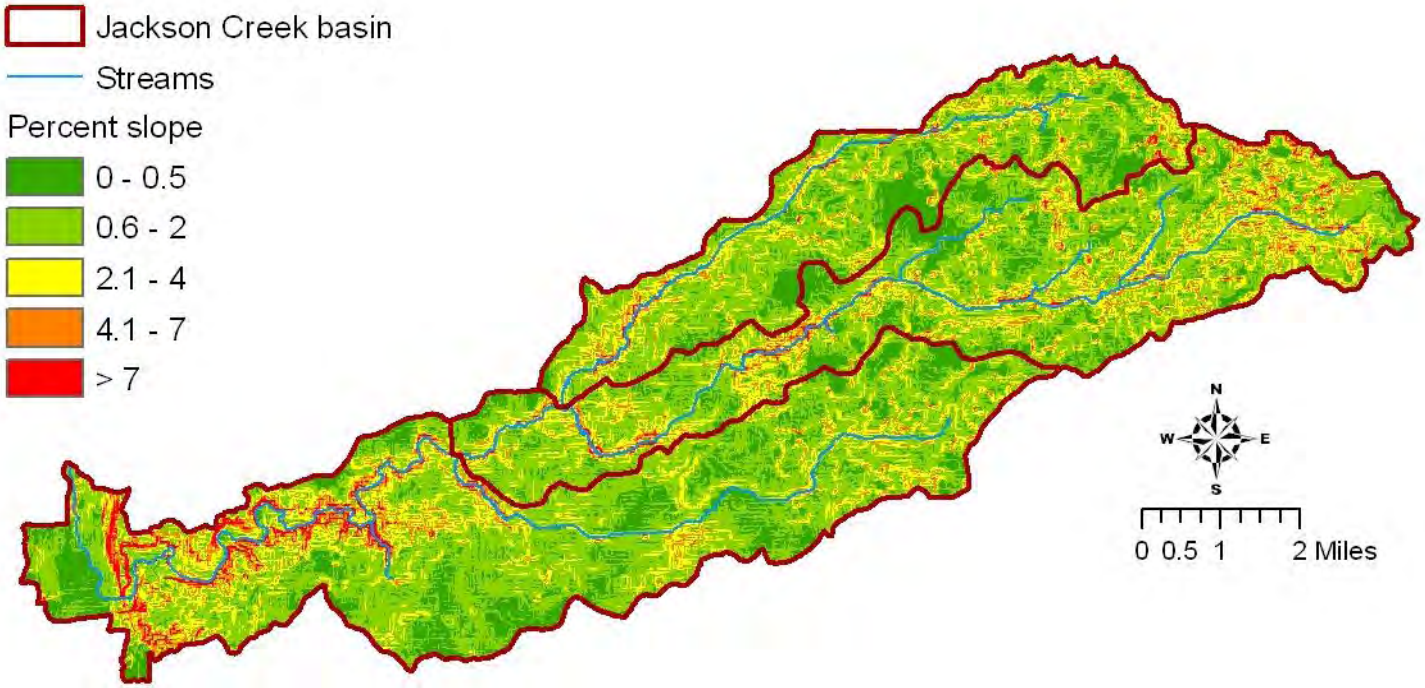


Figure 2-4. Soil Hydrologic Group

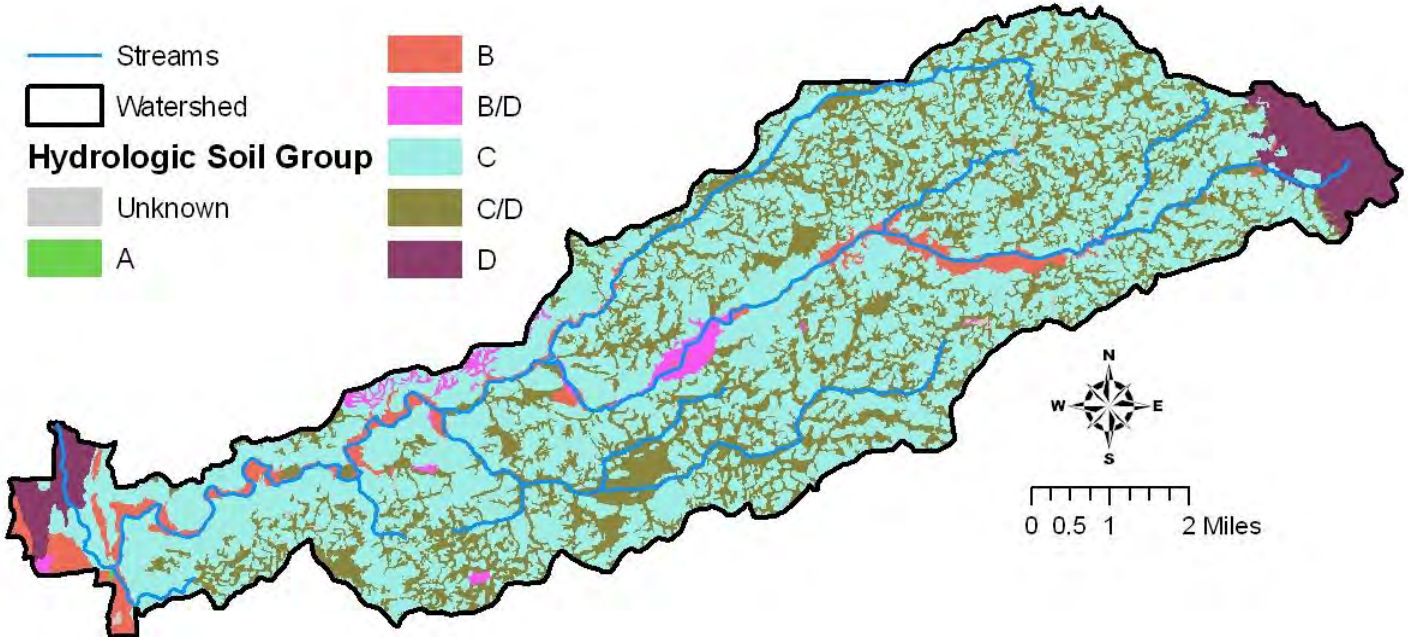


Figure 2-5. Erosion potential

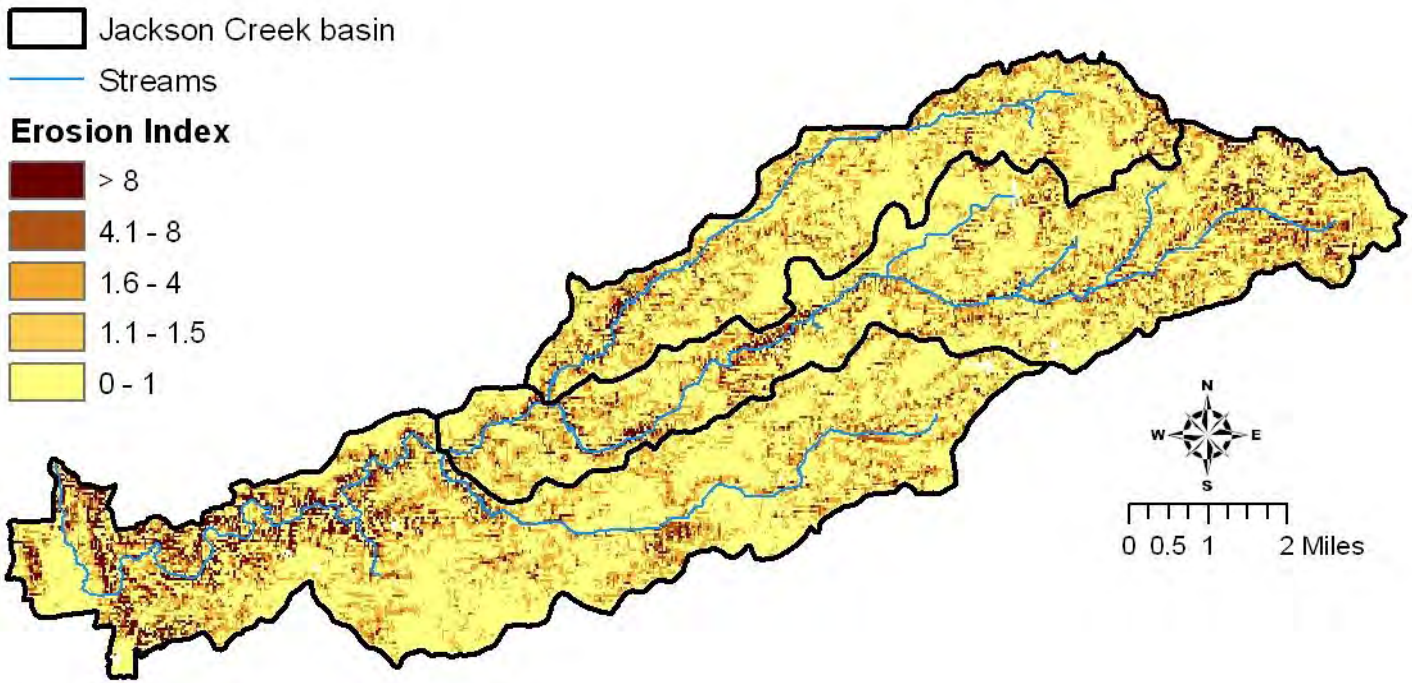


Figure 2-6. Hydric soils

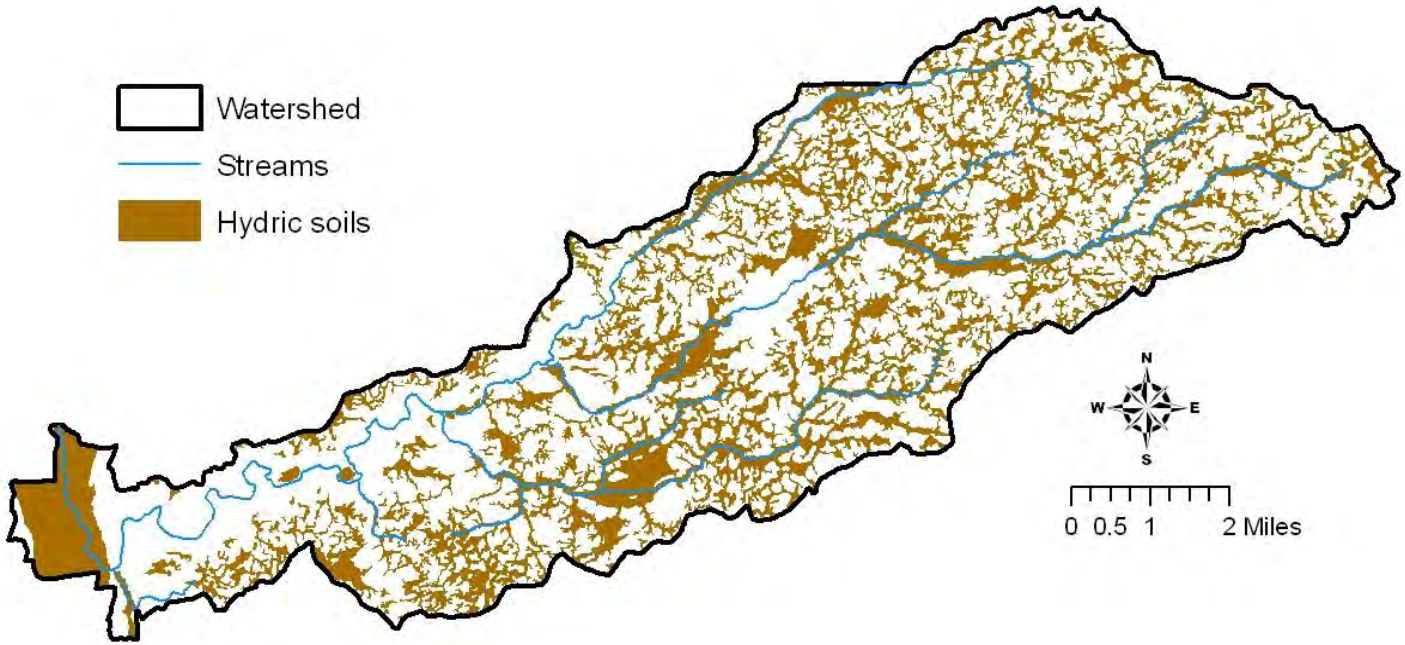


Figure 2-7. Wetlands and floodplain

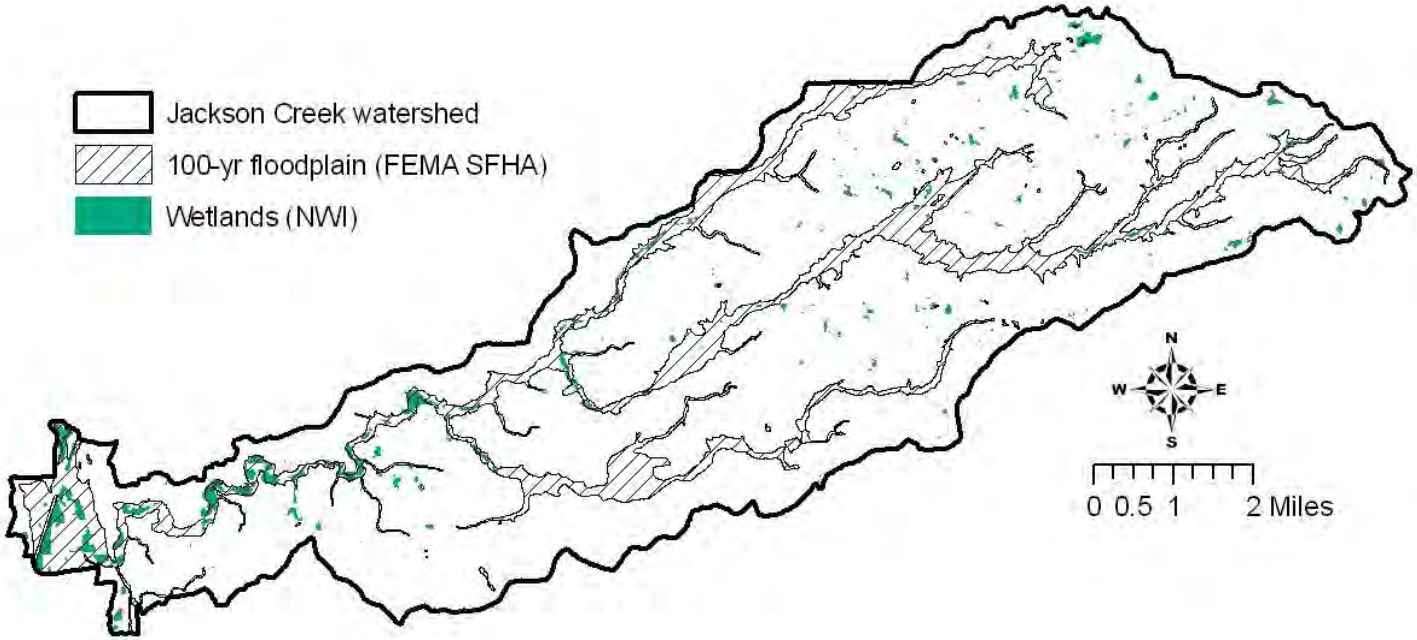


Figure 2-8. IEPA stream segments

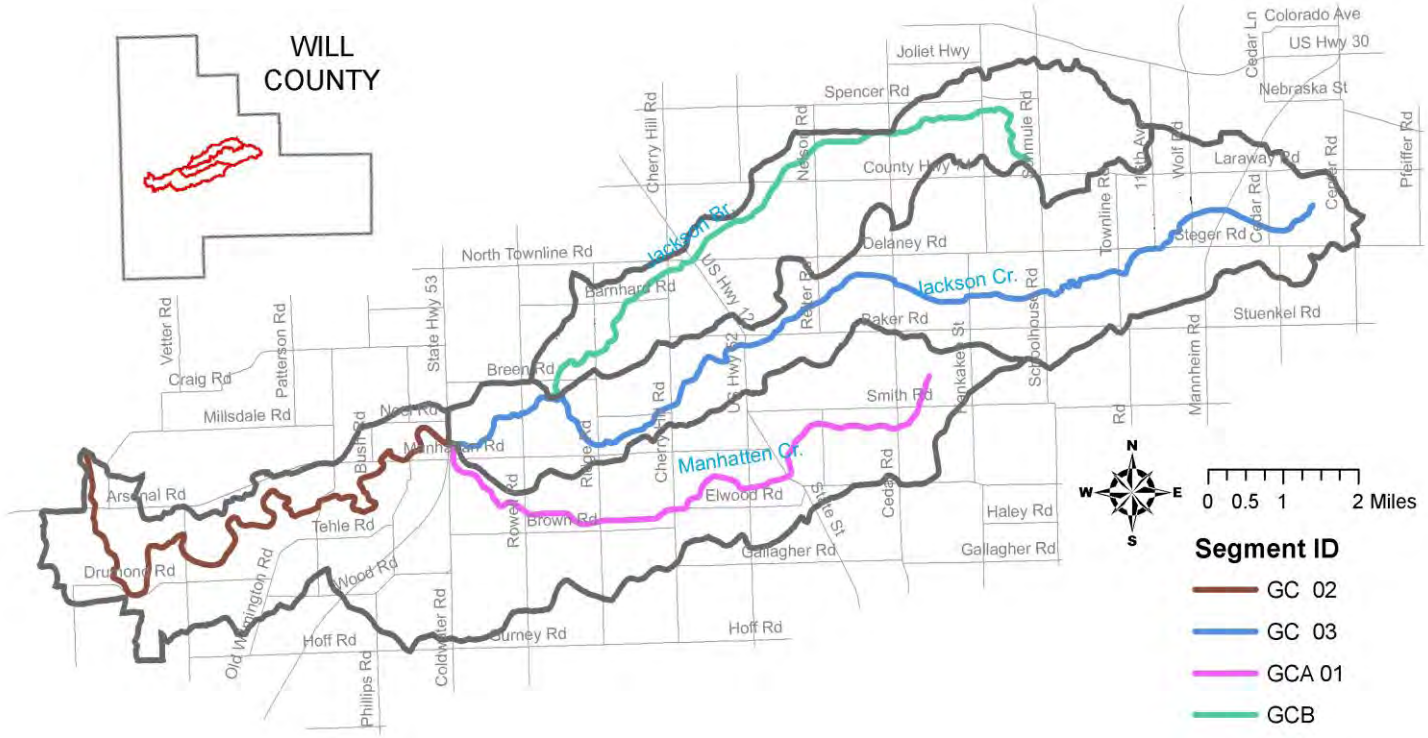


Figure 2-9. MBI sample sites and measurements

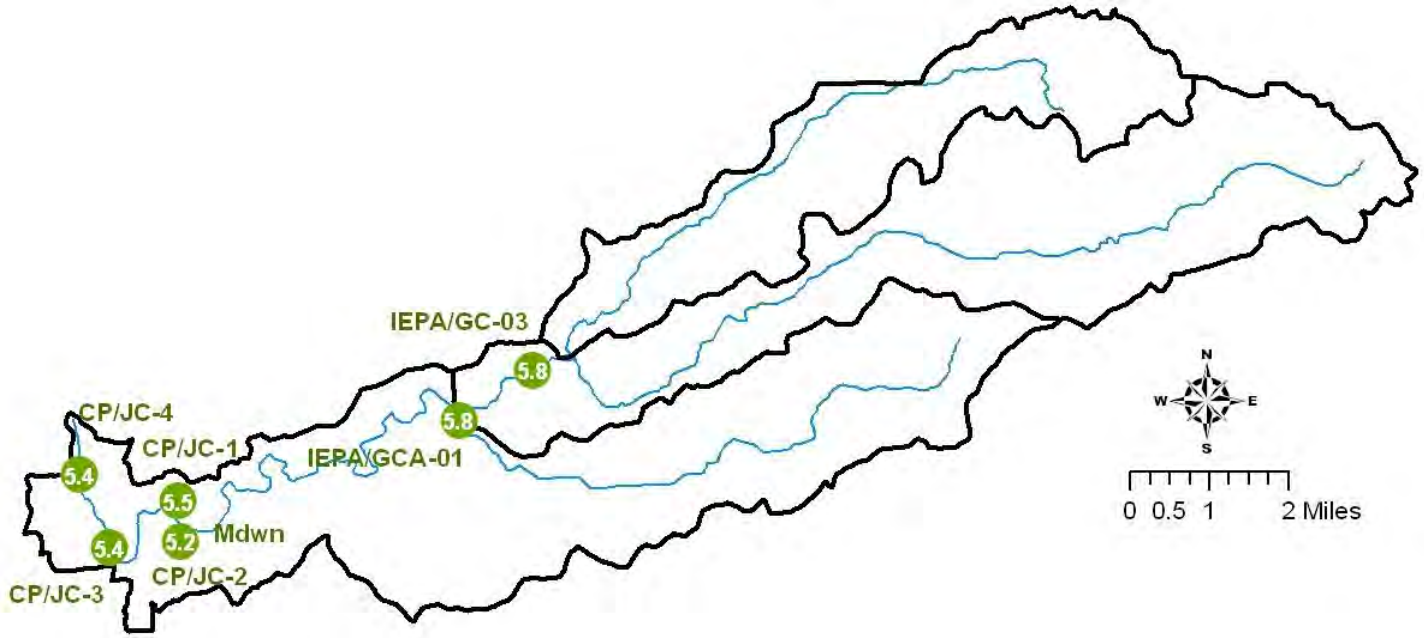


Figure 2-10. IBI sample sites and measurements

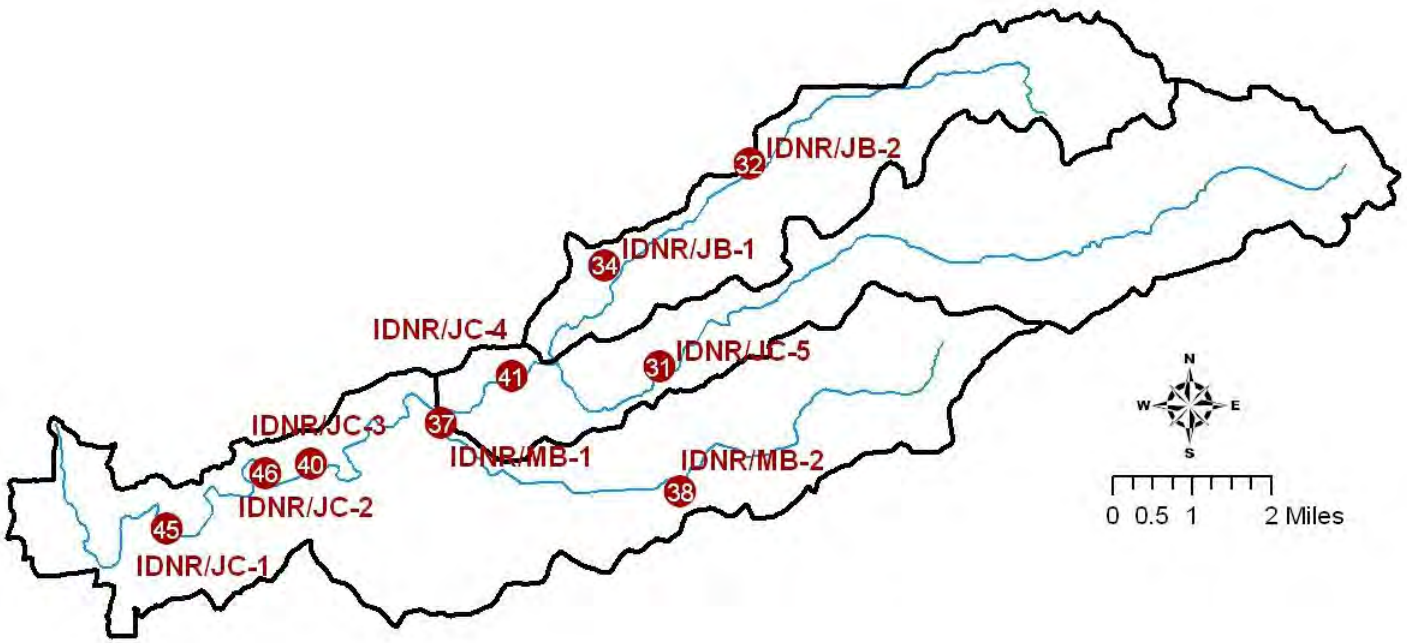


Figure 2-11. Wastewater treatment plant locations

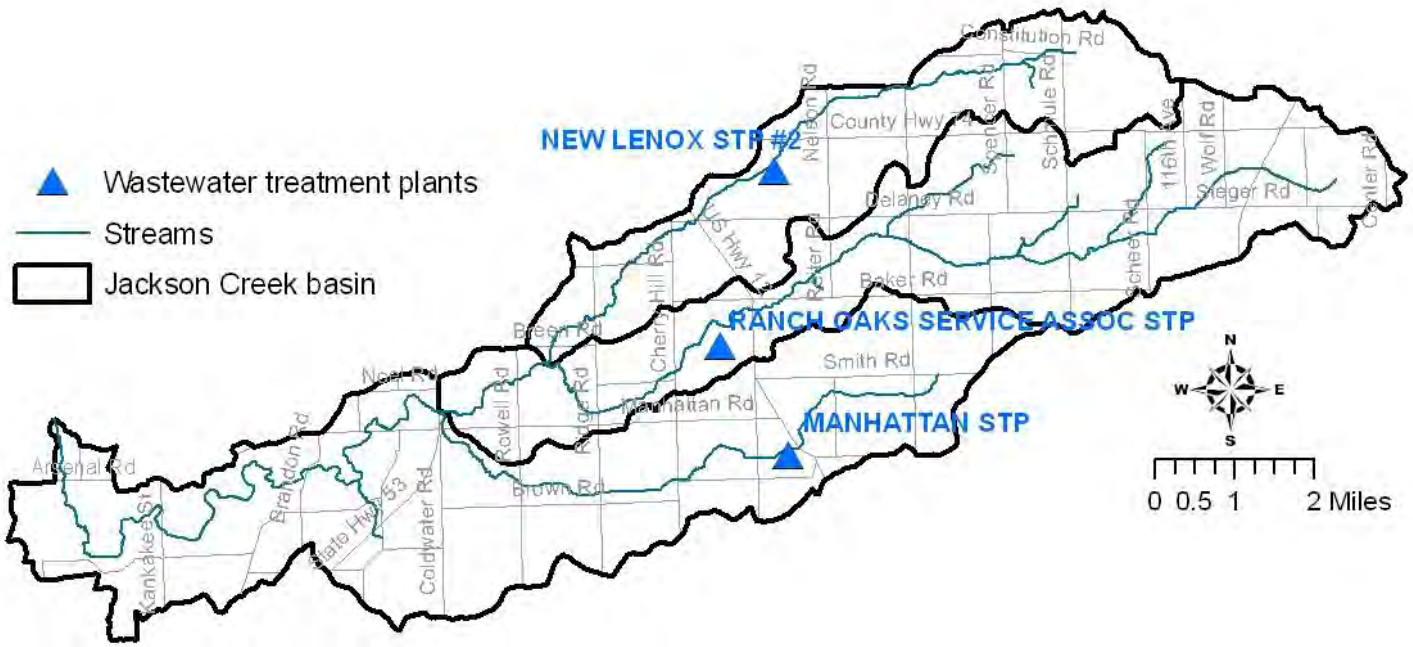


Figure 2-13. Estimated number of septic systems by subwatershed

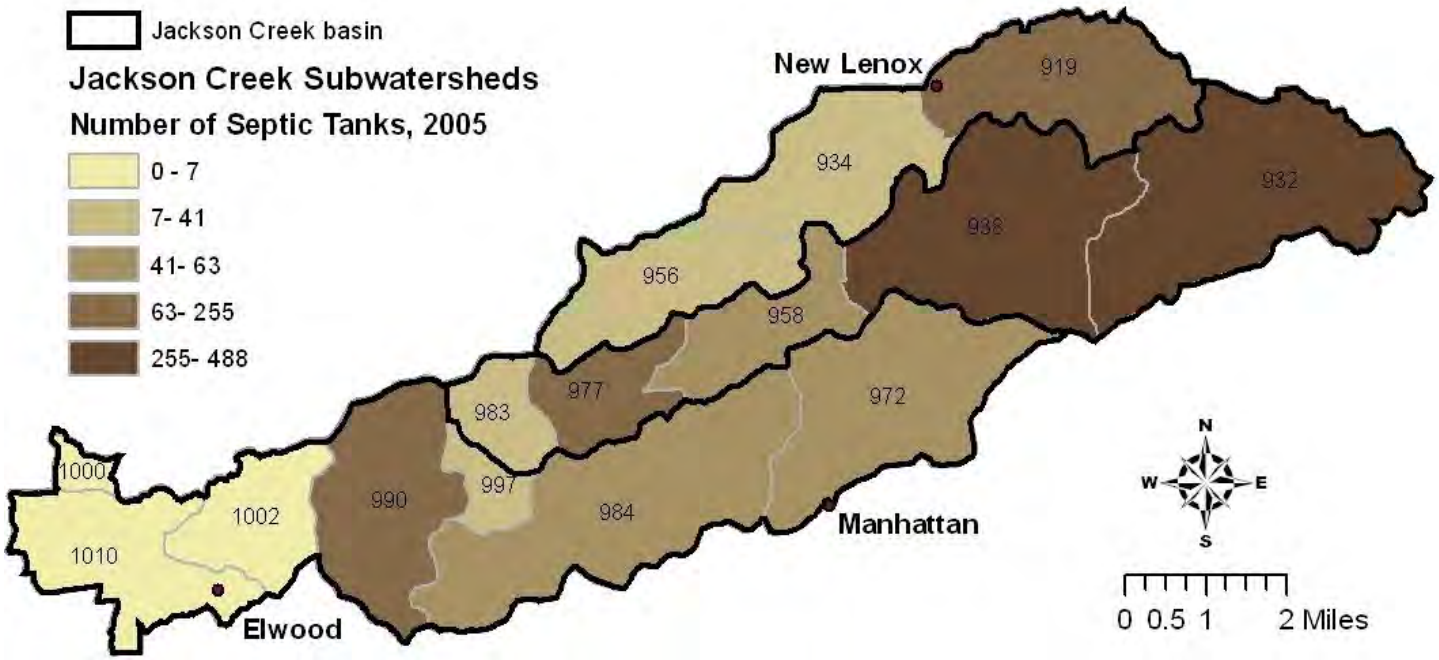


Figure 2-16. Soils in agricultural use expected to have tile drainage

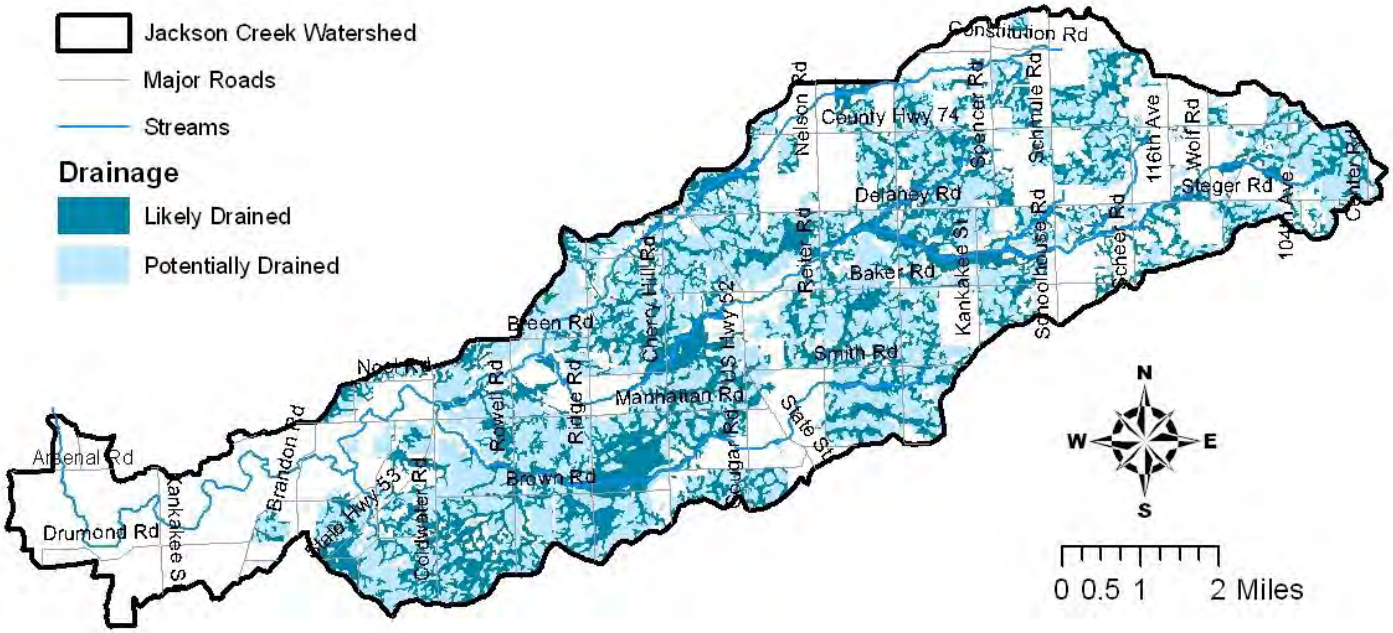


Figure 2-19. Facility planning area boundaries

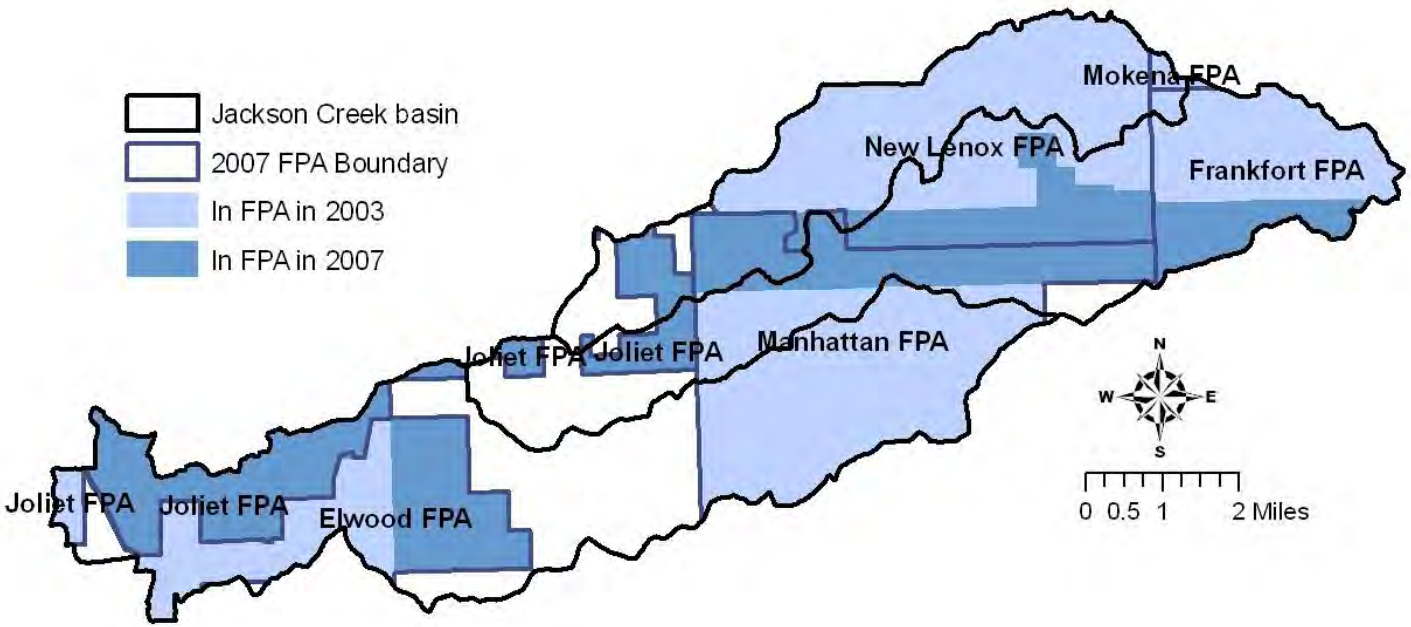


Figure 3-3. Locations for proposed projects.

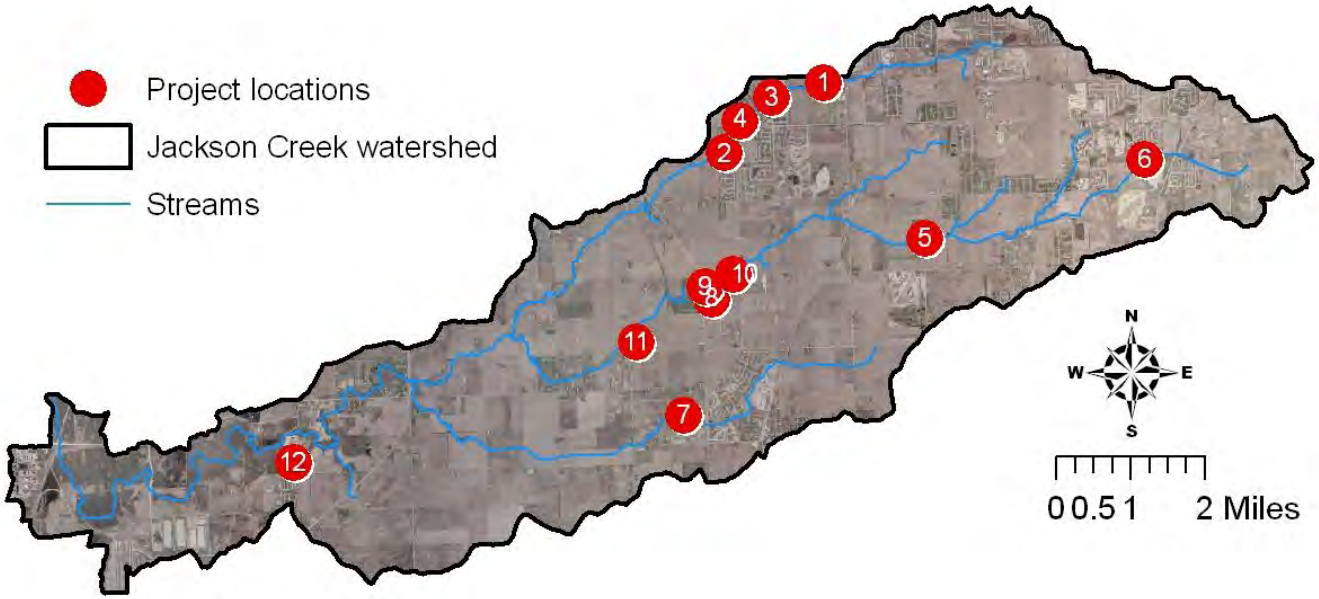


Figure 5-1. Potential wetland locations and treatment areas.

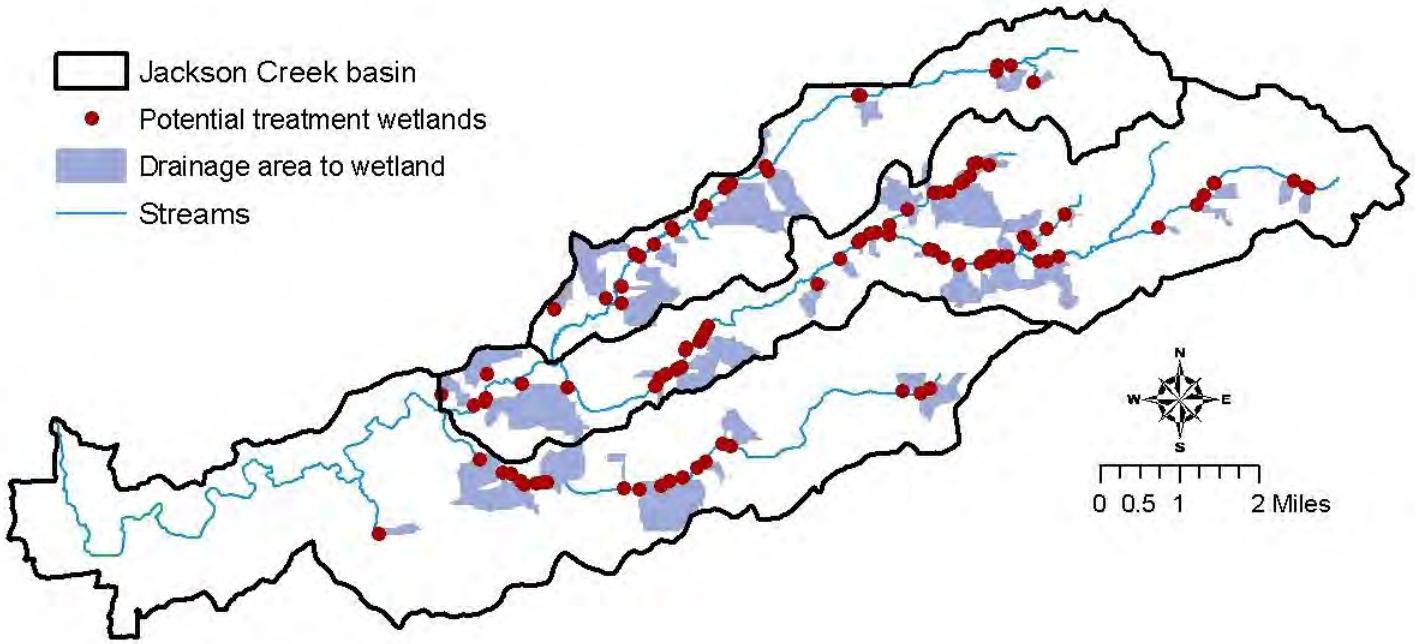


Figure 5-4. Potential locations for pilot controlled drainage projects

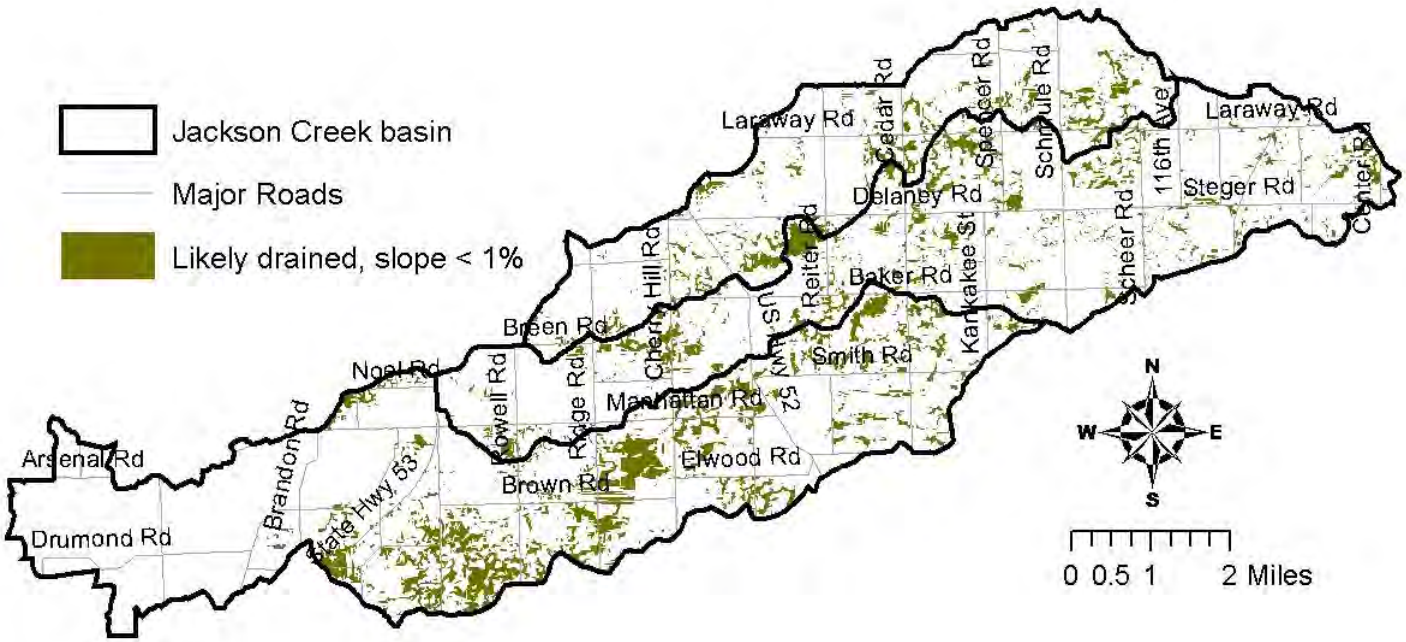


Figure 5-6. Erosion index values by tax parcel.

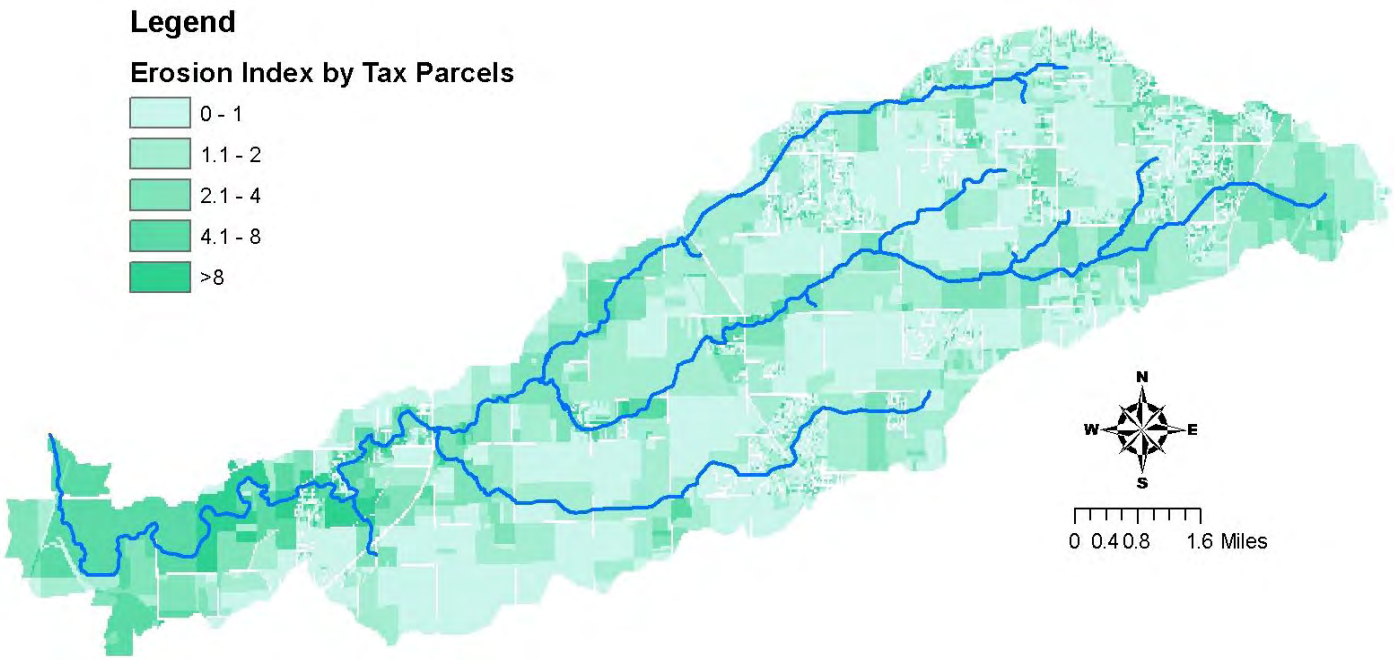


Figure 5-7. Agricultural areas lacking vegetated 100-ft buffer.

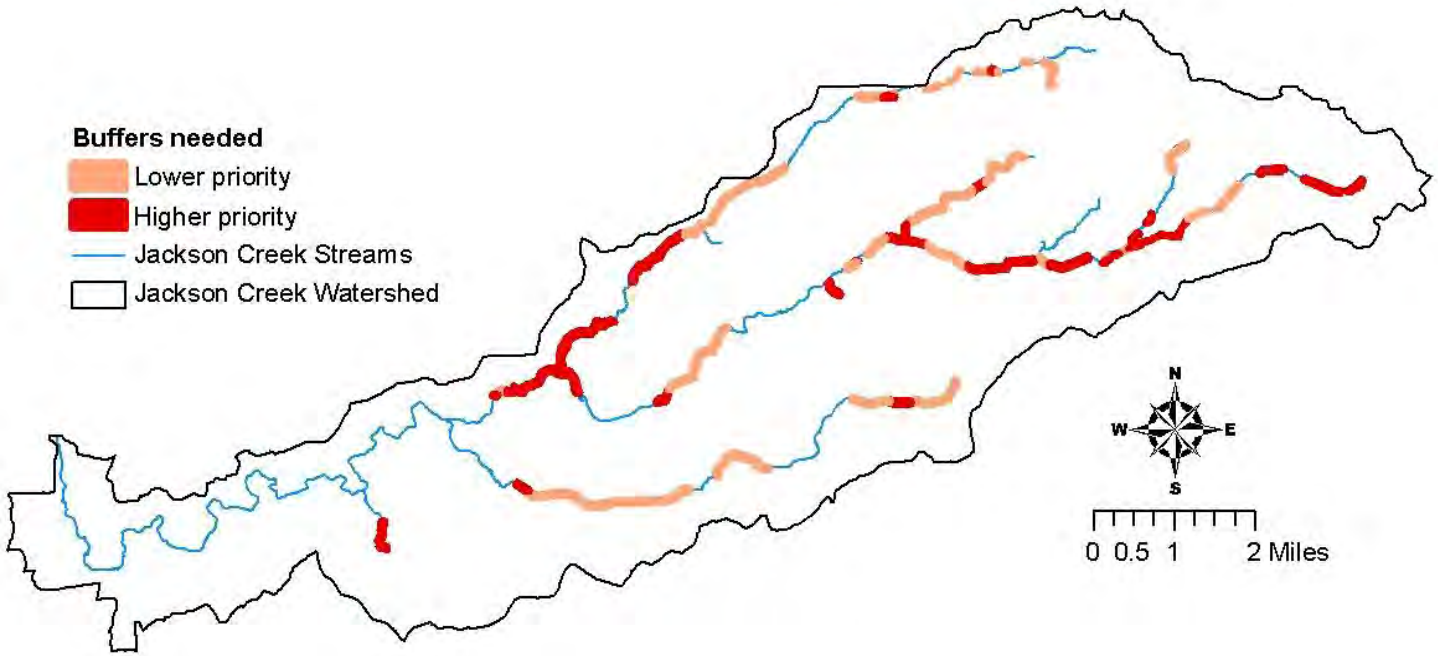
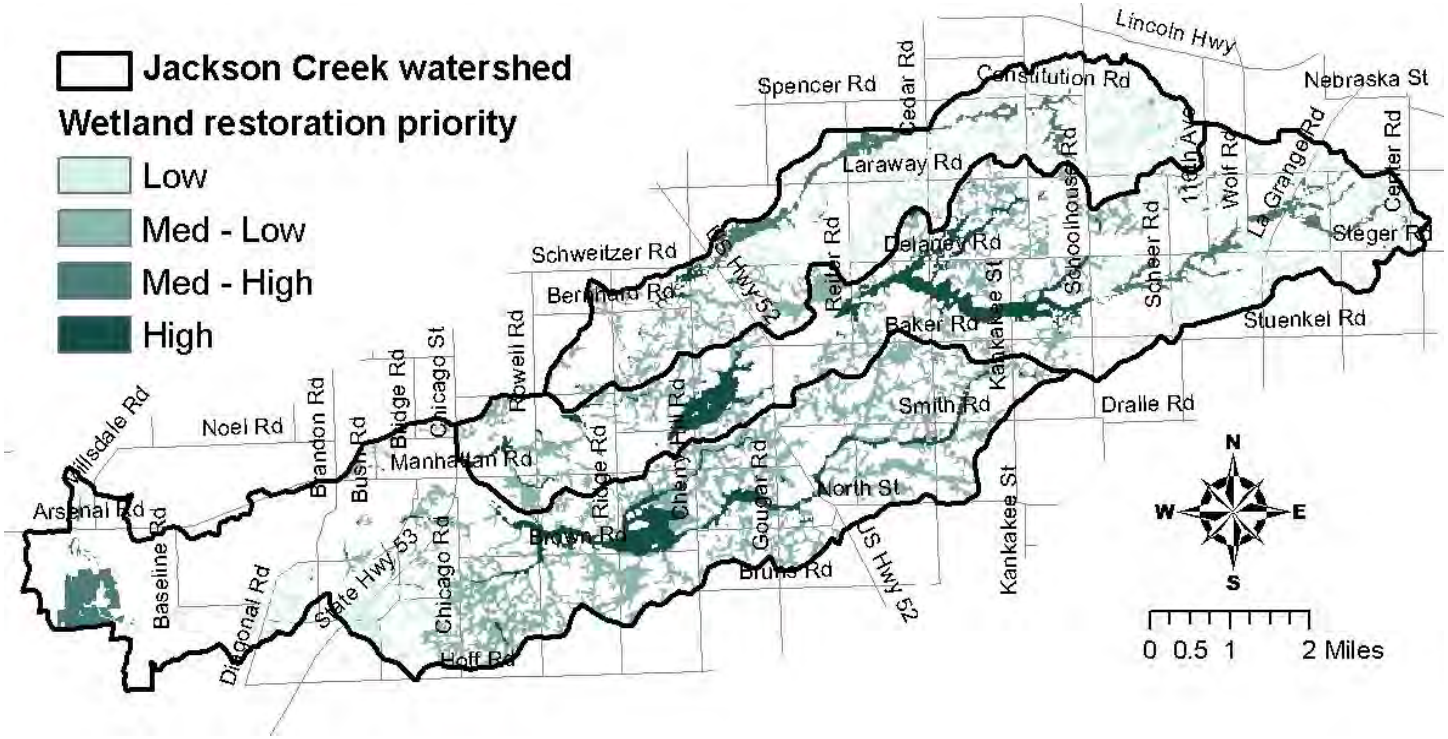


Figure 6-3. Relative wetland restoration priority



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