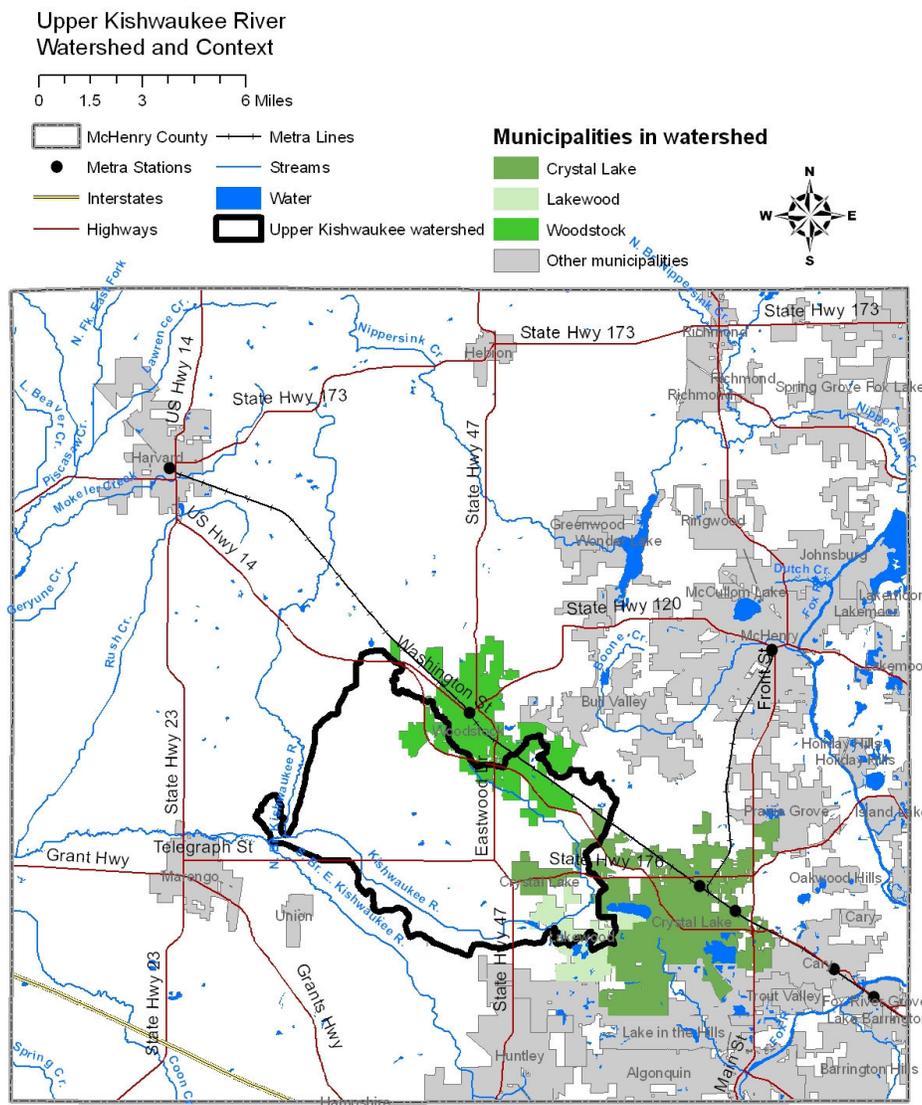


# UPPER KISHWAUKEE RIVER WATERSHED PLAN — EXECUTIVE SUMMARY

## Plan purpose

The Kishwaukee is perhaps best known for being one of the biologically richest river systems in Illinois. The river is also characterized by Illinois DNR as a *Biologically Significant Stream* from the Pleasant Valley Conservation Area all the way to the Rock River. Yet Illinois EPA has identified problems in the Upper Kishwaukee River, upstream from approximately McCue and Pleasant Valley Roads. Scores on a measure of fish community health are lower than desirable. Also, nutrient levels are high, sedimentation has occurred along the river, and vegetation and habitat along the river is of poor quality or lacking in some places. These are all *potential causes of impairment*, or likely reasons for the decline in biological conditions.

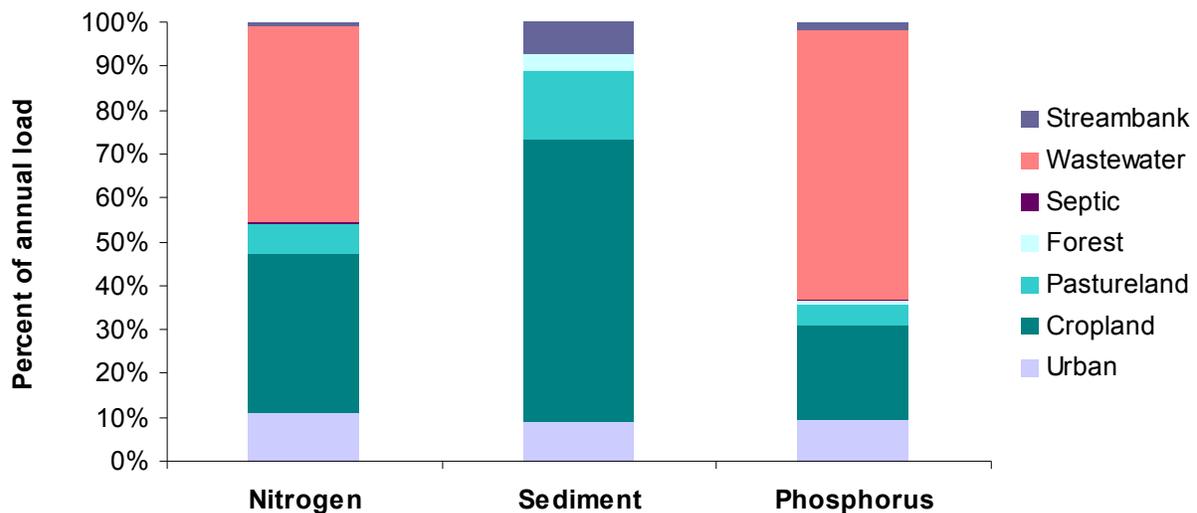


This plan has two main goals: first, to restore a healthy aquatic community in the Upper Kishwaukee River, and second to ensure the river remains a vital resource to the neighborhoods surrounding it. Since the Upper Kishwaukee is considered impaired, the first objective is to develop a strategy to address the existing impairment. Both *point* sources (wastewater treatment plants) and *nonpoint* sources (for example, sediment running off of cropland or phosphorus from a fertilized lawn) are taken into account. The second objective is to project conditions given expected land use change and loading from wastewater treatment plants and to offer recommendations to control the effects of that change. These recommendations include new policies as well as physical projects, such as stream habitat restoration or stormwater best management practices.

Finally, this plan is being treated as a pilot effort to utilize the framework developed by the Basinwide Management Advisory Group (B-MAG), a collection of stakeholders who came together in 2003 to help Illinois EPA devise an alternative to the Facility Planning Area review process. More information can be found at <http://www.epa.state.il.us/water/watershed/facility-planning/>. The major interest of the B-MAG framework is that Illinois EPA is expected to make permitting and financial assistance consistent with the plan, pending adoption by local governments and a public comment period.

**Pollutant sources**

A simplified model of the watershed was used to estimate the amount and source of nutrients and sediment entering the Upper Kishwaukee. The results of this analysis suggest that agriculture (cropland and pastureland) contributes 43 percent of the nitrogen load, while wastewater contributes 45 percent and urban runoff contributes most of the remainder. The two wastewater treatment plants add a significant amount of nitrogen in the course of releasing effluent to the stream from wastewater service to residents both within and outside the watershed. Septic systems appear to play a very minor role. The majority of total phosphorus loading, however, originates from the wastewater treatment plants, while cropland contributes much of the remainder. The sediment load is mainly agricultural in origin.



**Pollutant reductions needed**

Based on targets recommended by USEPA, it was estimated that annual nitrogen and phosphorus loading needs to be reduced by 36 percent and 73 percent, respectively. By adapting a relationship

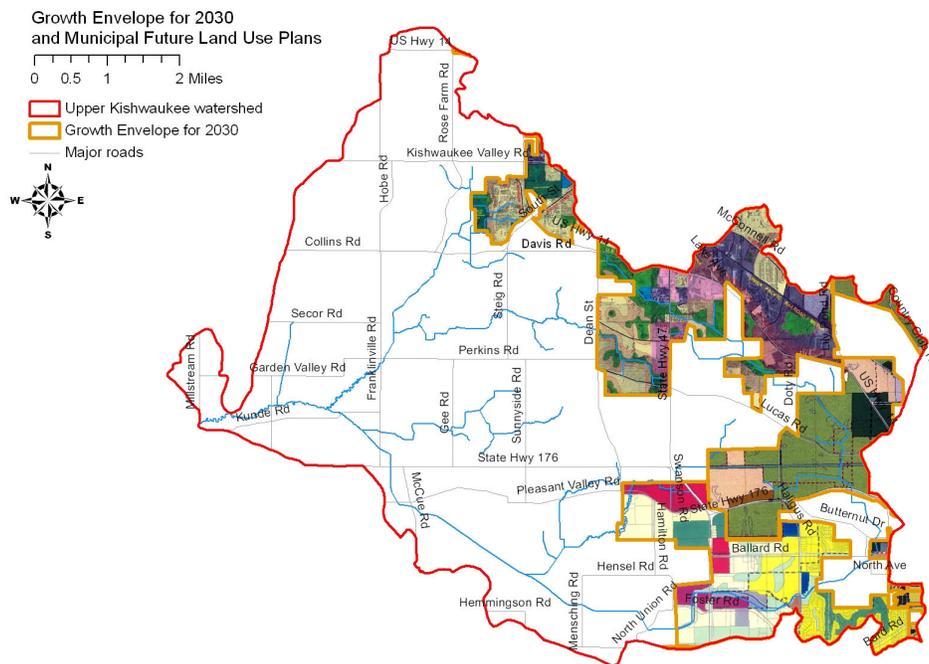
between an indicator of biological conditions (the Fish Index of Biological Integrity) and stream bed conditions, it was estimated that sedimentation needs to be reduced by 56 percent on an annual basis.

	Total Nitrogen	Total Phosphorus	Sediment
Percent reduction	-36%	-73%	-56%
Load reduction	76,088 lbs/y	26,191 lbs/y	2,785 t/y

While nutrients and sediment are important, watershed stakeholders and professional judgment suggest that historic channelization also impairs aquatic life. It has been quite extensive. Straightening, deepening, and cleaning out channels has drastically simplified the aquatic environment and removed habitat features. It is thought that biological conditions will not improve substantially by reducing nutrient and sediment inputs alone. Direct habitat and hydrological improvements to the stream need to be made to accomplish this.

**Expected changes in water quality**

In the Upper Kishwaukee, chemical water quality can be considered a function of direct discharges into the stream and of runoff, which in turn depends heavily on land use, although natural conditions play a role. Future land use in the watershed was estimated based on the implementation of the future land use maps in the municipal comprehensive plans. Future wastewater inputs were estimated by assuming the plants would achieve their design capacity near the year 2030. The results suggest that nutrient and sediment loading from nonpoint sources would *decrease* in the future. This is because cropland, the runoff from which generally contains higher nutrient concentrations, is projected to be converted to urban uses. In the near term, nutrient loading from point sources is also expected to decrease if Woodstock installs phosphorus and nitrogen removal technologies at its South plant when the plant is expanded. Over time, however, wastewater flow from the Lakewood and Woodstock plants is expected to triple from growth in population and employment, which would also increase nutrient loading even with nutrient removal technologies in place. In sum, estimated future loading would still be over the target. The projects and policy changes recommended to combat this are described in the sections below.



A number of other effects can be predicted from the expected land use change and wastewater flow increase. First, bacterial contamination may increase because of urbanization, which brings with it increased numbers of dogs and other pets, larger populations of geese attracted by manicured lawns and wet detention ponds, and other potential sources of fecal contamination. Wastewater would not be implicated because of permit limits that control bacteria. Increases in bacterial contamination could threaten the “primary contact” use of the stream, that is, a use in which there is prolonged contact with the water involving risk of ingesting water in significant quantities, such as swimming and wading. Certain heavy metals, as well as chloride from road salt, may also increase due to urban runoff. Finally, increased wastewater flow may bring with it more “emerging contaminants,” a general class of currently unregulated compounds such as pharmaceuticals.

### Policy recommendations

The two most important areas of policy recommendations in the plan are the *Vision of Land Use* and the *Vision for Wastewater Treatment*.

#### *Vision for Land Use*

1. As part of its *Vision for Land Use*, the plan recommends that all new planned developments in the watershed be conservation developments. This recommendation is in keeping with both municipal comprehensive plans and the current trend of development in the watershed. The main principles of conservation design are: (a) flexibility in site design and lot size, (b) thoughtful protection and management of natural areas, (c) reduction of impervious surface areas, and (d) sustainable stormwater management. Conservation design as such is also density neutral. The municipalities would work with developers submitting applications for planned developments to ensure that site design is in keeping with conservation design principles. The county would ensure that its *Conservation Design Standards and Procedures* addendum to the Subdivision Code is applied for maximum benefit.
2. As a more specific goal to limit imperviousness, it is recommended that local governments aim to prevent effective imperviousness from exceeding 10 percent in any subwatershed. *Effective* impervious area includes only impervious area directly connected to the drainage system. For example, a rooftop draining to the yard would not be considered effective impervious area, whereas a driveway running into a storm drain in the street would. Regulating effective impervious area, rather than total impervious area, is expected to be more protective of stream conditions as well as to allow more intense use of land.
  - a. The stormwater permit submittal requirements for the county and municipalities should be modified to also include a statement of how much effective impervious area is proposed. Each local government should formally track the amount of effective impervious area created in each subwatershed over time and compare it against baseline total imperviousness.
  - b. Reduce hard surfaces in developments by allowing narrower streets, shorter setbacks, etc. While subdivision standards like this become negotiable during planned development, a review of these standards helps improve the baseline from which negotiation proceeds. During the planned development process, local governments should strive to point out ways to developers that they can reduce imperviousness. This

- is already part of the volume reduction hierarchy in the MCSMO and in the municipalities' ordinances; this plan's recommendation is simply to emphasize impervious surface more in the development approval process. Neither the countywide nor municipal stormwater ordinances have specific performance standards for volume reduction. This plan recommends that local governments consider establishing volume reduction standards.
- c. Require or encourage the use of infiltration practices. The area of the watershed in which growth is foreseen has relatively permeable soils (Figure 4-6) that should be able to support such practices, although they are not as permeable as in the Crystal Lake watershed to the east.
  - d. A planning strategy can be pursued to encourage more development in subwatersheds where the imperviousness cutoff has already been significantly exceeded and discourage it elsewhere.
  - e. Existing impervious area can be reduced by helping property owners disconnect impervious surfaces, e.g., redirecting roof leaders to grassy areas. Local governments may wish to begin a program to contact property owners and offer assistance to those interested in reducing runoff from their properties.
3. As part of the *Vision for Land Use*, the plan also recommends preservation and restoration of natural areas. This is broken down into (a) creation of vegetated stream buffers where they are now inadequate, (b) legal protection of important natural areas, (c) minimizing the loss of forest in the watershed, (d) reconstruction of streamside wetlands, and (e) stream restoration and instream habitat improvement.

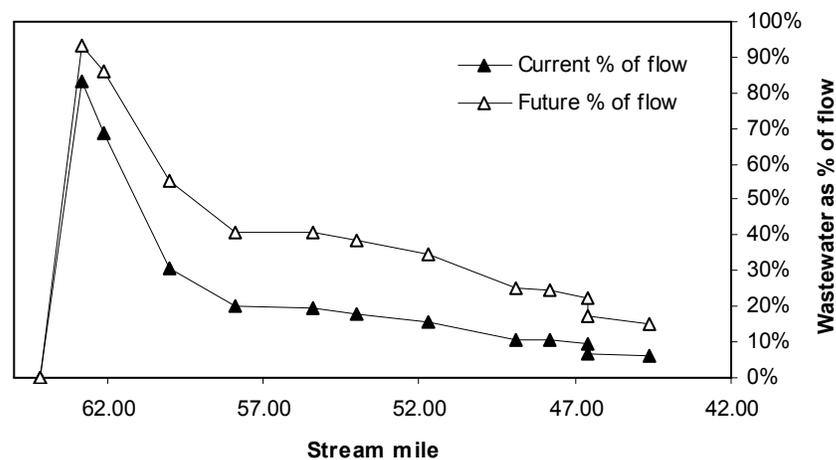
To provide the "skeleton" of an open space network along the streams, the vision of this plan is that the stream should be buffered by at least 100 feet with native vegetation. In agricultural areas, this should be accomplished by planting filter strips on cropland. In developing areas, the vision should be accomplished by buffer establishment during development. This plan interprets the McHenry County Stormwater Management Ordinance (MCSMO) as requiring 100-foot buffers along both the main stem and tributaries. Thus the municipalities and the county processing stormwater permits at the time of development under the MCSMO should require at least 100-foot buffers. Buffer composition should be determined based on inferred pre-settlement vegetation conditions. As mentioned previously, Illinois EPA identified poor quality buffers ("alteration of streamside and littoral vegetative covers") as one potential cause of impairment in the stream. Requiring 100-foot buffers during development is expected to provide 15 percent of the new buffer needed to achieve full buffer coverage for the entire stream network in the watershed.

#### *Vision of Wastewater*

Treatment practices at the two wastewater treatment plants are expected to contribute to major improvements in nutrient loading in the Upper Kishwaukee. The Lakewood plant has installed phosphorus and nitrogen removal technologies, and the Woodstock plant is expected to do the same when it expands. Implementing these controls at the Woodstock plant would provide 91 and 73 percent of the needed nitrogen and phosphorus reduction, respectively. Considering only the potential causes of impairment identified by Illinois EPA, the Woodstock expansion should be considered acceptable and eligible for financing from the state. Specific nitrogen effluent limits in the NPDES permits for either the Woodstock or Lakewood plants are not recommended because of uncertainty in the loading analysis and

the performance of the nitrogen removal technology. On the other hand, wastewater treatment is expected to be the major contributor to *increases* in nutrient loading over time since land use change is expected to decrease contributions from nonpoint sources. The *Vision for Wastewater* of this plan has three major components:

1. Woodstock and Lakewood together presently add about 1.48 million gallons per day (2.3 cubic feet per second, or cfs) to the Upper Kishwaukee. Discharging at the future design average flow would increase this to about 6.9 cfs, while peak flows could be much higher. Because this increase will exacerbate effluent dominance in the stream, it is recommended that the municipalities try to reduce discharge by undertaking indoor water conservation programs, partial wastewater reuse, and infiltration and inflow (I&I) control programs. Lakewood and Woodstock have been successful with wastewater reuse and I&I control, but indoor water conservation represents an important opportunity.



2. Decentralized treatment with land application (i.e., no-discharge systems) should be seen as an important and beneficial option for new systems. The McHenry County Conservation District could be a partner in such a project, helping underwrite the most significant cost of land application, the land itself.
3. Any additional increase in wastewater discharge will tend to make it more difficult to reach the nutrient target loads. If a no-discharge system is not pursued, it is recommended that Illinois EPA require any new discharge – not an expansion of an existing plant – containing nitrogen or phosphorus to fully offset its loading. This could be done through a trading system that would offset increases in nutrient loading by requiring dischargers to fund nonpoint source projects aimed at nutrient removal, such as agricultural BMPs or wetland reconstruction. An antidegradation assessment that finds no impact from a proposed new discharge should not be considered a sufficient condition for an NPDES permit if nutrient loading to the Upper Kishwaukee would still increase as a result of the discharge.

*Additional recommendations*

Four additional policies are recommended. Total phosphorus appears to be the pollutant for which it is most difficult to achieve target levels. With this in mind it would be appropriate for municipalities and the county to regulate phosphorus content in fertilizer. Second, public works departments should investigate ways of reducing their usage of road salt to help prevent an increase in chloride in the Upper

Kishwaukee. This could include improved storage and handling practices for road salt, use of pre-wetting or other salt application management techniques, or the use of alternative deicing compounds. Third, various approaches to limiting fecal coliform contamination should be pursued. For instance, detention basins should be ringed with a tall vegetative fringe to discourage geese from using them, while pet waste ordinances should be strictly enforced. Finally, stakeholders noted that construction site runoff continues to be a significant source of sediment in some cases. It is recommended that the municipalities each engage with the Soil and Water Conservation District (SWCD) and the developer of at least one new conservation design subdivision to produce a minimal-erosion development as a model. This model, contingent on SWCD resources, would involve enhanced education for the contractors as well as upfront technical assistance from the SWCD to ensure that soil erosion and sediment control measures are properly designed and installed.

### Project recommendations

Three types of projects were investigated for the plan: agricultural best management practices (BMPs), retrofits of urban stormwater infrastructure, and stream habitat restoration. While a number of potential urban infrastructure projects were identified, they appear to be costly while providing limited benefits. They should not be seen as a high priority or as an obligation of the municipalities. There are much more significant opportunities on agricultural land, including such practices as reduced tillage, filter strip installation, nutrient management, and wetland construction / restoration. Implementation of agricultural BMPs would be facilitated by the hiring of a coordinator who would work with farmers to encourage implementation in the Kishwaukee basin. The stream habitat restoration project recommendations vary, but they tend to focus on wetland restoration, projects to create more diverse flow and channel conditions in the stream, removal of invasive species, and addition of woody debris and streamside plantings. More detail on each of these projects can be found in the technical report accompanying this executive summary.

### Effectiveness and cost of recommendations

#### *Current pollutant loading*

Costs were estimated for all of the projects. Only the recommendations for policy changes, agricultural BMP implementation, and urban stormwater infrastructure retrofits have pollutant load reductions associated with them. It is assumed that the Woodstock expansion will occur soon and will include nutrient removal, providing the lion's share of the current nutrient load reduction needed. A summary of the potential means of reducing the remaining nutrient and sediment load is shown in the table below. It can be seen that the policies and projects identified would not result in meeting the phosphorus and sediment targets. Given the uncertainties in the estimates and the large effect of nutrient removal from wastewater, however, the reductions are reasonably close to the targets.

	<b>Nitrogen</b>	<b>Phosphorus</b>	<b>Sediment</b>
<b>Agricultural BMPs</b>			
Agricultural target	5,040	4,895	1,687
Reduction from identified opportunities	17,930	2,460	516
Additional reduction needed	(12,890)	2,435	1,171
<b>Urban BMPs</b>			
Urban target	1,532	2,081	1,098
Reduction from identified opportunities	2,122	689	82
Phosphorus ban	—	413	—
Wastewater reuse (@ 10% current flow reused)	1,960	217	—

BMP retrofit projects	162	59	82
Additional reduction needed	(590)	1,392	1,016

The estimated total capital costs of the projects are provided in the table below. The projects would be funded through state and federal grants, the cost-share programs of the U.S. Department of Agriculture, and local resources. The urban BMP retrofit projects, again, are not considered a high priority because of their high costs and limited benefits.

Project type	Estimated capital cost
Urban BMPs	\$970,000
Agricultural BMPs	\$76,500
Stream habitat restoration	~\$1,400,000

### *Future pollutant loading*

As discussed above, future wastewater flow is expected to keep nutrient loading above the targets even with nutrient removal and the decrease in agricultural land in the watershed. The table below shows the recommended means of reducing future loading. The most important project is one that is already in the pipeline, the MCCD's restoration of a large flowing marsh in Pleasant Valley Conservation Area. A number of other large wetland restoration projects are possible as well, and these should be pursued both for their nutrient removal and hydrologic benefits.

	Nitrogen	Phosphorus	Sediment
Total reduction from <i>target</i> needed	41,495	10,787	1,349
Reduction from identified opportunities	70,123	9,715	245
Infiltration practices in new development	5,534	587	245
Phosphorus ban (residential)		218	
Wastewater reuse	2,927	325	
Water conservation	5,855	649	
Wetland restoration	42,917	7,936	
Ag BMPs overage	12,890		
Additional reduction needed	(28,628)	1,072	1,104

### Timeline

A five-year schedule for plan implementation was developed that assumes the plan will be updated in five years, as recommended in the B-MAG framework.

Year	Action	Party	Section
2008	Conduct study to determine extent to which nutrient removal should be part of Pleasant Valley marsh restoration design	MCCD	4.1.5.1
	Approval of Woodstock South expansion*	Woodstock/IEPA	—
	Begin monitoring nitrogen in wastewater	WWTPs	6.1.2
2009	Submit applications for funding for agricultural BMP coordinator	KREP/SWCDs	5.1.5
	Begin physical-chemical monitoring program	IEPA/ISWS	6.1.1
	Implement phosphorus ban in Kishwaukee basin	Municipalities/county	5.2.2
	Submit applications for priority 1 & 2 restoration practices	Landowner/KREP	5.3
	Establish Wetland Reconstruction Fund	Municipalities/county	4.4
2010	Agricultural conservation coordinator hired and begins work	KREP/SWCDs	
	Hold site planning roundtable to review ordinances for water quality effects and recommend amendments	Municipalities/county	2.3.1.2

Year	Action	Party	Section
	Expanded Woodstock South plant begins operation*	Woodstock	—
	Submit applications for priority 3 & 4 restoration practice	Landowner/KREP	5.3
	Model development projects undertaken	Municipalities/county	4.2.2
	Begin biological monitoring program	MCCD	6.1.3
2011	Model development projects undertaken (con't)	Municipalities/county	4.2.2
	Submit applications for priority 5 & 6 restoration practice	Landowner/KREP	5.3
2012	Begin water quality model calibration and validation	ISWS	6.1.1
	Submit applications for priority 6 & 7 restoration practice	Landowner/KREP	5.3
	Completion of Pleasant Valley marsh restoration*	MCCD	4.1
2013	Begin plan update	IEPA/KREP/CMAP	—

### Additional information needs

1. The data available for the Upper Kishwaukee are inadequate to calculate watershed loading or water quality response with acceptable accuracy. Because of this the loads and targets described above should be considered provisional. It is recommended that Illinois EPA 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, total phosphorus, and total suspended solids should be collected with optimal spatial resolution. Second, a water quality model (for example, 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. In-place measurements of temperature, pH, and dissolved oxygen should also be taken for use in modeling. Third, the study should determine monthly and annual loads of total nitrogen, total phosphorus, and total suspended solids 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. Fourth, flow measurements are also needed from a stream gaging station. The cost of monitoring was developed for three watersheds. The cost for the Upper Kishwaukee would be roughly \$165,000 assuming no economy of scale.
2. It is recommended that Illinois EPA require the Lakewood and Woodstock plants to monitor total nitrogen and report effluent concentrations in their Discharge Monitoring Reports.
3. Since the ultimate measure of the plan's success is the Fish Index of Biotic Integrity (IBI), it must be determined whether IBI scores are improving or not. It is recommended that Illinois EPA provide funding for MCCD staff to undertake IBI measurements once per year, potentially at the locations described in the technical document.
4. It is possible that septic systems are significant contributors to nutrient loading, but this cannot be said without further study. Most of the septic systems in the watershed are located in the unincorporated area between Lakewood and Crystal Lake. Samples should be collected above and below this area to determine if nutrient concentrations increase downstream from the neighborhood.
5. It is recommended that Illinois EPA collect fecal coliform samples during its next Intensive Basin Survey in the Kishwaukee basin. In addition, local efforts should be made to collect fecal coliform

at various sites on the stream and tributary system. This can be led by Openlands, which has identified perhaps twelve sites to monitor eight times per year in May through October.