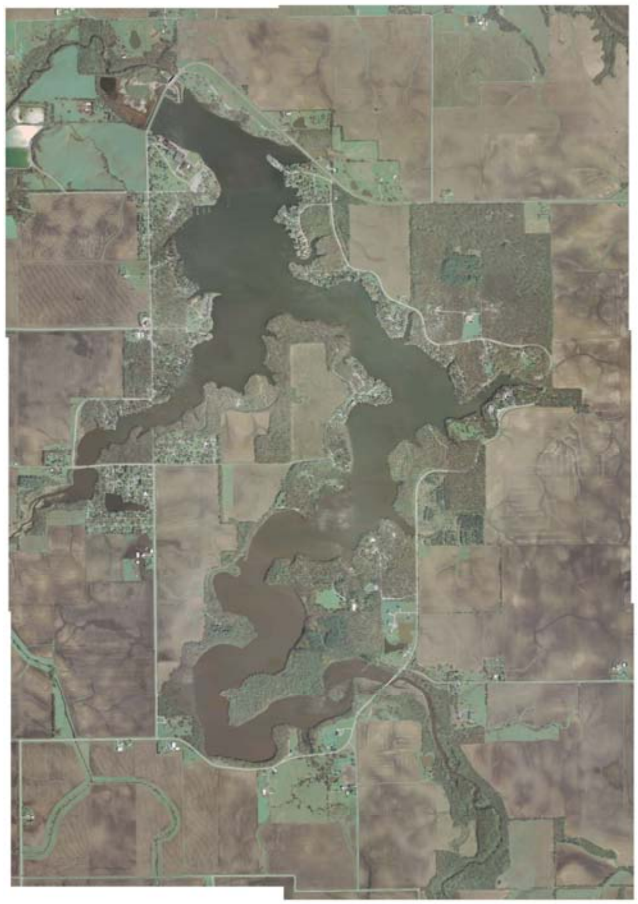
DRAFT

Lake Bloomington Watershed Plan



Prepared by:

Lake Bloomington Watershed Planning Committee

McLean County Soil and Water Conservation District

Illinois Environmental Protection Agency

Natural Resources Conservation Service

Association of Illinois Soil & Water Conservation Districts

Funding for this project provided, in part, by the Governor of Illinois and the Illinois Environmental Protection Agency through Section 319 of the Clean Water Act.

Table of Contents

Mission Statement

We the people of the watershed of Lake Bloomington will address water quality impairments using proactive strategies that maximize local control in order to improve and protect water quality and the sustainable use of our watershed resources.

Introduction

Section 303(d) of the Clean Water Act (CWA) and the U.S. Environmental Protection Agency (USEPA) Water Quality Planning and Management Regulations (40 CFR Part 130) require states to identify water bodies that do not meet water quality standards and to determine the Total Maximum Daily Load (TMDL) for pollutants causing the impairment. A TMDL is the total amount of pollutant load that a water body can receive and still meet the water quality standards. It is the sum of the individual waste load allocation for point sources, load allocations for nonpoint sources, natural background, and a margin of safety that addresses the uncertainty in the analysis. The CWA establishes the process for completing TMDLs to provide more stringent, water-quality based controls when technology-based controls are not sufficient to achieve state water quality standards. The overall goals and objectives in developing the TMDLs include:

- Assess the water quality of the impaired waterbodies and identify key issues associated with the impairments and potential pollutant sources.
- Use the best available science and available data to determine the maximum load the waterbodies can receive and fully support all of their designated uses.
- Use the best available science and available data to determine current loads of pollutants to the impaired waterbodies.
- If current loads exceed the maximum allowable load, determine the load reduction that is needed.

- Identify feasible and cost-effective actions that can be taken to reduce loads.
- Inform and involve the public throughout the project to ensure that key concerns are addressed and the best available information is used.
- Submit a final TMDL report to USEPA for review and approval.

The Illinois Environmental Protection Agency (IEPA) only requires a TMDL be developed for the chemical parameters with numeric water quality standards. Under Section 303(d) of the CWA, the State of Illinois prepares a list of waters that are not meeting state water quality standards (hereafter referred to as the “303(d) list”) in each 2-year cycle. Lake Bloomington (waterbody ID RDO) is listed as impaired because of excessive nitrate and phosphorus in the water (IEPA, 2006).

IEPA implements its TMDL Program in three stages. Stage One was completed in November 2006 and involved the characterization of the watershed, an assessment of the available water quality data, and an identification of potential technical approaches (Tetra Tech, 2006) Stage Two involves additional data collection which was not required for Lake Bloomington. Stage Three involves model development and calibration, TMDL scenarios, and implementation planning. The TMDL Stage Three Report documents the modeling and TMDL components of Stage Three and briefly describes the implementation plan.(Tetra Tech Phase 3, 2007). THE USEPA approved the Lake Bloomington TMDL for Total Phosphorus and Nitrate in September 2007.

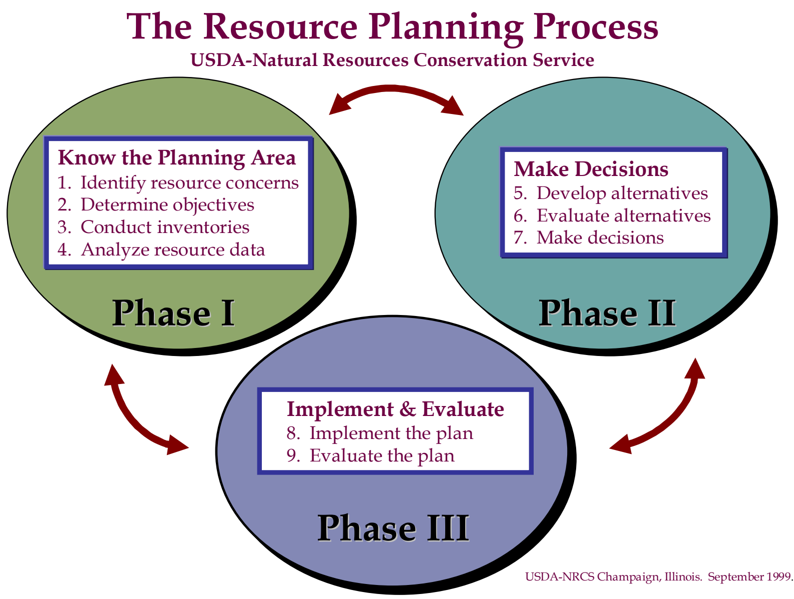
In the IEPA report, Chapter 1 discusses the rationale for beneficial use designations and impairments for Lake Bloomington which is located in central Illinois. Chapter 2 describes the characteristics of the watershed and water bodies. Chapter 3 describes the water quality standards and water quality assessment of existing data. Chapter 4 summarizes the nonpoint and point sources in Lake Bloomington. Chapter 5 describes the technical approach used for the TMDL development including modeling approach and calibration. Chapter 6 presents the TMDL components including load allocations. Finally, Chapter 7 briefly describes the implementation plan.

A review of the available water quality data from the TMDL Stage One report confirms the causes of impairments in Lake Bloomington. Of the pollutants impairing Lake Bloomington, total phosphorus and nitrate are the only parameter with numeric water quality standards. The water quality data also verified that total phosphorus is a limiting nutrient in the lake and frequently exceeded the 0.05 mg/L water quality standard. The nitrate plus nitrite nitrogen concentration data is used to verify the exceedance because nitrite nitrogen seldom appears in concentration greater than 1 mg/L and tends to transform to nitrate. The maximum observed nitrate plus nitrite concentration exceeded the standard of 10mg/L in Lake Bloomington.

All Illinois waters must meet general use water quality standards unless they are subject to another specific designation (CWA Section 302.201). The general use standards protect the state's water for aquatic life (except as provided in Illinois Water Quality Standard Section 302.213), wildlife, agricultural use, secondary contact use, aesthetics quality, and most industrial uses.

In December 2006, the McLean County Soil and Water Conservation Districts (SWCD) and the McLean County Natural Resource Conservation Service (NRCS) invited landowners, representatives of local governments, local experts, and concerned citizens to meet to address the issue of elevated levels of phosphorus, nitrates and sediment in Lake Bloomington. From that initial group a Planning Committee was formed, which then developed a list of action points that needed to be investigated. The Planning Committee then appointed a Technical Committee to address the individual problem statements, investigate existing data of Best Management Practices to address the problems, inventory resources in the watershed and develop alternatives. The Technical Committee divided into several areas of expertise: the Biological/Streams Committee, the Urban Committee, a Homeowners Committee, a Drinking Water Quality Committee, an Educational Committee, and the Agriculture Committee. Funding for the entire Lake Bloomington Watershed Plan development was through grants by the Illinois Environmental Protection Agency, while implementation funding will be from IEPA, Association of Illinois Soil & Water Conservation Districts (AISWCD), SWCD, Sand County Foundation, and NRCS, as well as other local and private funding.

The committee started the planning process under the guidance of NRCS and used a three phase planning approach.



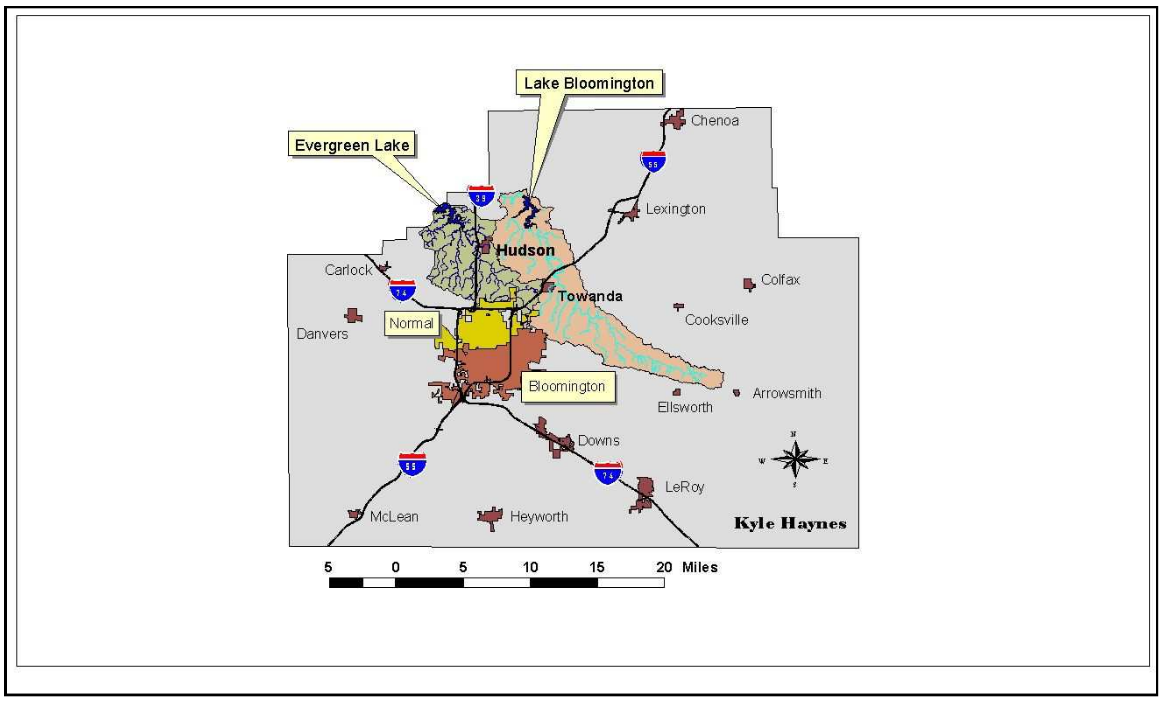
Stakeholders were invited to committee meetings and provided with plan drafts. Their input was integrated into the final plan. Members of the Planning and Technical Committees are in Appendix I.

Watershed Description

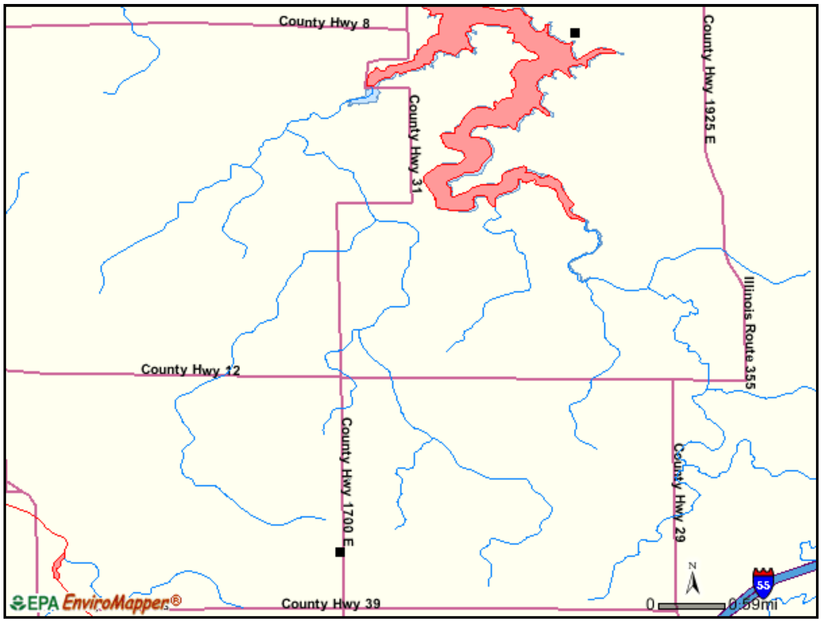
General Overview

Lake Bloomington (572 acres) watershed consists of 43,100 acres in the central part of McLean County, Illinois. It is located in central Illinois about 160 miles northeast of St. Louis and approximately 125 miles southwest of Chicago. It is in the Mackinaw River Basin, (Hydrologic Unit Code) HUC #07130004, sub-basin code 030. The watershed encompasses hydrologic unit 16, Upper Money Creek and the majority (upstream of the dam) of hydrologic unit 09, Lower Money Creek. The communities of Towanda and Merna are located entirely within the watershed. The City of Bloomington and Incorporated Town of Normal are expanding into the southwestern edge of the watershed.

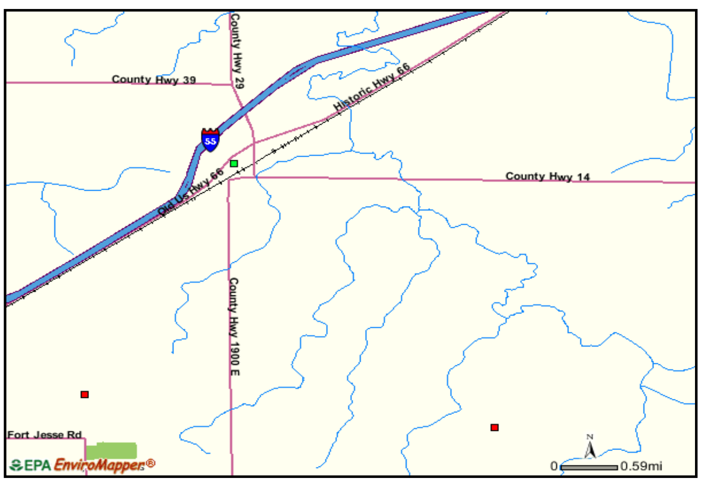
Lake Bloomington is located in the northern part of the watershed. It was constructed in 1929 by the impoundment of Money Creek. Hickory Creek is a tributary of Money Creek which empties into Lake Bloomington. Only two of the tributaries have IEPA identification numbers at this time: RDO (Bloomington) and DKP-20 (Money Creek). The lake was constructed to expand the water supply for the City of Bloomington. To fully utilize the lake's potential, recreation and residential development were established as second and third priority uses respectively. Water use is for domestic, commercial industrial, public and agricultural uses. The Lake Bloomington watershed is immediately adjacent to the Evergreen Lake watershed. Lakes Bloomington and Evergreen were both constructed for a water source for Bloomington, and have similar geology and land use. The similarities between the two lakes allows for studies and inventories on one lake to be applied to both lakes. The watershed plans for both watersheds, as well as any other watersheds contained entirely within McLean County, will be implemented and coordinated by the same oversite committee.



There are five water, multiple, and/or waste point sources in the watershed as identified by the EPA. Myers, Inc (Hazardous waste), East Bay Camp (multi), Ni-Cor Gas (multi), American Disposal Services (water), Vineyards Subdivision (water), and Myers, Inc. (Hazardous waste).



East Bay Camp and NiCor location



Vineyards Subdivision, Myers, Inc., and American Disposal Locations

Watershed History

Geological

The uppermost bedrock within the Lake Bloomington watershed is mostly Pennsylvanian age, 286-320 million years ago. The Pennsylvanian formations are made of cyclic beds of sandstone, shale, siltstone, limestone, coal, and clay. These rocks contain 1-2% coal by volume. Much of the Pennsylvanian bedrock is covered by Quarternary deposits up to 500 feet thick.

McLean County is mostly on a loess-covered till plain. Glacial movements, running water, and windblown deposits have contributed to the formation of the land within the county. McLean County also consists of a series of glacial deposits formed about 15,000 to 20,000 years ago by the Wisconsonian glacial movements. As the ice sheets moved south, they began to melt and recede, leaving moraines and ridges lying northwest to southeast. The Bloomington Moraine is one of the largest, which runs immediately south of the watershed. The land north of the Bloomington Moraine is gently sloping (1-4% slope), except for steeper slopes (4-10%) near the Mackinaw River to the north of the watershed.

Soils data and GIS files from the Natural Resources Conservation Service (NRCS) were used to characterize soils in the Lake Bloomington watershed. General soils data and map unit delineations for the country are provided as part of the Soil Survey Geographic (SSURGO) Database. Field mapping methods using national standards are used to construct the soils maps in the SSURGO database. Mapping scales generally range from 1:12,000 to 1:63,360; SSURGO is the most detailed level of soil mapping done by the NRCS. A map unit is composed of several soil series having similar properties. Identification fields in the GIS coverage can be linked to the database that provides information on chemical and physical soil characteristics. The SSURGO database contains many soil characteristics associated with each map until. Of particular interest are the hydrologic soil group and the K-factor of the Universal Soil Loss Equation (USLE).

The hydrologic soil groups have similar infiltration and runoff characteristics during periods of prolonged wetting. Typically, clay soils that are poorly drained have lower infiltration rates, while well-drained sandy soils have the greatest infiltration rates. USDA has defined four hydrologic groups for soils listed below:

Soil Group A-

Soils with high infiltration rates.

Usually deep, well drained sands or gravels.

Soil Group B-

Soils with moderate infiltration rates.

Usually moderately deep, moderately well drained soils.

Soil Group C-

Soils with slow infiltration rates.

Soils with finer texture and slow water movement.

Soil Group D-

Soils with very slow infiltration rates.

Soils with high clay content and poor drainage.

High amounts of runoff.

Soils may be assigned to dual groups if drainage is feasible and practical. Dual hydrologic groups, A/D, B/D, and C/D, are given for certain wet soils that can be adequately drained. The first letter applies to the drained condition, and the second to the undrained. Only soils that are rated D in their natural condition are assigned to dual classes. For the Lake Bloomington watershed, Hydrologic Soil Group B covers 38.7% and dominates the south-eastern portion of the watershed and is found adjacent to Lake Bloomington and the middle and northern sections of Money Creek. Group B/D accounts for 59.8% and is evenly spaced throughout the watershed and found adjacent to the southern section of Money Creek. Group C covers 0.6% and is found in small areas surrounding Lake Bloomington the the northern section of Money Creek upstream from the lake. Group C/D accounts for 0.9% and is found sparingly throughout the watershed.

The Lake Bloomington watershed is heavily tiled (7,500 acres or 18%) to promote agricultural drainage. The draining tile system increases the possibility for soluble nitrogen to reach surface water. In addition, some private septic systems may be connected with the drain tile system and provide a direct load to the streams, especially under low flow conditions.

BIOLOGICAL FEATURES OF LAKE BLOOMINGTON WATERSHED

The Lake Bloomington watershed lies within the Grand Prairie Natural Division of Illinois. Prior to settlement, watershed plant communities consisted of upland prairie (85%), wet prairie (3%), upland forest (10%) and bottomland forest (2%). Existing areas of these plant communities are currently limited in the watershed, with virtually no remaining upland or wet prairie. Present vegetative cover includes cropland (corn and soybeans), pasture, farmsteads, forest, and typical urban landscaping.

Grasslands and Prairie:

Although tallgrass prairie was the dominant ecosystem in the watershed, no original prairie remains. A few prairie plantings exist as a part of nature preserves and CRP lands, but except in the case of the Moon Tract of ParkLands, such plantings are of low diversity. Some prairie grassland animal species were able to shift to non-native grassy crops and pasture, but much of this habitat has been replaced by intensive row crop agriculture. Where non-native grassy habitat remains, outside of CRP acreage, much is made an ecological trap because of the timing of mowing interferes with migratory bird breeding. Prairie is an ideal vegetation type to control soil erosion, and encouraging of more acreage in such vegetation would confer great benefit to streams and wildlife.

Forest:

The forested area around Lake Bloomington is one of the larger remaining tracts in McLean County. Like many areas, it suffers from habitat fragmentation and both invasive non-native and aggressive native species. No botanical surveys have been done to assess the significance of the remaining fragments. Ecological restoration is critically needed to preserve remnant habitats, and special attention needs to be focused on preserving the oak and hickory species that are under threat from deer browse pressure, invading maple trees, and fire suppression.

Wetlands:

Wetlands were an important feature of the pre-settlement watershed, both in the floodplain of the streams and in the uplands. Wet prairies and riparian woodlands were important habitat for diverse species. There are approximately 1,100 acres of wetlands in the Lake Bloomington watershed. The National Wetland Inventory indicates that approximately 75 acres of wetlands are located around the lake where the tributaries approach the normal pool elevation of the lake. These are mostly palustrine areas with emergent and woody vegetation that are temporarily or seasonally flooded during the growing season.

Interestingly, the mud flats that form during dry years at the southern end of the Lake regularly attract migrating shorebirds. These are the most significant mud flats in the county, and attract enthusiastic birdwatchers from around Central Illinois.

Biota (Plants and Wildlife):

1. General

Our knowledge of the wildlife of the watershed consists of anecdotal information and, in the case of native fish and mussels, focused surveys. It is clear that much more work is needed to determine the species of plants, invertebrates (other than mussels), and vertebrates (other than fishes) that inhabit the watershed. A special focus is needed to determine the presence of organisms that are Species in Greatest Need of Conservation (Illinois Wildlife Action Plan: dnr.state.il.us/ORC/WildlifeResources/theplan/species.htm) or officially listed as state or federal Threatened and Endangered Species (dnr.state.il.us/espb/datelist.htm). Despite the lack of comprehensive surveys, there are a few of the latter known from McLean County (dnr.state.il.us/ORC/list_tande_bycounty.pdf), although their presence in this watershed is not known.

Additionally, there is enough forest surrounding Lake Bloomington that a breeding bird survey is likely to find some area sensitive forest species (Herkert et al. 1993). The forest does serve as a migratory stopover site for neotropical migratory songbirds and other species.

2. Mussels:

Although found worldwide, freshwater mussels reach their highest diversity in eastern North America. Unfortunately, due to degradation of our waterways, they are among the most imperiled group of Midwestern animals. Since 1987, four surveys of the mussels of Money Creek have been performed by the Illinois Department of Natural Resources, all at one site (the area around the County Road 1975E bridge) with the last being in 2005. Due to the physical barrier to dispersal of mussels resulting from the dam for Lake Bloomington, the degradation of water quality in Money Creek, and the loss of native fishes that may have been key to the dispersal of certain species, the original complement of mussel species is likely to be no longer present. However, a cumulative total of 11 species were found in the fours surveys, including two species that are on the list of Illinois Species in Greatest Need of Conservation. Those two species are the Pondhorn (*Uniomerus tetralasmus*) and Ellipse (*Venustaconcha ellipsiformis*).

3 FISH:

In 1953 the first Department of Natural Resources (IDNR) fish survey on Lake Bloomington was completed and resulted in the collection of only 6 species. These same species are still collected in the lake today. The second fish survey was conducted in 1958 and consisted of 18 species. In the report for the second survey it was noted that siltation can be readily observed in the areas of Hickory and Money Creeks entering the lake. The biologist also stated that reproduction of smallmouth bass in this type of habitat with the presence of so many other species is not typical and therefore doubtful if smallmouth bass can be successfully managed. In the 1958 survey they collected 26 smallmouth bass. In the 2007 fish survey they collected zero smallmouth bass. Smallmouth are still present in the lake, but at a very low density.

In 1960 a fish survey report stated that a complete watershed conservation program would improve the game fish habitat of the lake. The biologist suggested using BMPs of the day for all farmland in the watershed. The survey report also stated that shoreline bank erosion should be controlled by grading back the high eroded banks, vegetative plantings and rock rip-rapping. Wave action was noted to be causing a large amount of shoreline erosion. In a 1952 State Water Survey Report, the lake was losing 0.5 percent of its storage capacity per year. Even though some BMPs have been used in the watershed, Lake Bloomington still faces the same issues as it did in 1960. (ISWS 1952)

Since 1960, there has been over 30 fish surveys completed on Lake Bloomington by IDNR personnel. These surveys have been used to set fishing regulations, recommend fish stockings, and document changes in the fish community. The first fish stocking was in 1940 and consisted of largemouth bass, bluegill, crappie, bullhead catfish, and striped bass. Since 1984 the IDNR has stocked almost 127,000 largemouth bass fingerlings, 575,000 walleye fingerlings, and 25,000 hybrid striped bass fingerlings. There have been stockings of smallmouth bass, northern pike, and white bass over the years.

The game fish populations in Lake Bloomington still have difficulties producing strong year classes and this can be attributed to the lack of quality habitat. As the water levels change so does the amount of suitable habitat for young fish. The erosion of shorelines and deposition of silt also hamper fish reproduction. Recent surveys suggest that bass and crappie are having a difficult time reproducing in the lake. The stocking of largemouth bass failed to increase the number of bass in the lake. Suitable littoral habitat is needed to bolster game fish populations in Lake Bloomington.

Fishing regulations have been used to regulate fishing pressure and the number and size of fish harvested. Lake Bloomington currently has fishing regulations for bass, bluegill, hybrid striped bass, white bass, and crappie. Fishing pressure can be determined from creel surveys and these were conducted in 1996 and 2003. Almost every major game fish showed an increase in catch rates and harvest rates from 1996 to 2003. Even though catch rates improved for anglers during the creel surveys, catch rates during the 2007 fish survey did not meet management objectives for most game fish. Only the catch rate for largemouth bass met the management objective.

Money Creek was surveyed by IDNR during intensive basin surveys four times between 1987 and 2005 (Table 1). The number of fish species collected ranged from 13 in 2000 to 19 in 2005. Carp, quillback, and bluegill were collected in 2005 and not during the previous surveys. These species are found in Lake Bloomington and will move from the lake upstream into Money Creek. Catch rates for spotfin shiner, orangethroat darter, and fantail darter have declined over the 4 surveys. These species are indicators of good habitat and water quality.

The Index of Biotic Integrity (IBI) was developed to assess the quality of streams using fish species collected during surveys (Smogor 2000). The IBI score is based on 10 matrices that were developed for different regions across Illinois. With each region comprising a unique set of matrices, the IBI score better reflects the effect of human disturbance on fish. The IBI scores obtained during the intensive basin surveys ranged from 24 to 30 (Table 1). The highest score obtainable is 60. The score of 60 represents a stream that has characteristics of the benchmark conditions set to develop the IBI. The benchmark conditions reflect the biological conditions expected in Illinois streams least disturbed by human impacts. Therefore, the degree to which an IBI score deviates from the maximum score reflects the relative amount of human impact additional to that already represented by the reference conditions. The developers of the Illinois IBI suggested that a score difference of 10 or less should not be interpreted as a meaningful difference in biotic integrity (Smogor 2003). The IBI scores of 24 to 30 put Money Creek into the low category of biotic integrity (Table 2). Only minor changes in a few fish species can be seen from 1987 to 2005, which has kept the biotic integrity of Money Creek low.

Table 2: IBI score description

IBI-Score	**Biotic**	**Description of Typical Biological, Physical, and**

Subrange	**Integrity Class**	**Chemical Conditions.**
56-60	Moderately High	Values of fish metrics are very similar to values expected in Illinois streams where levels of human impact appear to be least in the state.
46-55	Moderate	Number of native fish species is reduced primarily due to loss of intolerant species. Reduced abundances of mineral-substrate spawners indicates disruption of reproductive functional structure.
31-45	Moderately Low	Number of native fish species is reduced further primarily due to further loss of intolerant species, but also due to loss of sucker species and benthic-invertivore species. Reduced abundances of specialist benthic invertivores and increased abundances of generalist feeders, indicate imbalance in trophic functional structure.
16-30	Low	Number of native species is reduced further due to near-complete loss of intolerant species and further pronounced loss of sucker species and benthic-invertivore species. Disruption of fish-community structure is evidenced as indiscriminate loss of species across major families (minnows, suckers, sunfish). Further reductions in abundances of specialist benthic invertivores and mineral-substrate spawners indicates disruption of trophic and reproductive functional structure.
0-15	Very Low	Number of native species is reduced further due to pronounced, indiscriminate loss of species across major families (minnows, suckers, sunfish) with a concurrent increase in the proportion of tolerant species. Intolerant species are absent; benthic-invertivore species are nearly absent. Pronounced reductions in abundances of specialist benthic invertivores ans mineral-substrate spawners indicate further disruption of trophic and reproductive functional structure.

No threatened or endangered fish species were collected from Money Creek during these surveys, nor is there evidence to suggest the presence of threatened and endangered fish species in Money Creek

Table 1. Fish collected during four basin surveyed conducted on Money Creek, Mackinaw River Watershed between 1987 and 2005.

Common name	Scientific name	Money Creek 07/29/87 DKP-02	Money Creek 09/08/94 DKP-02	Money Creek 07/20/00 DKP-02	Money Creek 07/11/05 DKP-02
Carp	*Cyprinus carpio*				1
Creek chub	*Semotilus atromaculatus*	205	81	22	39
Hornyhead chub	*Nocomis biguttatus*	77	54	6	88
Central stoneroller	*Campostoma anomalum*	15	6	6	12
Suckermouth minnow	*Phenacobius mirabilis*		7		4
Striped shiner	*Luxilus chrysocephalus*	29	52	8	164
Redfin shiner	*Lythrurus umbratilus*	15	4	12	31
Spotfin shiner	*Cyprinella spiloptera*	18			
Red shiner	*Cyprinella lutrensis*	41	5	83	117
Bluntnose minnow	*Pimephales notatus*	336	103	17	311
Bigmouth shiner	*Notropis dorsalis*	163		2	311
Sand shiner	*Notropis ludibundus*	73	10	45	194
Quillback	*Carpiodes cyprinus*				9
Smallmouth buffalo	*Ictiobus bubalus*		2		
White sucker	*Catostomus commersoni*	2	83	7	45
Golden redhorse	*Moxostoma erythrurum*				16
Yellow bullhead	*Ameiurus natalis*	16	6		5
Stonecat	*Noturus flavus*	1	1		1
Blackstripe topminnow	*Fundulus notatus*			1	5
Bluegill	*Lepomis macrochirus*				2
Johnny darter	*Etheostoma nigrum*	32	15	10	37
Orangethroat darter	*Etheostoma spectabile*	2	6	4	
Fantail darter	*Etheostoma flabellare*	7	3		
Total fish		1032	438	223	1081
Total species		16	16	13	18

Table 1. Fish collected during four basin surveyed conducted on Money Creek, Mackinaw River Watershed between 1987 and 2005.

Common name	Scientific name	Money Creek 07/29/87 DKP-02	Money Creek 09/08/94 DKP-02	Money Creek 07/20/00 DKP-02	Money Creek 07/11/05 DKP-02
Electrode minutes		30	35.73	30	27.5
Kilograms of fish		1.38	1.977		18.635
Native fish species		16 (3)	16 (3)	13 (2)	17 (3)
Native minnow species		10 (6)	9 (5)	9 (5)	9 (5)
Native sucker species		1 (2)	2 (3)	1 (2)	3 (3)
Native sunfish species		0 (0)	0 (0)	0 (0)	1 (1)
Benthic invertivore species		5 (3)	6 (4)	3 (2)	4 (2)
Intolerant species		1 (2)	1 (2)	1 (2)	1 (1)
Prop. specialist benthic invertivores		0.04 (2)	0.05 (2)	0.06 (2)	0.05 (2)
Prop. geneneralist feeders		0.87 (2)	0.79 (3)	0.88 (2)	0.85 (2)
Prop. mineral-substrate spawners		0.13 (2)	0.29 (3)	0.16 (2)	0.29 (3)
Prop. tolerant species		0.31 (5)	0.31 (5)	0.31 (5)	0.35 (4)
Extrapolated IBI		27	30	24	26

Human Use

Social and Economic Characteristics

The population of McLean County is 161,202. The two largest communities in McLean County are the City of Bloomington (pop. 74,975) and the Town of Normal (pop.

50,519). Both of these municipalities are in the southern part of the watershed. In 2007, the McLean County labor force was 91,382 with 87,926 employed and 3,456 unemployed or a 3.8% unemployment rate. The largest employer is State Farm Insurance Company with 15,297 employees. The median income for McLean County for FY 2008 is $70,900. (EDC, 2008)

East Bay Camp

East Bay Camp started in 1929 when Lester Martin, an attorney from the Bloomington Water Company, approached the Reverend Frank Breen. According to Breen, Martin said, "...since our first plan for the lake, we decided to raise it five feet and we had to buy an extra 40 acres. There'll be a lot of ground back in here and I think it would be wonderful for a camp. Do you think you could start a camp here?"

Today, East Bay Camp lies on 146 acres and has 87 buildings. The most recent major addition is the Seager-Denham recreation center. The indoor pool is used by campers in the summer and by Lake residents year-round for water exercise classes. (LBA 2007)

East Bay Camp was given a WLA for their discharge into Lake Bloomington for both phosphorus and nitrates. This is based on the facility's Design Average Flow (0.03 mgd) multiplied by an assumed concentration of 3.5 mg/L total phosphorus. While the concentration is a best guess, it is known, through reporting requirements, that this facility has always discharged less than their Design Average Flow (average discharge of 0.018). There is potential that during the reissuance of their NPDES permit (expires Dec 31, 2009) they could be required to report their monthly phosphorus concentrations. Once this is known, a more accurate determination of their phosphorus load can be made.

Timber Pointe Outdoor Center

The camp now known as the Timber Pointe Outdoor Center was founded over 60 years ago, soon after the Lake was built. The camp has 170 acres of woods and four miles of shore line.

It served as the Corn Belt Council Boy Scout Camp until 1989, when it was purchased by the Easter Seals Rehabilitation Center, Inc. In 2005, 1700 children with special needs attended the camp.

In 2006, The Lodge at Timber Pointe was completed as a joint project between the four Bloomington-Normal Rotary groups and the Timber Pointe Charitable Foundation. The complex has a kitchen and dining areas, a medical facility and lodging for the medical staff, a storm shelter, program and assembly areas, and camp administration and support services.(LBA 2007)

Camp Peairs

Camp Peairs was built as a camp for Girl Scouts in early 1940. It has been improved over the years, and in a recent summer, over 1300 Girl Scounts attended the camp. (LBA 2007)

Construction of Lake Bloomington

The Lake Bloomington watershed consists of approximately 43,100 acres (~ 70 square miles) in the central part of McLean County, Illinois. The watershed encompasses hydrologic unit 16, Upper Money Creek and the majority of hydrologic unit 09, Lower Money Creek. Money Creek flows from the southeast to the northwest in the watershed and is a tributary of the Mackinaw River (Mackinaw River Basin, Hydrologic Unit Code 07130004). Portions of the City of Bloomington, Town of Normal, Merna, Towanda and unincorporated rural subdivisions also are located in the watershed.

Lake Bloomington is located in the northern part of the watershed. It was constructed in 1929 by the impoundment of Money Creek. Hickory Creek is a tributary of Money Creek which also empties into Lake Bloomington. The lake was constructed to expand the water supply for the City of Bloomington. A secondary use for Lake Bloomington is recreation activities.

In 1958 the City of Bloomington raised the dam to increase the normal pool elevation by 5 feet resulting in a 56% increase in storage capacity. The increase in pool elevation resulted in a volume increase from 4710 acre feet to 7380 acre feet. A 1999 Hanson Engineering sedimentation survey yielded a volume of 6798 acre feet. Lake Bloomington, as of 2007, has a surface area of 572 acres, 9.5 miles of shoreline, a maximum depth of 35 feet, a mean depth of 12.9 feet, and a storage volume of 6768 acre feet.

Recent issues

Pending Pipeline Construction

One of the recent topics is a proposed crude oil pipeline. This pipe would be a 36" in diameter pipe capable of transporting 400,000 barrels of crude oil per day. In the future it could be increased to 800,000 barrels per day by adding pumping stations to the route and increasing the pressure of the liquid. The proposed corridor is 60' in width to allow for additional pipes to transport refined petroleum products, additional crude or any other products. The proposed pipeline enters the watershed 3 miles east and 3.5 miles south of the entrance to the lake. It continues south through the watershed for 6 miles, at a depth of not less than 5 feet to the surface where practical.

The effects of this pipe could include:

- Damage to tile that feed into the Money Creek.
- Additional sedimentation until the ground has an opportunity to regain its structure and cover.
- Contamination of soil in the watershed from a leak.
- Contamination of subsurface aquifers and surface streams.

East Side Highway and Other Roads

Introduction.

Land use changes within a watershed can have significant effects, positive or negative, on the ability to: 1) predict the future delivery of TMDL pollutants into impaired streams and lakes, 2) evaluate the choice and likely effectiveness of Best Management Practices (BMPs) to reduce TMDL pollutants, and 3) assess the future overall ecological health of a watershed. One category of land use change that can alter significantly a watershed, through both direct and indirect effects, are roads (Forman and Alexander 1998, Forman et al. 2003).

Interstate-type roads often have the largest impacts due to the size of their direct and indirect ecological footprints, and due to their magnet effect on future growth. In the context of the Lake Bloomington/Money Creek watershed, an important direct effect of a major road is the potential increase in sedimentation and runoff, both of which can contribute to sediment and other pollutant loading into Lake Bloomington. An indirect effect of a major road would be the potential for conversion of agricultural to urbanized land. This conversion would change the relative percentages of major land use and thus would affect the current modeling of inputs of TMDL pollutants into Lake Bloomington.

East Side Highway Corridor.

Currently, one interstate (I-55) traverses the Lake Bloomington/Money Creek watershed, roughly through the middle portion. A second major road that would link I-55 to I-74 has been proposed for examination in various studies over the years and, if built, would include part of the Lake Bloomington/Money Creek watershed.

The first recommendation for examining a "parallel freeway or expressway between I-74 and I-55" was in 1994 (*Long Range Transportation Plan for the Bloomington-Normal Urbanized Area*). Subsequent plans included the recommendation for this examination in 1999 (*2025 Long Range Transportation Plan*) and 2000 (*McLean County Regional Comprehensive Plan*).

These recommendations led to a cooperative effort by Bloomington, Downs, Normal, Towanda, McLean County and the Illinois Department of Transportation, administered by the McLean County Regional Planning Commission, to hire Bernardin, Lochmueller & Associates, Inc. of Charleston, Illinois, for a study. They produced the *2002 East Side Corridor Feasibility Study Final Report* which can be found at the website www.mcplan.org/tran/eastside/ecfs.shtml. The project goals included the evaluation of "the effectiveness of the build alternates relative to each other and the no build alternative". For the evaluation of the build alternatives, they assumed "a four-lane rural freeway...that is typical of interstate facilities in McLean County as well as throughout the State of Illinois".

Key conclusions of the 2002 study were that 1) there is a significant identified need, and 2) the preferred corridor (of 5 examined) is Alternate C. Alternate C passes through the central southwest portion of the Lake Bloomington/Money Creek watershed. An environmental profile was performed and used to compare the advantages and disadvantages of alternate corridors. The effect on TMDL pollutant loading was not one of the impacts examined at that time.

A Phase 1 engineering study began in late 2006. This effort is a partnership among Bloomington, Normal, McLean County, the Illinois Department of Transportation, and the Federal Highway Administration (FHA) and it is called the East Side Highway Corridor Study (www.eastsidehighway.com/). The company, Clark Dietz, Inc. of Champaign, Illinois, was hired to perform this study. The goal is to start afresh in assessing three parameters: 1) the need for a transportation facility; 2) the type of transportation facility, if it is determined that it is needed; and 3) the location within the study area of a corridor of 300-500 feet in width, if it is determined that it is needed.

The study area for the Clark Dietz study has been expanded from the 2002 study to include an area between I-55 and I-39 north of Normal and between I-74 and Highway 51 south of Bloomington (see map within the East Side Highway Corridor Study web site:

www.eastsidehighway.com/index_files/pdfs/Corridor%20Study%20Limits.jpg).

This study area includes the entire central third of the Lake Bloomington/Money Creek watershed and also extends into the Evergreen Lake watershed. The final report from Clark Dietz is scheduled for Spring 2008.

The Clark Dietz study incorporates a new FHA standard called Context Sensitive Solutions (CSS). This process allows for involvement of all stakeholders in all phases of study design and data collection, although the final report and recommendations will be the product of Clark Dietz. Although a full Environmental Impact Study will result should a transportation corridor be recommended, the Clark Dietz CSS process has included assembling comments from stakeholders regarding environmental issues that should be considered, including potential impacts on TMDL pollutant loading into Lake Bloomington.

Other Road Projects.

Of the major road projects listed in the draft *Long Range Transportation Plan 2035 for the Bloomington-Normal Urbanized Area*, the only one within the Lake Bloomington/ Money Creek watershed is the widening and upgrade of Towanda-Barnes Road north from Fort Jesse Road to the Village of Towanda. No evaluation has been made of the direct or indirect effects of this project on the watershed. However, it is likely to increase the conversion of the watershed from agricultural to urbanized land use and may have other impacts as identified in the introduction to this section. This should be included in any future modeling efforts of TMDL pollutant loads.

Smaller road projects, including bridge work, are likely on county roads within the watershed. Examination should be done of the current and future planned utilization of soil erosion BMPs in such projects. Also, proposals for these and other road-related maintenance and upgrade projects should include assessment of impacts on TMDL pollutants, both by the individual project and in terms of the cumulative impacts when all projects are considered together.

Twin Groves Wind Farm

Beginning in 2006, a noticeable land use change started in the southeasternmost portion (south of Route 9) of the Lake Bloomington/Money Creek watershed with the construction of the Horizon Wind Energy's Twin Groves Wind Farm. When completed in 2008, the wind farm will consist of 240 turbines producing 400 megawatts of power, making it the largest wind facility east of the Mississippi River. In addition to the turbines, there will be access roads, operations facilities, and substations. Although it is difficult to precisely determine the placement of all facilities within the irregular boundaries of the watershed, maps indicate that approximately 40 turbines along with supporting access roads, substation(s) and transmission lines will be in this watershed. However, the majority of the wind farm will be located south and east of this watershed.

The placement of wind turbines will not change greatly the existing agricultural land use of the watershed because each turbine + access road will replace only one-half acre of farmed land. Some additional displacement of farmed land will occur with the substation(s), transmission lines and other infrastructure support.

A temporary increase in sedimentation that can carry TMDL pollutants will result from upgrading the county roads to handle movement of the large equipment as well as construction of the turbine platform and graveled access road through each field. In terms of the platform and access road construction, the company has an NPDES permit and a SWPPP plan using best management practices for soil erosion control.

It is likely that the presence of these turbines will inhibit the conversion of this portion of the watershed from agricultural to urbanized, thus keeping it under current land use. This is because: 1) there is a minimum distance of 1,500 feet required from the wind turbine to any residence, and 2) the stable farm income resulting from hosting a wind turbine may reduce the pressure on landowners to sell farmland for urbanized development. Therefore, it seems unlikely that there will be any direct long-term effects on the delivery of TMDL pollutants to Lake Bloomington/Money Creek resulting from this wind farm.

Watershed Activities

In 2003, Both the City of Bloomington and the Town of Normal were required to submit storm water management plans in accordance with United States Environmental Protection Agency law. These documents were prepared jointly between the two communities and outline programs to develop, implement and enforce storm water management practices designed to reduce the discharge of pollutants to the maximum extent practicable, to protect water quality, and to satisfy the appropriate requirements of the Federal Clean Water Act in accordance with the USEPA Phase II program. These plans address six minimum control measures as required by state regulations:

- Public Education/Outreach
- Public Participation/Involvement
- Illicit Discharge Detection/Elimination
- Construction Site Runoff Control
- Post Construction Runoff Control
- Pollution Prevention/Good Housekeeping

These storm water management plans present a mix of best management practices within each control measure to address erosion, sediment, fecal coliform, grease and oil, household and lawn/garden chemicals that could potentially end up in local streams.

Public awareness and educational activities in the watershed include:

- Earth Express- a county wide activity for 3rd and 4th graders.
- Conservation Day- 3rd graders
- Wilderness Camp- 5th through 8th graders
- Yard Smart- a county wide campaign to encourage pesticide free and wildlife friendly yards
- Wellness and Sustainability Fair at Illinois Wesleyan University
- Ecology Action Center- provides ecology and recycling programs for all grade levels and McLean County at large
- Lake Fest- Family oriented single day special event providing presentations and demonstrations of Fisheries Management, Aquatic Vegetation, shoreline/streambank erosion control techniques, and lake related outdoor activities.

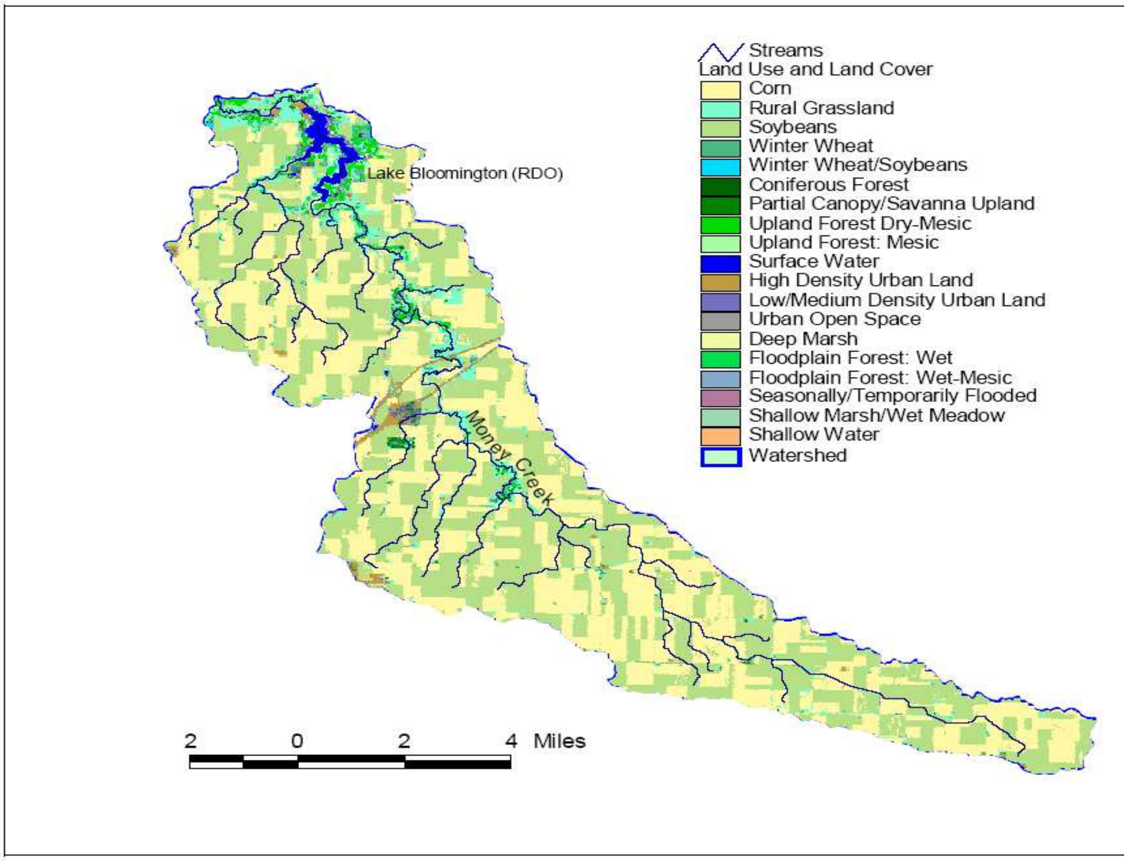
- Storm Drain Stenciling
- Lake Smart activities:
- Clean Water School Program at Hudson, Carlock and Towanda Elementary schools
- Lake Smart Workshops targeting residents
- Raingarden Workshop
- Yard Smart Walk
- Lake Festival
- Production of Living on the Lake Handbook and brochures
- Production of watershed displays

Large management and research projects include:

- Nutrient Management Programs
- 2000/01, 2001/02 Funded by IEPA
- 2005/06, 2006/07 Funded by Sand County Foundation
- Lake Bloomington Sustainable Water Program- Tile research Hoffman/Troyer farm- City of Bloomington sampled and Illinois State University compiled data from 1998 to date
- Wetlands Research- Dr. David Kovasic from the University of Illinois conducted research on City of Bloomington property from 2000 to date
- Nitrate Research on Money Creek- Recording and compiling data on tiles, organic use, pond data done by the City of Bloomington and ISU from 1992 to date
- Rain Reporters- volunteers who collect data on rainfall in McLean county 24/7 from 1997 to date

Watershed Resource Inventory

Land Uses



Land Use and Cover Map

The majority of land in the Lake Bloomington watershed is used to grow row crops, with soybeans covering 50 percent of the land and corn covering 33 percent, according to the McLean County SWCD transect survey in 2007. Rural grassland, high density (urban), and surface water each cover less than ten percent of the total surface area. The T- transect has been conducted by the McLean County Soil and Water Conservation District for the whole county biannually since the mid 1990's to give a statistically accurate gauge of the acres in conservation tillage for the primary crops in the county. The same route is completed each time in early June with a determination of which crop is growing, how much residue is left on the field and if no-till, strip till, mulch till or minimum tillage is used to establish the growing crop. This information when combined with the soil types and slopes in each field gives an estimate for the field if it is above or below the Tolerable soil loss or "T" hence the name T-transect.

In a 2007 inventory of the Lake Bloomington watershed conducted by the McLean County SWCD there were 286 cattle and 128 other livestock animals in 25 operations in the area, a number likely to have declined over the years. This is a relatively low livestock density and therefore does not represent a high priority source.

Land Cover Description	**Watershed Area**	
	Acres	**Percentage**
AGRICULTURAL:		
Corn	19,095.0	42.72
Soybeans	19,439.9	43.5
Rural Grassland	3,076.2	6.88
Winter Wheat	45.8	0.1
Winter Wheat/Soybean Double Cropped	9.3	0.02
Subtotal	**41,666.2**	**93.2**
URBAN:		
High Density	780.2	1.75
Low/Medium Density	263.3	0.59
Open Spaces	72.5	0.16
Subtotal	**1,116.0**	**2.5**
WETLAND:		
Floodplain Forest	325.8	0.73
Seasonal/Temporarily Flooded	21.6	0.05
Wetland: Shallow Water	11.8	0.03
Shallow Marsh/Wet Meadow	2.7	0.01
Deep Marsh	6.2	0.01
Dry Mesic Forest	482.2	1.08
Floodplain Wet Mesic	252.2	0.56
Subtotal	**1,102.5**	**2.5**
Forest:		
Partial Canopy/Savanna Upland	281.6	0.63
Coniferous	13.3	0.03
Upland	85.2	0.19
Subtotal	**380.1**	**0.9**
OTHER: Surface Water	428.8	0.96
Total	**44,694.2**	**100**

Data Date: 2000

The entire watershed lies within the Till Plains Section of the Central Lowland Province physiographic area. It is specifically located in the Bloomington Ridged Plain which is the unit that is more rolling and contains most of the Wisconsin glacial moraines located in Illinois. The El Paso Moraine lies to the northeast of the lake and this low ridge helps to funnel water into this watershed and direct it toward the lake. In most areas, Peoria Loess overlies glacial till of the Delavan Member of the Tiskilwa Formation of the Wedron Group (Wisconsin) that is generally loam or clay loam in texture. The Delavan Member is a brownish gray till that is calcareous and contains lenses of gravel, sand, silt and clay. The loess ranges from 4 to 6 feet in thickness over the general area, but can be thicker along the broad ridge tops and thinner on the eroded side slopes. Stream and gully dissection has exposed the underlying calcareous glacial till in a few areas along Money Creek and the major drainage ways.

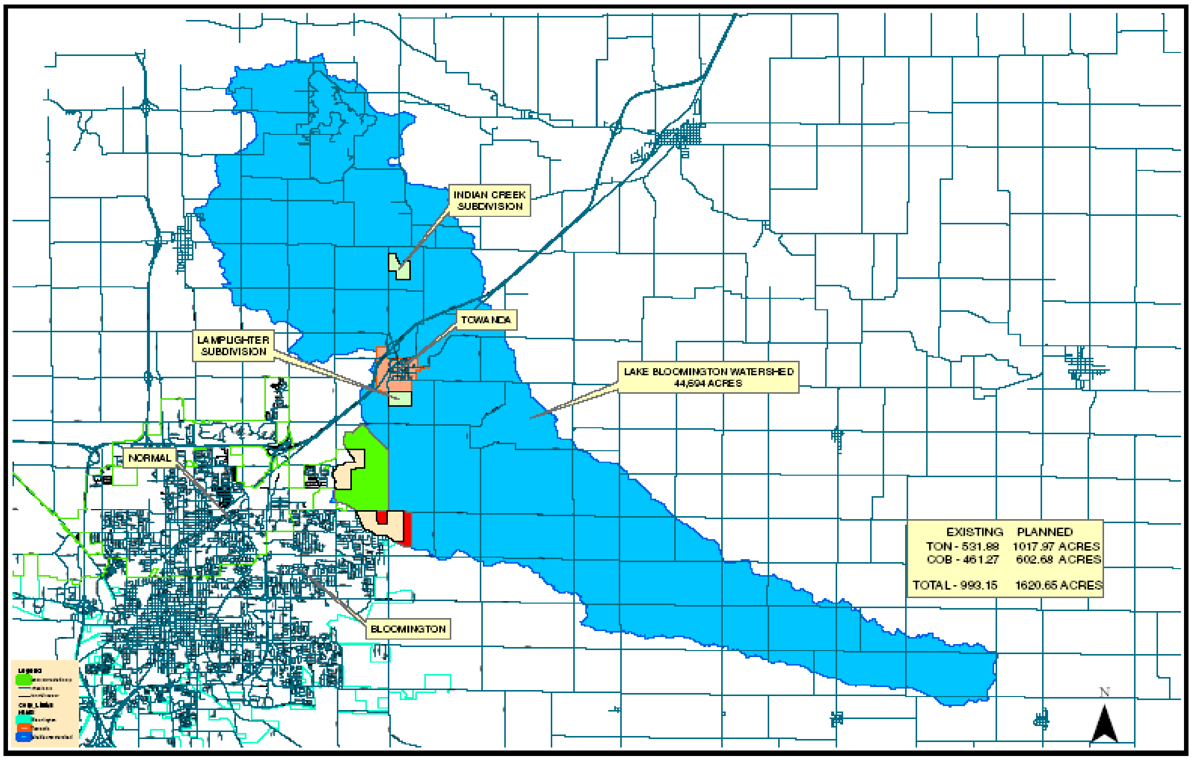
The major stream valley is composed of deposits of Cahokia Alluvium (old) that is generally less than 20 feet thick. Sandy deposits of the Henry Formation can be below the alluvium along Money Creek but glacial till is probably below the alluvium on the upper reaches of the streams or where smaller tributaries join the main drains as they exit from the surrounding uplands. On the steeper slopes, where erosion has been more intense, the glacial till is occasionally exposed. Soils mapped in this watershed reflect the parent material differences discussed above. The surface texture of the soils in greater than 80% of the watershed is a silt loam, reflecting the characteristics of the loess cover that blankets nearly the entire region. The loess is quite erosive and is easily removed by running water. The alluvium in the stream banks can contain a variety of materials with a variety of textures and grain size content. This is especially noticeable where stones are present in the channel. Stability of the stream banks is greatly dependent on the shear characteristics of the material, and on a *watershed* scale, it is difficult to make "general" statements about overall conditions. Site specific determinations are essential for future stream bank stabilization activities. (Windhorn-Appendix III)

The most common soil type in the watershed is Sable silty clay loam, which is a byproduct of the windblown silt, called loess, distributed during glacier retreat. This soil has slow infiltration rates and a high clay content, as well as poor drainage with high runoff levels. The second most common soil is Ipava silt loam.

Subsurface drainage, or tiling of fields, is practiced to remove excess water from the soil. Drainage tiles are installed below the root zone and release the water into a ditch or stream. In Illinois, tiles are usually installed at a depth of 3 to 4 feet and 80 to

120 feet apart. Based on the amount of soil classified as poorly drained, the McLean County SWCD estimates that 7500 acres in the watershed are tiled.

Effects of Urban Development



TOWN OF NORMAL / CITY OF BLOOMINGTON
EXISTING & PLANNED GROWTH LANDUSE IN LAKE BLOOMINGTON WATERSHED

0 0.5 1 2 Miles

The majority of non-agricultural use within the Lake Bloomington Watershed is confined to far eastern edges of the Town of Normal and City of Bloomington. Other significant pockets of non-agricultural land use include the Village of Towanda, northern portions of 1800 East Road and long-established residences around Lake Bloomington. Forested areas and natural grasslands are severely limited except around Lake Bloomington itself and a small pocket that sits within the middle of the watershed.

Urban development within the watershed will continue as the Town of Normal and the City of Bloomington continue to expand east and northeast toward the Village of Towanda. Sanitary sewer extension along Pipeline Road may also encourage additional development expansion that has already taken place near the Ironwood Development and north.

There are approximately 1,490 dwellings in the Lake Bloomington Watershed as found in the 2006 aerial photo. There were approximately 976 dwellings in the watershed as found in the 1994 aerial photo. This is an increase of 514 dwellings (52.7%) over this twelve year period of which 416 of these additional dwellings were built within the Bloomington/Normal urban area. Sanitary sewer effluent from these Bloomington/Normal dwellings discharges to the Bloomington Normal Water Reclamation District (BNWRD) through public sewer collection systems.

Lake Bloomington Community

There are approximately 206 dwellings located within 300 feet of Lake Bloomington as shown in the 1994 aerial photo; there are 215 dwellings shown in the 2006 aerial photo. This is an increase of nine dwellings (4.4%) in this twelve year period.

Existing development surrounding the Lake consists primarily of residential with a few commercial establishments. Some of the main commercial establishments within this Lake community include the City of Bloomington Water Treatment Plant, two restaurants and Davis Lodge. The developed area is surrounded by agricultural land. The City of Bloomington owns all lands adjacent to the lakeshore and leases lots to homeowners.. Originally, homes were summer cottages but most have been remodeled or rebuilt to permanent homes. The City of Bloomington provides water service via publicly owned and operated water treatment and distribution system. Water services are metered and customers are charged a rate for water according to usage. (Farnsworth Group, December, 2003)

The Lake Bloomington area has no centralized sewer system or wastewater treatment/transfer facility. Each home on the Lake is responsible for its own wastewater treatment. Most homes have individual septic systems, which includes a septic tank discharging into leaching fields, sand filters, existing field tiles, cisterns, and/or in a few instances directly into Lake Bloomington. All septic systems ultimately discharge effluent to Lake Bloomington either through direct surface discharge or seepage to groundwater that reaches the Lake. Some homes have entire septic systems (septic tank and sand filter/leach field) on their property. A number of homes, which are built close together and/or have relatively small lots, have a septic tank on the property but have a leaching field or sand filter on adjoining City-owned property (Farnsworth Group, December', 2003)

The McLean County Environmental Health Department keeps a comprehensive record of location, condition, and number of septic systems in the County, including Lake Bloomington and the surrounding area. (Farnsworth Group, December, 2003)

A study conducted in 2003 by the City of Bloomington produced several alternative methods for providing conveyance and treatment of the wastewater generated by residences and public facilities surrounding the lake. The study presented a pressure sewer collection/conveyance system as being the most cost effective at a cost of $6,400,000 in 2003 dollars. Lagoons in two forms, aerated and covered with aeration, were considered to be the most cost effective means of giving treatment with a cost of an additional $3,400,000.

The second least costly option produced by the study was dependent upon construction of a pumping station by the Bloomington and Normal Water Reclamation District. This option involved pumping wastewater from the Lake Bloomington pressure collection system to a pump station owned by the Bloomington and Normal Water Reclamation District. The wastewater would then be pumped to the District's Southwest Treatment Plant. The estimated cost for this addition to the collection system resulted in a total cost of $10,900,000.

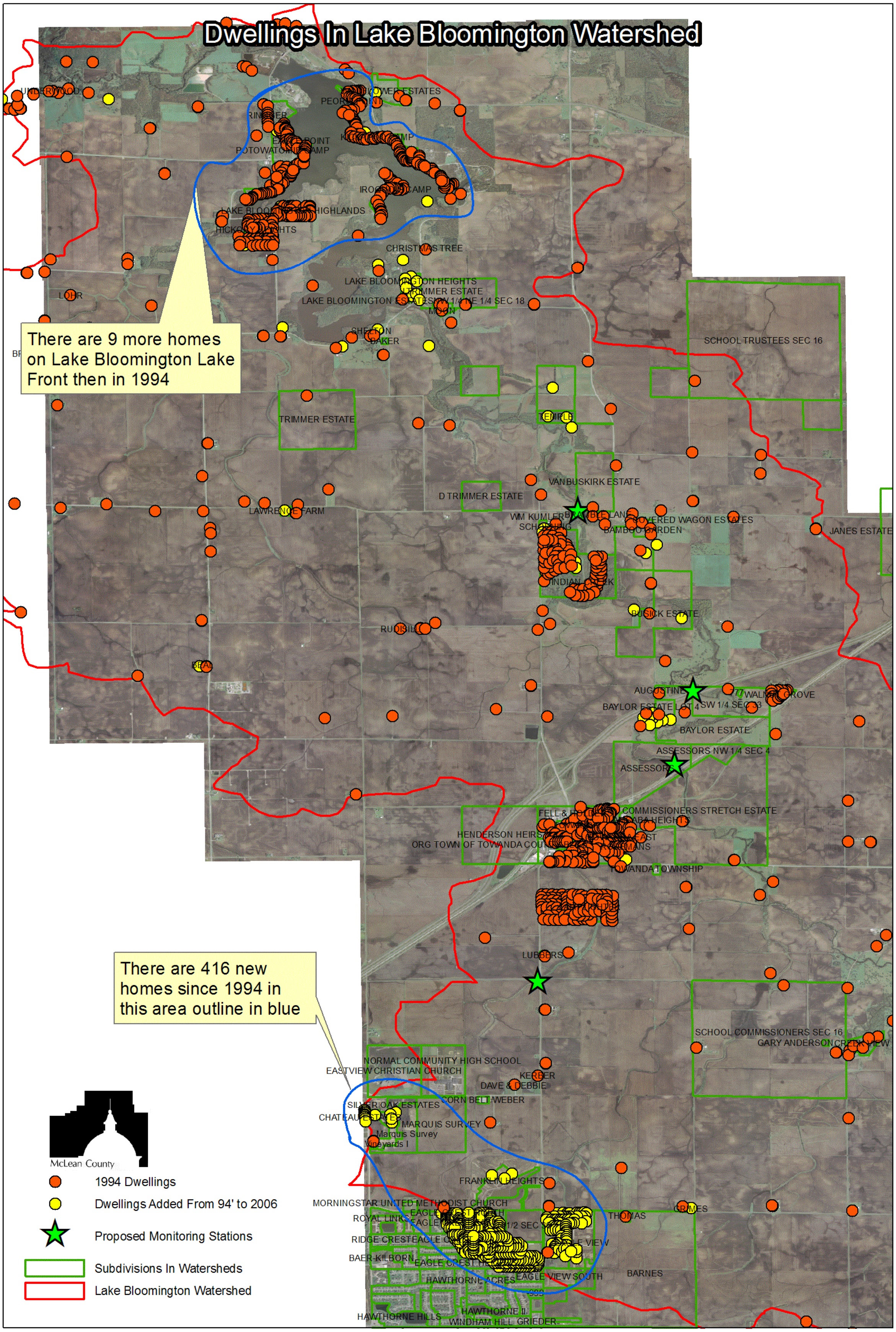
Rural Communities and Subdivisions

The County Comprehensive Plan does not show areas of medium to high density for development in the Lake Bloomington Watershed except where adjacent to Bloomington/Normal and Towanda. Erosion control regulation in the unincorporated area of the county is triggered by the Subdivision Ordinance. The County is not likely to approve subdivisions where such development is inconsistent with the Comprehensive Plan.

In addition to the 416 dwellings in Bloomington/Normal and the nine dwellings adjacent to Lake Bloomington, there was a net increase of 89 dwellings (9.1%) over the remainder of the watershed over the same 12 year period.

As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) controls water pollution by regulating "point sources" that discharge pollutants into water bodies. These include, but are not limited to, pipes and man-made ditches or ravines. Residences that are connected to a municipal discharge system, use a septic system or do not have surface discharge do not need an NPDES permit. However, industrial, municipal and other facilities must obtain permits if discharges from the facilities are released directly into surface waters. By and large, the NPDES program is administered by authorized states. Since its introduction in 1972, the NPDES permitting program has resulted in significant improvements in water quality. *(U.S. Environmental Protection Agency – Office of Wastewater Management, 2007)*

The number of active NPDES permits is sometimes an indicator of growth. As of 2007, more than 400 NPDES permits have been issued for McLean County, Illinois.


Dwellings In Lake Bloomington Watershed
There are 9 more homes on Lake Bloomington Lake Front then in 1994
There are 416 new homes since 1994 in this area outline in blue
McLean County
1994 Dwellings
Dwellings Added From 94' to 2006
Proposed Monitoring Stations
Subdivisions In Watersheds
Lake Bloomington Watershed

Bloomington and Normal Urban Expansion

Approximately 993 acres or 2.2% of the total watershed area has been annexed either to the City of Bloomington or the Town of Normal and has been developed or is currently under development. Current comprehensive planning studies for both communities project that the total urban area within the watershed will increase to 1620 acres or 3.6% of the total watershed area by the year 2035. (See Map Above)

Lake Bloomington Community Survey

On August 30, 2007 a survey was conducted at the annual dinner meeting of the Lake Bloomington Homeowners Association. The members were surveyed on their personal lawn fertilizer use. Out of 200 households, 70 responded. Results as follows:

Occupancy:

- 54 were full time residents
- 10 were part time
- 6 did not indicate

Lawn fertilizer use:

- 19 (27%) do not fertilize
- 21 (30%) fertilize less than once per year
- 35 (50%) fertilize at most once per year
- 17 (24%) fertilize 3 or 4 times per year

Water Usage:

Even though lake residents can pump water from the lake for no charge:

- 14 of 57 responses (24%) never water grass
- 26 of 57 responses (46%) water rarely or never

Using Lake Friendly Lawn Care:

- 51 of 66 (77%) are interested in learning about lake-friendly fertilizers
- 45 of 56 (80%) would pay more for it
- 13 of 17 (76%) of those who fertilize 3 or 4 times a year would like to learn about lake-friendly fertilizers
- 11 of these (85%) would be willing to pay more for it

Lake Bloomington Shoreline Erosion

Lake Bloomington has 55,580 feet of shoreline. Areas of Lake Bloomington shoreline are eroding at significant rates resulting in loss of land and unsightly areas. Three shoreline erosion surveys have been completed in the past twenty years on Lake Bloomington. In 1989, a field reconnaissance survey of Lake Bloomington's shoreline was completed as part of the Report on Drought Emergency Water Sources and Options to Improve Existing Lake Supplies for the City of Bloomington, IL by Farnsworth & Wylie/Hanson Engineers. Roger Windhorn, NRCS Resource Soil Scientist, also completed a Shoreline study in 1998. The most recent and in-depth analysis was completed in November 2005 by Midwest Streams, Inc. under contract to the City of Bloomington.

Visual observations were made by Midwest Streams, Inc. of the Lake Bloomington Shoreline in October, 2005 by walking the shoreline with the water level approx. 10 to 12 feet below normal pool. In addition to the visual observations around the entire lake, a survey along the park extending along the North Shore near the spillway has been completed for approximately 2900 feet. The survey shows nearly vertical eroding bank heights ranging from only 1 or 2 feet up to 10 to 12 feet. This survey allows for more accurate calculations of potential solutions and cost estimates that can then be used as a guide to other eroding sites around the Lake Bloomington shoreline.

The shoreline erosion has been classified in 6 categories based on the bank height and the width of eroded cobble material left in the wake of the receding bankline. Classes are related to bank height and amount of erosion, with class one being the lowest erosion and class six the most severe. This method of classification is based on two assumptions. First, the height of the eroding bank generally increases as the bankline recedes resulting in more sediment being contributed by these sites due to the increased bank height. The assumption being that the rate of erosion is determined by the combination of soils, the wave generation from long fetches, prevailing wind directions, and boat traffic. Therefore even though the bank heights are higher and the sediment contribution larger, the rate will stay fairly constant as long as these four factors remain constant.

Second, the cobble material eroded from the glacial till is too heavy to be transported by wave action and remains near the receding bankline. The width of the heavy cobble material left in the wake of eroding bankline therefore is a guide to the rate of past erosion. Based on the first assumption, then it is also a guide to the likely future erosion rate. One unknown factor could be the varying content of heavy cobble within the eroding bankline, however there seems to be no visual indication that there are significant changes within the glacial till and Roger Windhorn, Resource Soil Scientist with NRCS confirmed that the cobble content would not be expected to vary within the till surrounding Lake Bloomington.

Therefore, each segment of bankline has been classified based on the product of the bank height and the width of the heavy cobble material found along the shoreline. Each segment of shoreline was recorded in GPS UTM coordinates where the erosion rate changes based on this criteria of height and cobble as the soils, fetch, wind direction and boat traffic are assumed to be relatively constant over time. The GPS coordinates were plotted on maps indicate the starting point of each erosion class with the length of each class measured from the GPS starting point and extending toward the spillway.

The "Shoreline Inventory" provides the locations, lengths and erosion class of each shoreline segment. Protected areas of shoreline in the developed areas of Lake Bloomington's shoreline are also inventoried using a different classification system.

Note: GPS points were identified with a handheld GPS unit and some points appear to be located away from the shoreline a significant distance due to inaccuracy of the unit. Revisiting these sites could provide better GPS location, but has not been deemed necessary as the general locations of erosion classes are identifiable.

Lake Bloomington Shoreline Erosion Summary

Erosion Rating	Erosion Class	Total length of Unprotected Bank	Percent of Total Bank
<10=	Class 1	27,962 feet*	50.30%
11-49=	Class 2	10,790 feet	19.40%
50-99=	Class 3	3,256 feet	5.90%
100-149=	Class 4	4,356 feet	7.80%
150-199=	Class 5	2,670 feet	4.80%
>200=	Class 6	6,546 feet	11.30%
total		**55,580 feet***	**100%**

*This includes 18,480 feet of protected shoreline, generally near residential areas.

Residential Shoreline Inventory

Approximately 3.5 miles or 37% of the Lake Bloomington shoreline are now residential and almost all the residential sites have a seawall of some type installed.

These seawalls are largely sheet piling, with some timber walls, concrete walls and a few rock bins fashioned with chain link fencing.

Each segment of seawall has been inventoried and located using UTM coordinates with a handheld GPS unit. As each segment was located a visual rating was assigned along with a measurement of the sheet piling to check for variation from vertical and has been classified as "Good", "Fair", "Poor" or "Critical". There are no objective standards for these ratings but they are an assessment of the overall condition of the seawall based on the observed condition of material and vertical integrity. A "Good" means that there were no observed concerns with the seawall and "Critical" means that the condition was judged to be near failure. A "Fair" rating was assigned where there were observed deficiencies in the wall that indicate some maintenance is needed. A "Poor" rating was assigned where there were numerous or serious problems developing, but the seawall was not yet in danger of failure.

This study provides only an inventory of observed conditions for informational purposes only, no recommendations are given for treatment or repairs to seawalls observed to be in need of maintenance. Installation and maintenance of seawalls has traditionally been the option of the tenant.

Approximately 48% (8,870 ft.) of the protected shoreline at Lake Bloomington was rated as Good in the 2005 Survey. 26% (4,805 ft.) of the shoreline protection was rated as fair, followed by 14% (2,587 ft.) of protection in poor condition and 11% (2,033 ft.) in critical condition.

Streambank Erosion Study

Stream Technical Resource Evaluation and Management Services (STREAMS) was contracted in the fall of 2005 to conduct an inventory and evaluation of the stream network feeding Lake Bloomington. The study has been designed to:

1. Quantify the sediment contributions generated from within the stream system.
2. Evaluate the stability of identified stream segments.
3. Locate and prioritize critical areas of sediment generation.
4. Provide alternative solutions to reduce the sediment contributions.
5. Develop preliminary design and cost estimate data to support the recommendations.

Procedure for Assessment

Money Creek Inventory Map --Lake Bloomington

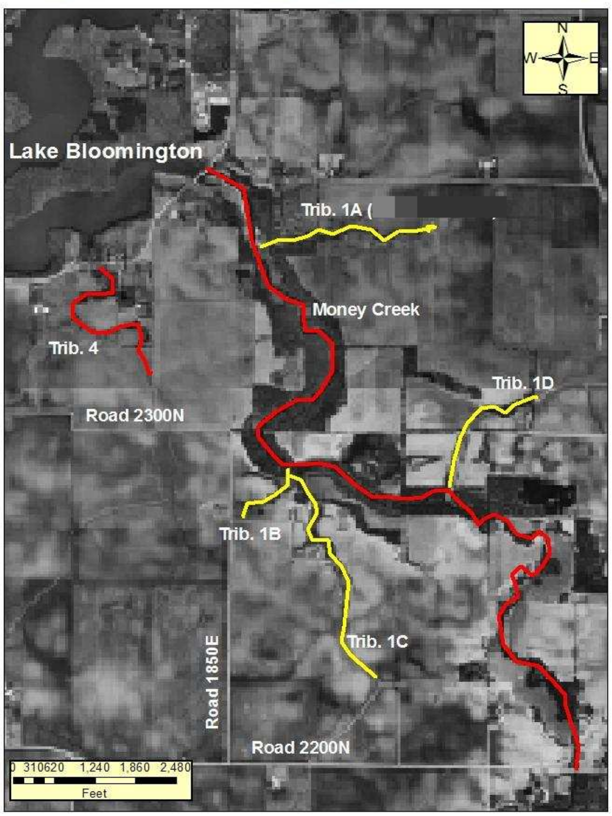


Illustration 1: Inventories Streams Money Creek 1

In October 2005, a reconnaissance survey determined that the upper reaches of the stream system appear to be maintained drainage ditches and waterways with very low sediment contributions. The lower portions of the stream system however begin immediately above Lake Bloomington as natural channels and progress through various levels of “improvements” at intermittent locations before reaching the more actively managed drainage ditches and waterways. The study has been designed to complete a 100% inventory on the lower portions of the major channels beginning at the lake and extending upstream to the start of the “managed” drainage system in each channel. The length of channel inventoried is primarily on 15 miles of Money Creek above Lake Bloomington. The smaller channels and tributaries inventoried include Big Slough and eight additional unnamed tributaries (Illustrations 2-6)

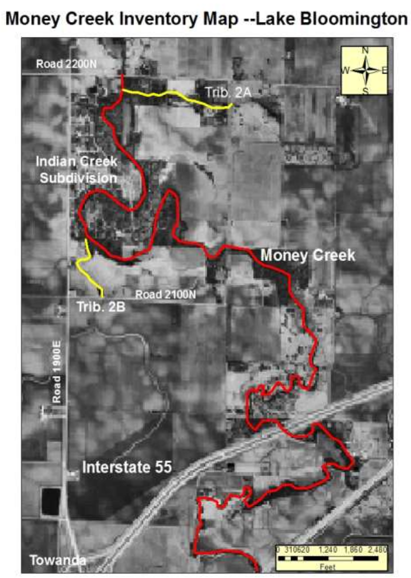


Illustration 2:Inventoried Streams Money Creek 2

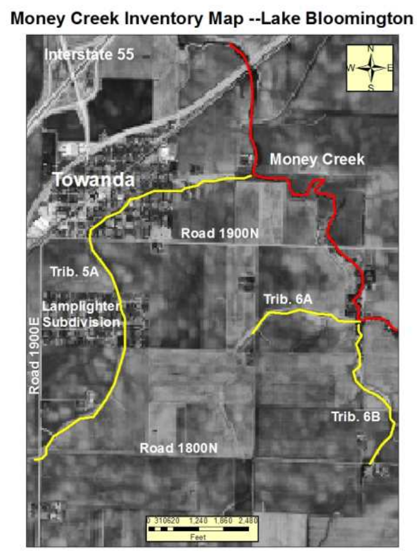


Illustration 3:Inventoried Streams Money Creek 2

Money Creek Inventory Map --Lake Bloomington

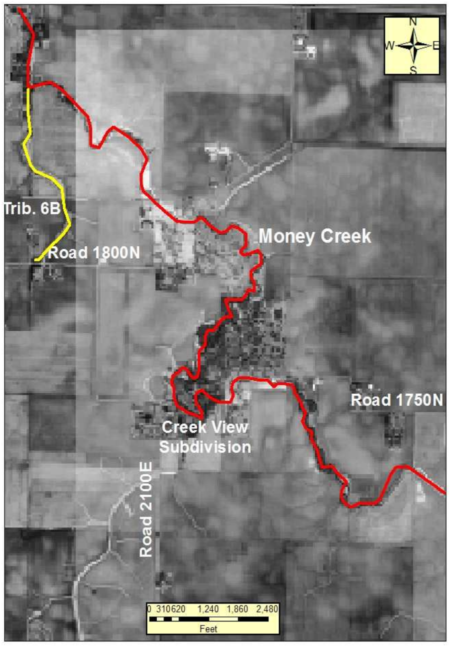


Illustration 4: Inventoried Streams Money Creek 4

1

Money Creek Inventory Map --Lake Bloomington

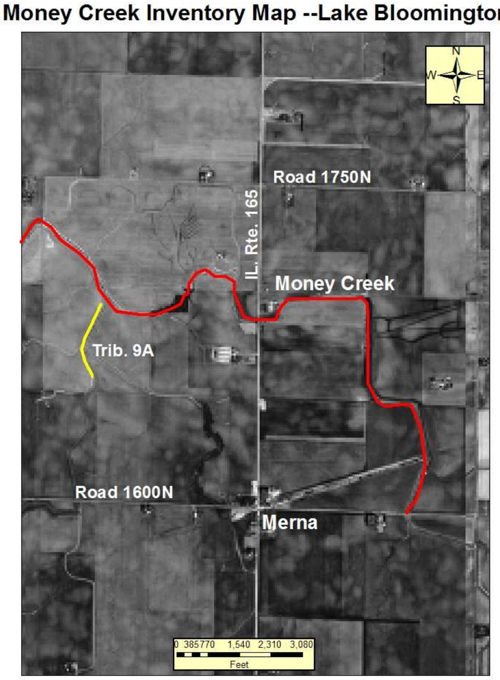
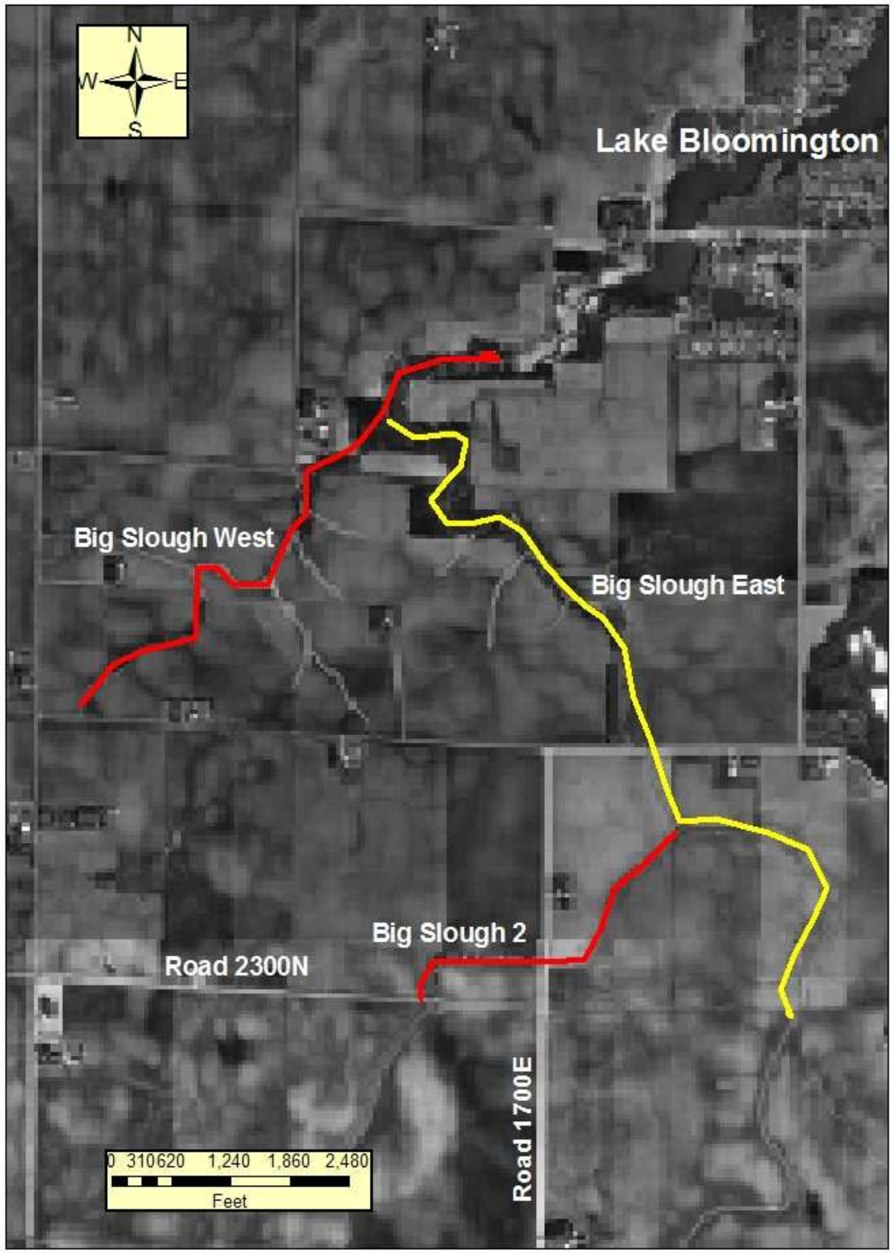


Illustration 5: Inventoried Streams Money Creek 5

Illustration 3: Inventoried Streams Big Slough

Big Slough Inventory Map --Lake Bloomington



The method used to inventory the channels is an expanded adaptation of the Rapid Assessment, Point Method of Erosion and Sediment Inventory Procedures for Illinois, April 2001, Natural Resources Conservation Service. The NRCS procedure is intended to use 160 acre sample plots to estimate erosion from all sources and then expand the results to a larger watershed. In this study only the “streambank” erosion section of the RAPM method was used to estimate sediment contributions. However, rather than use the 160 acre sample plots to estimate soil loss, a 100% inventory has been completed on the major streams as identified earlier. (RAP-M 2007)

A total of approx. 28 miles of channel were physically walked and streambank erosion calculated by estimating the length, height and lateral recession rate of each eroding streambank that met or exceeded the “moderate” level. Lateral recession rates were assigned based on field observations using the guidelines given in the NRCS procedure. Areas determined to have only “slight” streambank erosion were not individually inventoried however the lengths and erosion rates include estimates of contributions from these areas of “slight” erosion.

The method used to inventory the channels is an expanded adaptation of the Rapid Assessment, Point Method of Erosion and Sediment Inventory Procedures for Illinois, April 2001, Natural Resources Conservation Service. The NRCS procedure is intended to use 160 acre sample plots to estimate erosion from all sources and then expand the results to a larger watershed. In this study only the “streambank” erosion section of the RAPM method was used to estimate sediment contributions. However, rather than use the 160 acre sample plots to estimate soil loss, a 100% inventory has been completed on the major streams as identified earlier. (RAP-M 2007)

A total of approx. 28 miles of channel were physically walked and streambank erosion calculated by estimating the length, height and lateral recession rate of each eroding streambank that met or exceeded the “moderate” level. Lateral recession rates were assigned based on field observations using the guidelines given in the NRCS procedure. Areas determined to have only “slight” streambank erosion were not individually inventoried however the lengths and erosion rates include estimates of contributions from these areas of “slight” erosion.

Erosion Category Description		
Estimated Loss (ft/yr)	**Category**	**Description**
0.03	Slight	Some bare banks but active erosion not readily apparent. No vegetative overhang. No exposed tree roots. Bank height minimal.
0.13	Moderate	Bank predominantly bare with some vegetative overhang. Some exposed tree roots. No slumping evident.
0.40	Severe	Bank is bare with very noticeable vegetative overhang. Many tree roots exposed and some fallen trees. Slumping or rotational slips present. Some changes in cultural features, such as missing fence posts and realignment of roads.
1.5	Very Severe	Bank is bare and vertical or nearly vertical. Soil material has accumulated at base of slope or in water. Many fallen trees and/or extensive vegetative overhang. Cultural features exposed or removed or extensively altered. Numerous slumps or rotational slips present. Generally silty or sandy bank material, NOT glacial till or exposed shale bedrock.

Bankfull discharges in Lake Bloomington watershed fall near the typical 1.5 year return interval for rural streams, which means that the height to the top of the bank of the channel is typical for a rural stream. There is little down cutting of the streambed, but lateral movement of the channel may still occur.

- Over 83 percent of the sediment contributed from streambank erosion is generated from Money Creek. The streambank erosion inventory found the total sediment yield to Lake Bloomington from Money Creek alone to be approx. 1050 tons of sediment delivered annually.
- Stream channels inventoried are delivering to Lake Bloomington from 2 tons to 78 tons of sediment per mile of stream channel. The sediment generated from streambank erosion varies widely from the lowest at 1.7 tons per sq. mi.(Trib. 6A) to the highest at 77.8 tons per sq. mi. (Trib. 1B). While Money Creek is producing the most overall sediment since it is the major channel above Lake Bloomington through which approx. 80 percent of total flow can be attributed.
- Unlike Six Mile Creek above Evergreen Lake, Money Creek above Lake Bloomington does not show significant signs of downcutting. Therefore the primary source of streambank erosion comes from lateral bank migration alone. Of the 11 cross sections taken on Money Creek all were found to be in either CEM (Channel Evolution Model) stage 2 or 6, meaning there is no active degradation and/or widening within Money Creek.

- The extent and the magnitude of the CEM Stage 2 and 6 stream segments indicate there are no “system-wide” instability problems in Money Creek.
- Sediment delivery to Lake Bloomington from streambank erosion is significantly less that that found on Evergreen Lake. The total sediment delivered annually from streambank erosion in the Lake Bloomington watershed is estimated at 21 tons per square mile of drainage area while Evergreen Lake was estimated to be delivering 53 tons per square mile.

RAP-M Watershed Study

An erosion/sedimentation inventory was conducted for all land uses in the Lake Bloomington watershed in McLean County. The watershed totals approximately 43,100 acres or about 67.3 square miles. Sediment Delivery Rates (SDR) for each type of erosion occurring within the watershed were also calculated. The main goal was to estimate total sediment load to the lake from the main branch of Money Creek and the major tributaries. This study in its entirety can be found in Appendix III.

SUMMARY OF EROSION AND SEDIMENTATION IN LAKE BLOOMINGTON WATER SHED

In Lake Bloomington watershed, an estimated 106,800 tons of erosion occurs on an annual basis from the six major types of soil erosion: sheet, rill, ephemeral, shoreline, gully, and streambank. If this number is divided by the number of acres in the watershed, a rate of about 2.4 tons per acre per year is obtained, when ALL sources of erosion are considered. Approximately 29,900 tons of suspended and bedload sediment is actually “delivered” to the lake on a yearly basis. This estimated amount of sediment delivered is based on watershed-derived erosion and doesn’t represent a measured amount at the outlet end. This gives an overall rate of 0.69 tons per acre per year or 445 tons of sediment per square mile of watershed when the entire watershed is considered. At 30 pounds per cubic foot, this calculates to be 45.7 acre-feet of sediment deposition on an annual basis or at 40 pounds per cubic foot, it calculates to be 34.3 acre-feet of deposition per year.

Roughly 68% of the suspended sediment comes from sheet and rill erosion on all cropland slopes. This land makes up the majority of the watershed with B slopes, 2-5% slope, dominating the crop fields. Approximately 5% is coming from ephemeral erosion (channel) which seems a little low for this type of watershed. Gullies or concentrated flow areas are only contributing about 2% of the total suspended sediment. About 5% comes from streambank erosion (channel). Surprisingly, shore line erosion contributes nearly 14 % of the suspended sediment total. The A/B slope cropland areas appear to be contributing significant sediment but there is still much discussion on SDR rates for slopes less than 5%. It is believed presently that SDR base rates of 0.10 to 0.15 may be more appropriate. These lower rates would reduce sediment totals from the A/B slopes.

Bedload material is commonly sand and gravel and is very seldom measured as an output at the point of delivery, because of the cost and extensive sampling equipment that is necessary to complete this job. USGS gage stations do not routinely sample or measure this material. General estimates can be made, based on suspended sediment quantities. In Illinois, estimates of 5 to 30 percent of this total can be used. In this case, roughly 3,900 tons were added to the total suspended load delivered of 26,000 tons to arrive at the total delivered sediment amount of 29,900 tons. In most cases, bedload type, composition, and grain size coming from the streambanks and shore lines is used extensively in channel design and channel geomorphology studies. The gullies, streambanks, and shore line sources contribute the majority of the bedload to the system.

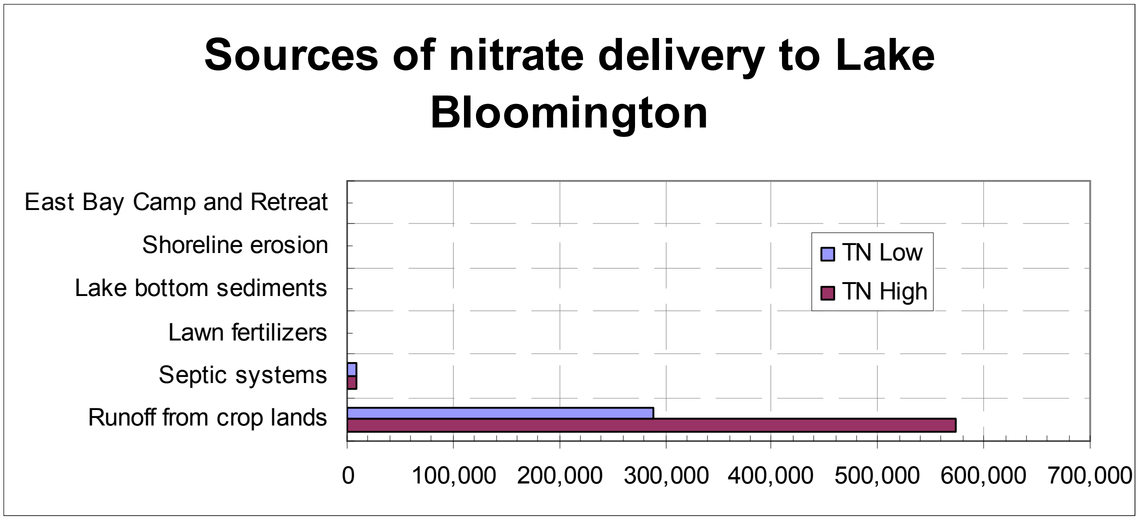
IN-LAKE SEDIMENT STUDY

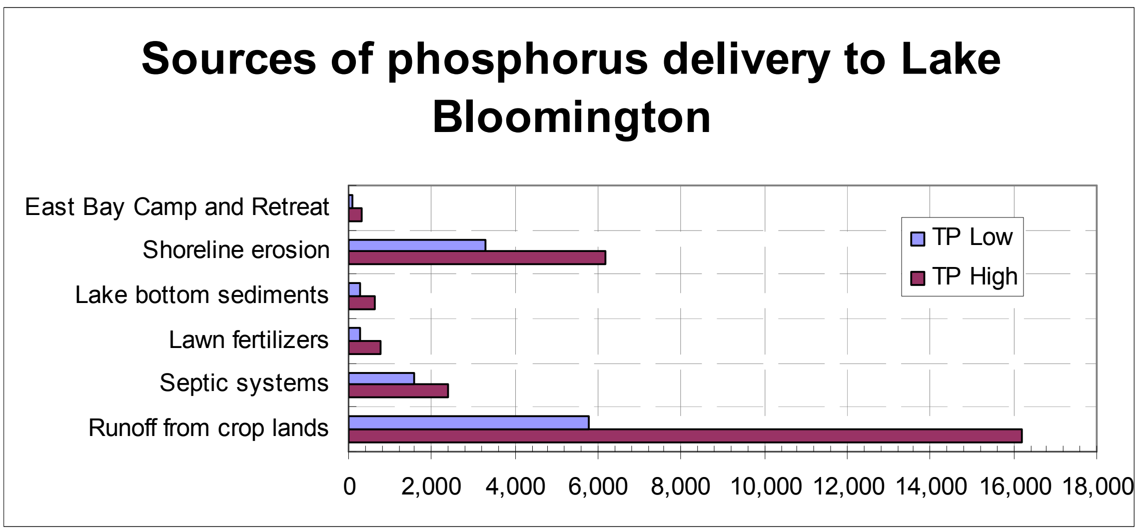
An in-lake sediment survey was completed in summer and fall of 2005 by Hanson Engineers Inc. The purpose of these surveys is multiple, but one major objective is to determine amount of sedimentation that has taken place in the lake since the dam was closed. The accompanying objective is to then determine how much storage volume remains in the lake and if long-range changes in a lake management plan are needed. They concluded that between the years of 1929 and 1999 approximately 2,436 acre-feet of sediment has accumulated in the lake or about 34.8 acre-feet per year for the entire 70 years lifespan. (See complete report: "Bloomington Lake Sedimentation Survey" by Hanson Engineers Inc., January 5, 2000)

If we compare the sediment that has accumulated in the lake to that which is estimated by this inventory, we can validate both methods and increase the degree of reliability of these projects. Bulk density of the sediment was not directly determined in their survey. If we assume 30 pounds per cubic foot, the total from our inventory would be 45.7 acre-feet on an average annual basis. If we assume 40 pounds per cubic foot, our acre-feet of annual sediment accumulation would be about 34.3. It appears from this that both the "watershed estimate" and the "sink estimate" were very similar. This gives us a certain degree of reliability in the processes that were applied within this watershed.

Erosion and Sediment Totals for Lake Bloomington

Location	Erosion (tons)	SDR	Sediment Delivered (Tons)
Cropland A/B	93,100	0.18	16,760
Cropland C/C+	1,810	0.55	1,000
Grasslands, CRP, Etc (All Slopes)	3,100	0.25	755
Woodland (All Slopes)	860	0.60	520
Ephemeral	2,000	0.6	1,300
Gully-Lakeside	280	0.85	240
Gully- Money Creek	285	0.70	200
Streambank	1,260	1.0	1,260
Shoreline	3,756	1.0	3,760
Total	**106,800**		**26,000**
		Suspended sediment	26,000
		Estimated Bedload (15%)	3,900
		Sediment transported to lake	**29,900**





Water Uses

The primary use of Lake Bloomington (572 acres) is as a reservoir for the City of Bloomington. The city has 3 pumps rated at 27.5 million gallons of water per day total pumping capacity at the lake. Pumpage levels vary widely between the years and during the year, depending on the weather and the water quality in both Lake Bloomington and Evergreen Lake, and (if other factors permit) maintenance of a water level to support recreational uses during the summer. At the current average pumping level of 11.4 million gallons per day, the lake contains enough water for approximately 250 days. In addition, leaseholders are permitted to draw water directly from the lake for irrigation purposes only.

Much of Lake Bloomington's shoreline is occupied by residences and camps (three) on land leased from the City of Bloomington. In addition, several city parks are scattered around the shoreline. Accordingly, Lake Bloomington experiences considerable recreational use including motor boating, waterskiing and tubing, sailing, canoeing and kayaking, swimming and fishing. In the winter there is some ice skating, ice fishing and snowmobiling when ice thickness permits, but given central Illinois climate this usually occurs only for brief periods, if at all, each winter. While residents and their guests are the primary recreational users, a marina provides mooring for boats (primarily pontoon boats) owned and operated by non-residents and many non-residents use the boat launch to put in boats on a daily basis.

Boats must be registered with the lake ranger and have complete access to the lake. Motorized boats are limited to a 40 horsepower motor and jet skis are prohibited. Outside of the large basins, the lake is posted as a "no wake zone" where motors are to be operated at idle speed. Since these zones are generally narrower and shallower than the basins, this regulation has the dual purpose of helping to minimize shoreline erosion due to wake action and enhancing boating safety. Most of the shoreline area in the "no wake zones" is natural as opposed to the primarily steel seawalls that front the great majority of the residential sites.

Lake Bloomington is inhabited by fish species including large- and smallmouth bass, hybrid striped bass, walleye, bluegill, crappie and catfish. While some species occur naturally, the Illinois Department of Natural Resources also direct a long-term fishery management plan for the lake. Since 1984, the lake has been stocked with almost 127,000 largemouth bass fingerlings, 575,000 walleye fingerlings and 25,000 hybrid striped bass fingerlings.

Conservation

Conservation Practices

The City of Bloomington, Pheasants Forever, and the McLean County Soil & Water Conservation District (SWCD) have provided funds for filter strips along waterways in both the Evergreen Lake and Lake Bloomington watersheds. Filter strips, an important Best Management Practice (BMP) and easily installed, had 213 acres formerly enrolled in the Lake Bloomington watershed in the Conservation Reserve Program (CRP) by the beginning of 2007.

The city of Bloomington has installed interlocking concrete blocks and seawall protection as erosion control measures around Lake Bloomington and plans to implement extensive shoreline stabilization measures, possibly to include riprap and plantings as described in the implementation section of this plan.

Nature Preserves in the Watershed

The Lake Bloomington/Money Creek Watershed contains some lands that are protected as nature preserves in which the emphasis is maintaining and restoring native vegetation. Such lands are very important in reducing the inputs of TMDL pollutants because they keep portions of the watershed in a native vegetational condition. Two entities have worked to establish such nature preserves: ParkLands Foundation and the Indian Creek Homeowners Association. In total, these preserves protect approximately 122 acres.

1. Parklands Foundation

ParkLands Foundation (www.parklandsfoundation.org) is a nonprofit, public membership land trust dedicated to acquiring, preserving and restoring natural areas in central Illinois since 1967. ParkLands manages over 1,500 acres of its own land, including the Merwin Nature Preserve along the Mackinaw River in McLean County, and also assists with the management of The Nature Conservancy's (TNC) Chinquapin Bluffs Natural Area in Woodford County.

Within the Lake Bloomington/Money Creek watershed, ParkLands Foundation owns 102 acres of lands that it manages and restores into native vegetational communities such as tallgrass prairie and deciduous woodlands.

The Moon Tract Nature Preserve consists of 42 acres of a former farm field/pasture that is located one-half mile east of Carver Corner on the north side of the road, on the central-west side of Lake Bloomington. The goal for this preserve is to restore the site to high-quality tallgrass prairie and oak savanna woodland through planting a diverse assemblage of native wildflowers, grasses, and trees using local ecotypes whenever possible.

The Breen Woods I Preserve consists of 38 acres of woodlands southwest of the East Bay Camp on the east side of Lake Bloomington. The site consists of a scotch pine plantation and an old field that is regenerating in trees. The goal for this preserve is to restore the site to native deciduous woodlands.

The Breen Woods II Preserve consists of two separate tracts totaling 22 acres and are located on the south side of the P.J. Kellar Blacktop approximately one mile east of the Lake Bloomington dam. The tracts are interspersed with land owned by East Bay Camp. The tracts consist of a high quality deciduous woodland dominated by oaks. Management is needed to prevent the invasion of maple trees that are displacing the higher quality oaks and hickory which provide more value to wildlife.

2. Indian Creek Homeowners Association

The Indian Creek Homeowners Association (www.frontiernet.net/~indiancreek) is a group of nearly 100 homeowners making up the Indian Creek subdivision. The wooded, rural subdivision is located within the Lake Bloomington/Money Creek watershed two miles due north of Towanda on the east side of County Road 1900. It straddles Money Creek about 3 miles southeast of where it enters Lake Bloomington.

The Indian Creek subdivision consists of approximately 160 acres of former farmland, pasture, and deciduous woodland, including approximately 60 acres of common ground that was deemed unsuitable for home construction. Approximately 20 acres of this common ground are being maintained by the residents as a private nature area with hiking trails along Money Creek. Management efforts carried out entirely by resident volunteers include trail maintenance, exotic species control, placement of bird houses, tree identification tags, and removal of "weed" trees in areas where older oak and hickory trees are still found. Future goals include continued restoration of the woodland, and establishment of a prairie in an open area that had previously been used as a soccer practice field.

Problem Statements

The primary problems in the Lake Bloomington watershed are that the level of phosphorus and nitrates are too high, and that sedimentation of the lake is occurring. The Lake Bloomington Steering and TAC Committees have addressed the sources of phosphorus, sedimentation, and nitrates and prioritized them.

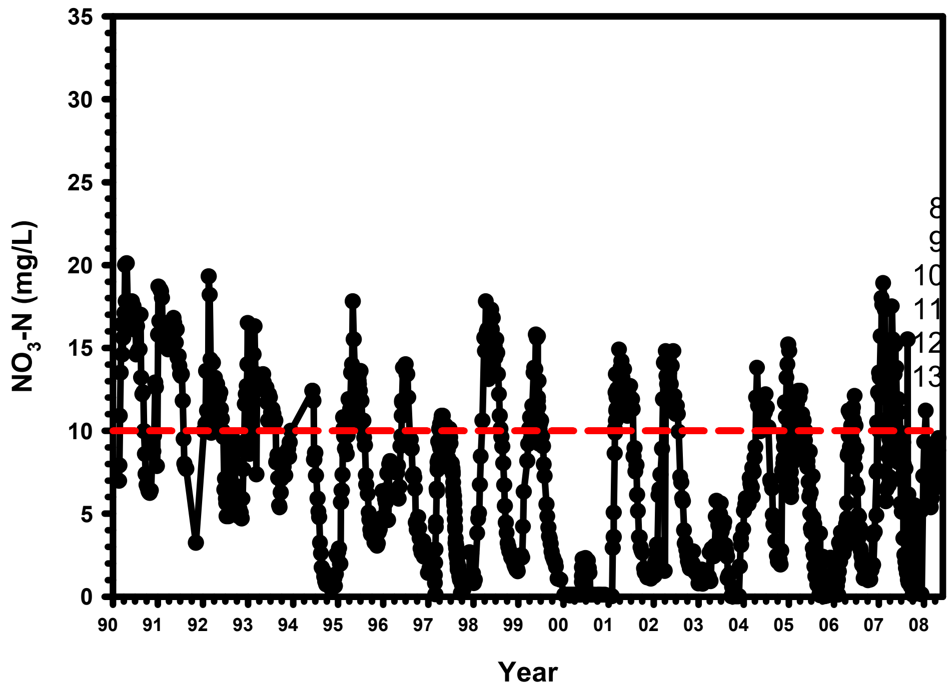
A. Inconsistent water supply to the City of Bloomington:

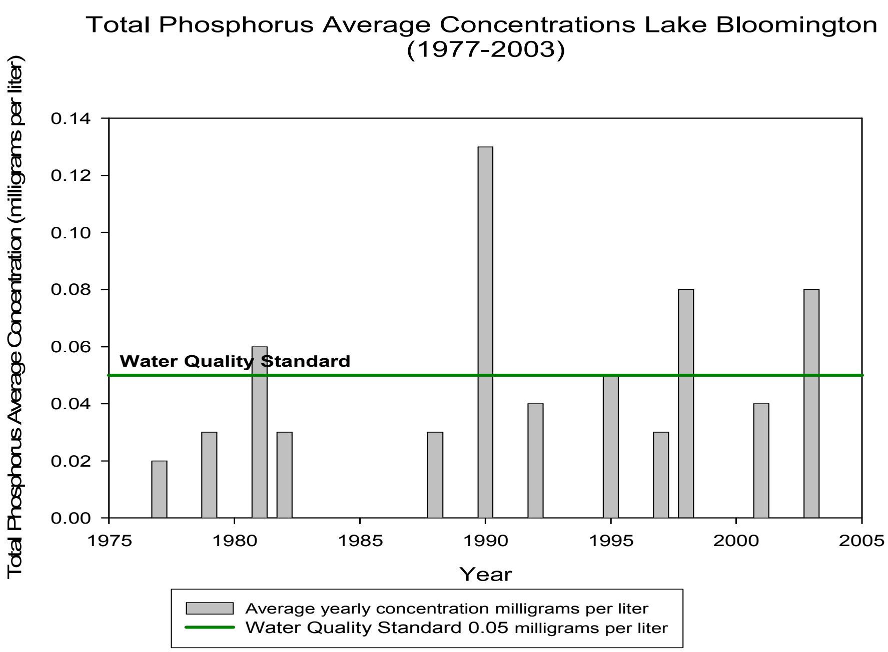
The IEPA TMDL phosphorus limit level (0.05 mg/l) may or may not be attainable, and as standards might be revised over the course of the implementation, the planning committee met to address problems in the watershed based on current regulations. The IEPA TMDL nitrate level is 10ppm. Sedimentation and/or turbidity does not have a mandated level. The plan will strive to implement strategies to work toward the current limits. Lack of data in many areas acts as a significant detriment to planning, therefore data gathering is part of future planning.

TOTAL PHOSPHORUS AVERAGE CONCENTRATIONS & RANGES LAKE BLOOMINGTON 1977-2003		
Year	Average Yearly Concentration (milligrams per liter)	Minimum – Maximum Concentration (milligrams per liter)
1977	0.02	0.01 – 0.04
1979	0.03	0.01 – 0.05
1981	0.06	0.01 – 0.2
1982	0.03	0.01 – 0.04
1988	0.03	0.02 – 0.22
1990	0.13	0.02 – 0.51
1992	0.04	0.02 – 0.09
1995	0.05	0.02 – 0.11
1997	0.03	0.01– 0.06
[illegible]	[illegible]	[illegible]

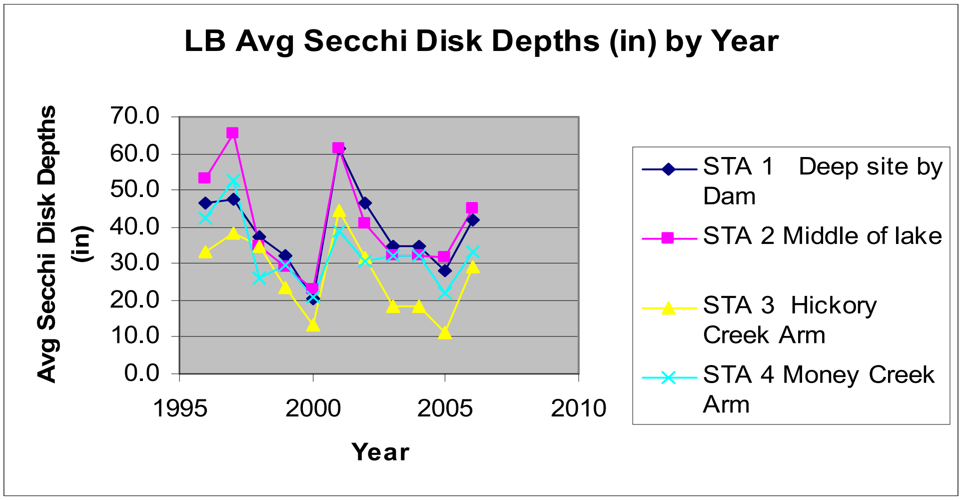
Lake Bloomington Nitrate-N Concentrations

B.





Water Clarity



Water clarity is a commonly used indicator of lake water quality. Water clarity (also called transparency) is measured in lakes using a Secchi disk. The 20 centimeter diameter disk is lowered into the lake and recording the depth at which it disappears from view.

Regular measurements of Secchi disk transparency are taken over the course of the summer and over many years. The general trend in transparency over the years gives an indication of the trend in water quality for the lake. Increasing water clarity indicates decreases in suspended sediment or decreases in nutrients entering the lake. Decreasing clarity indicates increases in suspended sediment or nutrients.

Continued shoreline, streambank, and sheet and rill erosion

An estimated 106,800 tons of erosion occurs on an annual basis from the six major types of soil erosion within the Lake Bloomington watershed. Approximately 29,900 tons of suspended and bedload sediment is actually “delivered” to the lake on a yearly basis.

The 2005 study by Wayne Kinney predicts approximately 3800 tons of sediment are generated annually in Lake Bloomington shoreline erosion.

C. Volume loss of Lake Bloomington by sedimentation

After the 1958 raising of the dam, at normal level Lake Bloomington held 7352 acre/feet of water. Since then 33% of the volume of the lake has been lost due to sedimentation. Overalll, 2436 acre/feet of sediment has entered the lake, with the average of 0.4% loss every year.

D. Nutrient impacts (high nitrates, phosphorus, algae, sedimentation)

1. Upland erosion from cropland is carrying phosphorus into the feeder streams.
   - Studies done by local fertilizer dealers show an average phosphorus level in area agricultural land is 37-42 pounds per acre.
   - Nitrogen from agricultural land is released by fertilizers applied to enhance crop production as well as being released naturally from the soil profile.
2. Agricultural animals in the watershed are contributing phosphorus through their waste.
   - There are 414 head of livestock in the watershed in 25 operations.
     - 286 cattle (6 operations)
     - 6 swine (2 operations)
     - 42 Horses (18 operations)
     - 80 sheep (8 operations)

E. Effects of Urban Development

1. Older or malfunctioning septic systems discharge nutrients to the watershed.
- 1,600-2400 lbs. of phosphorous per year.
- 8,400-9,500 lbs of ammonia per year

2. Urban lawn fertilization adds nutrients to the watershed.
- 7/10th of 1% (302 acres) of the watershed is urban lawn area
- total input data is unavailable, but data from studies indicates that urban fertilization has less than 1% of the nutrient load to the watershed.

3. Urban construction runoff contributes excessive sediment and phosphorus to surrounding surface waters.
- Construction sites that are mass graded are often left free from protection the entire year
- Rich black soils high in organic matter are stripped off and expose highly susceptible subsoils to erosive elements
- Compacted soils on construction sites reduce infiltration of rainwater and contribute more runoff and therefore erosion of highly susceptible soils

- Rain events occurring on one acre of a construction site can contribute 20 times the sediment or more that of typical agricultural lands of same soil type and grade if not protected using proper soil erosion and sediment control BMP.
- The lbs of Phosphorus contributed by these lands is only obtainable through specific analysis of soils data and compliance with recommended NPDES Phase II requirements for construction site BMPs.
- Nitrogen, associated with eroded soil, from construction sites results in a negligible amount of nitrate input to surrounding surface waters.

4.Increase in impervious surfaces

- Reduced groundwater recharge
- Increased flashiness in receiving water bodies
- Increased flow/velocity in receiving streams
- Increased temperature of receiving waters
- Increased delivery of urban pollutants

F. **Impacts to recreational resources and wildlife habitat**

1. Fish survey data indicates that Money Creek has an IBI index of 24-30, which indicates it is Class Low.
2. Game fish management objectives have not been met in Lake Bloomington due to contributions of sedimentation and water level fluctuations.
3. Studies have shown that carp in the lake increase turbidity and resuspend phosphorus in the lake.

G. Gaps in scientific information

1. Biota information.-Further information on the plants and animals of the watershed is needed to:
   - track changes in water quality;
   - improve knowledge of the presence and health of any Illinois listed species (Illinois Species in Greatest Need of Conservation, Illinois Threatened, Illinois Endangered);
   - counteract current ecological degradation.

Regular stream surveys of mussels, fishes, and EPTs (invertebrate groups ephemeroptera, plecoptera, and trichoptera) will provide an important biotic index of water quality. Surveys searching for and restoring listed species will ensure that our natural biotic legacy is known, appreciated and protected. Ecological health surveys and ecological restoration of public land and cooperating private land will help reverse the negative impacts of invasive species (e.g., garlic mustard) and overabundant native species (e.g., maple trees, white-tailed deer) that are degrading the native ecosystems, thereby reducing their ability to retard soil erosion, ameliorate high and low flows, and act as a natural water purification agent.

2. Tile information in watershed in incomplete and not collected in an organized coordinated manner.

3. Discharge from onsite waste systems from homes adjacent to Lake Bloomington in not measured in any manner at this time.

4. Gauging stations from Money and Hickory creeks needs to be restored to collect current data.

5. Inadequacies in the modeling.

Future modeling efforts can benefit from improvements in data collection. Some specific data needs that need to be considered are:

- local measurements of precipitation and pan evaporation;
- updated measurements of flow from Money, Hickory and other creeks;
- direct measurements of septic flow along the lake boundary.

In addition, there should be coordination with The Nature Conservancy's modeling efforts in the Mackinaw River valley that includes this watershed. Finally, expert watershed modelers should be consulted to establish the key parameters that need measurement for future modeling efforts and assist in choosing the most appropriate models for this type of watershed.

H. Adequacy of knowledge, awareness of, and incentives to implement BMP’s and other suggested strategies in the watershed

There are numerous challenges for the implementations of best management practices (BMPs) including, for example, funding challenges, staffing challenges and educational challenges. While the Lake Bloomington watershed employs some BMPs, including nutrient management programs and filter strips coordinated through the NRCS, more BMPs could be employed.

While not measurable, anecdotal evidence suggests significant outreach programs (i.e. education and marketing) result in higher utilization of both existing and proposed programs.

Ongoing education and information to stakeholders of the Lake Bloomington watershed, including but not limited to funding agencies, is imperative to implement BMPs in the watershed.

Goals/Objectives

There are three water quality issues in Lake Bloomington: nitrate/nitrite levels, phosphorus levels, and overall increased sedimentation. The goals are geared toward reductions in these areas. Goals are divided as to the three geographical areas in the watershed: the Riparian Area, which included the lake itself and all shoreline, stream banks, and feeder streams; The Urban Area, which includes all urban high density developments in the watershed; and the Agricultural Area which is the majority of the watershed land use.

Riparian Area Goals:

1. Streambank erosion

    Stabilizing the streambank erosion on the lake feeder streams will reduce the amount of phosphorus entering the lake by 20%.

1. Lakeshore erosion

    Controlling lake shore erosion will reduce the amount of phosphorus entering the lake by 60%.

2. Internal Loading

    The destratifier is presently responsible for reducing the amount of phosphorus held in the deep zone of the lake. We would expect that the effectiveness of the destratifier would continue. The destratifier increases the oxygenated zone from 16 ft to 30 ft. The oxygenated zone has approximately 65% less phosphorus than the anoxic zone.

Urban Area Goals:

1. Development of Construction Erosion and Sediment controls

    Develop and enforce ordinances to control the discharge of sediment with associated phosphorus so that water leaving these sites does not contribute to the turbidity of receiving water bodies.

2. Urban Lawn fertilizer reduction

    An increase in educational programs will raise awareness in the community to low or non-chemical lawn care.

3. Urban Septic system replacement and inspection

    a. Replacement of inadequate septic systems as detected by inspections would reduce the amount of phosphorus and nitrates entering the watershed.

b. Attaching the Lake Bloomington developed area to the Bloomington-Normal Water Reclamation District would reduce phosphorus and nitrates from onsite waste delivery entering the watershed by 100%.

Agricultural Area Goals:

1. Voluntary nutrient management plan. (Specific goals articulated in the table following.)
2. Upland Cropland erosion

   a. Reduce delivery of sediment from upland erosion caused by sheet and rill, and ephemeral erosion by 21% in the next 10 years to the lake if there is 100% compliance. The expected compliance is 25%. This will be accomplished through implementation of agricultural Best Management Practices such as no-till/strip-till, grassed waterways, terraces and water and sediment control basins, filter strips and field borders. Along Agricultural corridors, reduce streambank and shoreline erosion and the accompanying sediment delivery to the lake by 16%, at 100% compliance, through streambank and shoreline stabilization projects. The expected compliance is 20%. These practices will include rock riffles, stream barbs and longitudinal peak stone toe protection.
3. Livestock Management Plan

   a. The estimated phosphorus load created by livestock operations in the Lake Bloomington Watershed is 1503 pounds. Based on NRCS staff surveys of the 6 livestock producers in the watershed, it is believed that 17% of the producers would voluntarily engage in BMPs. However engaging this 17% would eliminate approximately 25% or 376 pounds of phosphorus.
4. Tile Drainage

   Based on a study by David Kovacic, it is estimated if 5% of the estimated tile area that is drained in the watershed is converted to wetlands (382 acres), then a 46% reduction of nitrogen load would be obtained, which would be 95% of the required reduction of TMDL requirements. NRCS/SWCD staff has estimated that 20 acres of constructed wetland would be realistic.

Lake Bloomington Nitrate/Nitrite Reduction Goals				
Source	**Estimated Nitrate Load (tons)**	**Estimated participation Per unit**	**Estimated reduction of existing load**	**Projected reduction percentage**
Field Tile runoff	72,000	63%	50% (36,000 lbs)	5.8%
Post-construction urban runoff	Data not available			
Septic tank Ammonia	8,700	See Problem Statement		
Agricultural Livestock	41,338	25%	25% (1034.5 lbs)	1.6%
Feeder stream delivery	591,319	8%	5% (29,825 lbs)	4.8%
Estimated Total	718,544	-------------	66,859 .5 lbs	9.3%
Mandated Reduction Total	**----------------**	**-------------**	**622,441 lb/yr**	**48%**

Lake Bloomington Sedimentation Reduction Goals				
Source	**Estimated Sediment Load (tons)**	**Estimated participation per unit**	**Estimated reduction of existing load**	**Projected reduction tons**
Streambank erosion	1,260	5,434/217,360 feet	20%	315
Sheet and rill erosion	20,355	18,000/36,000 acres	5%	1,018
Shoreline erosion	3,688	6,546/55,580 feet	20%	738
Post-construction urban runoff	Data not available			
Urban construction runoff	Data not available			
Estimated Reduction Total		**N/A**		**2,071**

Lake Bloomington Phosphorus Reduction Goals				
Source	**Estimated Phosphorus load (lbs)**	**Estimated participation per unit**	**Estimated reduction of existing load**	**Percentage Of Mandated Reduction**
Streambank erosion	1,237	5,434/217,360 feet	20% (247 lbs)	3.65
Sheet and rill erosion	19,988	18,000/36,000 acres	5% (999 lbs)	14.5
Shoreline erosion	3,087	6,546/55,580 feet	60% (1852 lbs)	27.4
Field tile runoff	198	15,360/36,000 acres	50% (94 lbs)	1.5
Agricultural livestock	1,503	1 /4 operations	50% (376 lbs)	5.6
Post-construction urban runoff	Data not available			
Urban Lawn fertilizer	Data not available			< 1%
Internal lake loading	351	100%/ 1 unit	65% (228 lbs.)	3.3%
Urban septic system	2,000	See Problem Statement		
Estimated ReductionTotal	-------------------	--------------------	3,568 lbs	52.7%
Mandated Reduction Total (89% of existing load)			**6,762 lb/yr**	

An error was found in the original Lake Bloomington TMDL report estimating the needed reductions to meet Illinois Environmental Protection Agency water quality standards. This errata sheet is dated February 19, 2008; therefore, the errors were found after we had completed our calculations for this watershed plan. TetraTech recalculated the needed reductions based on their revised load estimates, with the new reductions for the watershed now estimated to be 34% for nitrate-N and 66% for total P. We report these new reductions for information only, and have not adjusted our estimates.

Best Management Practices

Riparian Practices

Lakeshore Erosion Control

Solutions considered to halt the bank recession in this area are evaluated in this report based on seven factors.

1. The solution should first provide long term control of the receding bankline, in excess of 50 years.
2. The solution must be socially acceptable and aesthetically pleasing given the public use of these areas.
3. The solution must allow for installation during normal lake operation levels.
4. Contamination of the lake during construction should be at the lowest possible level.
5. If possible it should enhance the aquatic habitat and improve fisheries in the lake.
6. Cost per foot of bank is always a consideration.
7. The solution should maintain as much lake volume as possible.
8. All erosion class 2 to class 6 shoreline (27,618 feet) would benefit from stabilization.

Using these criteria, the tradition method of bank control using "sheet piling" in the residential portion of the lake has not been considered due to cost and aesthetics, assuming a more natural looking bankline is the desired result. Six alternative approaches were considered in the 2005 Study.

All six traditional alternatives would utilize a stone bankline below the waterline and extending approximately 2 ft. above the waterline. While there is not a comprehensive study of the wave action on Lake Bloomington, this height proved to be sufficient in the study conducted on Evergreen Lake and given the similar size and orientation the Evergreen Lake results will be applied to Lake Bloomington. This stone bankline will provide the bank stability to prevent additional bank recession and will be constructed of RR-5 stone which will provide a rocky substrate as an additional element useful for aquatic habitat enhancement.

Initial consideration was given to utilizing the existing cobble eroded from the bankline to supplement the stone requirements of the bank protection measures. However, discussions with fisheries biologist, Mike Garthaus from IDNR suggest that the cobble found in the lake provides a useful habitat element that should be left in place for fish enhancement. The shallow water depths found along the eroding banks are also a negative factor for fisheries; however the alternatives proposed will all reduce the extent of the shallow water area near the bank by placing fill material within the lake near the present shoreline.

Armor Stone Breakwaters with Transitional Wetland Alternative

An additional alternative to the traditional shoreline protection alternative selected in the 2005 report is Armor Stone Breakwaters with Transitional Wetlands. Normally recommended for reservoir shorelines where the fore slope has been reduced to at least 8h:1v. Toe protection for the breakwater is generally provided by a riprap apron placed on the fore slope.

A proposed armor stone breakwater is sometimes considered to be a hazard to boating, however, when located near the original shoreline, the structure is in shallow water where an operating power boat would be in imminent danger of running aground regardless of the existence of a breakwater. A shallow water location also minimizes the required quantity of stone.

An armor stone breakwater stops shoreline retreat, provides an area of quiet water near shore where a beneficial wetland habitat can flourish and space is available for the back slope to attain it's angle of repose.

At Kinkaid Lake in Jackson County, IL , just a few years after it began, armor stone breakwater shoreline work already is reaping clear benefits. New wetlands created between the rock berms and the shore are filled with vegetation and aquatic life where bare dirt once existed. Biologists report 121 species, including two state-threatened species, have moved in to colonize those new wetlands. Even the view from above looks different as water clarity improves. (IDNR, Outdoor Highlights, 7/07)

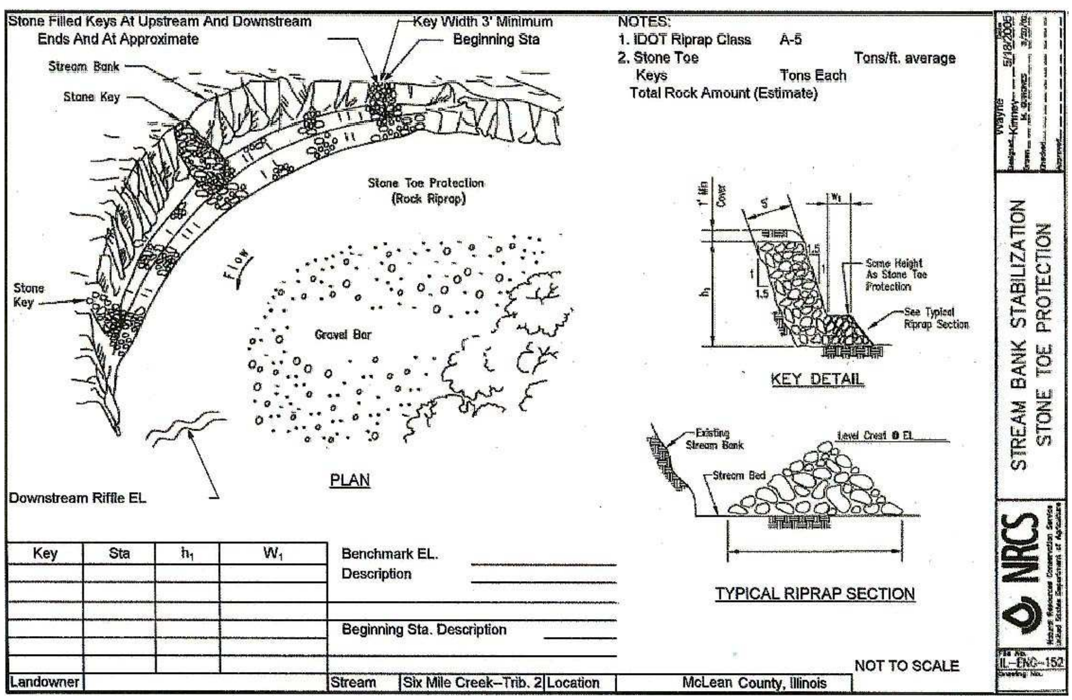
Traditional, shoreline stabilization has been accomplished by using heavy construction equipment to build temporary roads, reshape the eroded shoreline, and place riprap. This method can be destructive to valuable woodland habitat and steep slopes, particularly in areas where there are no existing roads. Armor Stone Breakwaters can also be developed using construction methods that utilize boats to deliver materials to remote shorelines without damaging the woodland habitat or steep slopes. The Armor Stone Breakwaters do not require reshaping the shoreline and facilitate a diverse shoreline habitat.

Streambank Erosion Control

The Bankfull Width over Bankfull Depth ratios (W/D) range between 8 and 15 with the exception of Cross Section #2 on Big Slough East with W/D ratio of 5.5. Therefore the recommendation is to avoid use of Stream Barbs and/or Bendway Weirs to redirect flow from eroding banks. Use of these techniques is only applicable to wider W/D ratio channels with significant bar material that can be easily moved by the channel flow. The most effective and economical treatment in the majority of locations within the Lake Bloomington watershed will be to “harden the toe” of the eroding banks to prevent continued undercutting and slumping of banks. In isolated cases there will be a need for limited use of “grade control” to halt active downcutting. Stone Toe protection (STP) and Rock Riffles (RR) are the preferred methods recommended.

Stone Toe Protection (STP): (Fig. Below) Each eroding bank can be protected with non-erodible materials. Typically meandering bends similar to those in the Lake Bloomington watershed can be stabilized by placing the hard armor only on the toe of the bank. The most common method is to use quarry stone properly sized to resist movement and placed on the lower one third of the bank in a windrow fashion. This technique is called Stone Toe Protection (STP) and is widely accepted and successful.

There are a few obstacles to overcome in this watershed to make use of STP successful. First, some of the bends in the channel are “unstable” having a radius of curvature less than 1.5 times the channel width. Research has shown that bends with a radius of less than about 1.8 times the bankfull width are unstable and tend to “cutoff”. In order to use STP successfully under these conditions the channel would need to be “realigned” in order to produce a radius of curvature that falls within the range of “stable” geometric planforms. Installing STP without making these channel adjustments would be to risk failure of the STP and encourage channel cutoffs leaving the STP application in an “abandoned” reach of channel. Second, the total amount of eroding bank will require many sections of the stream to have STP on one side or the other, resulting in extensive use of STP and a very costly application.

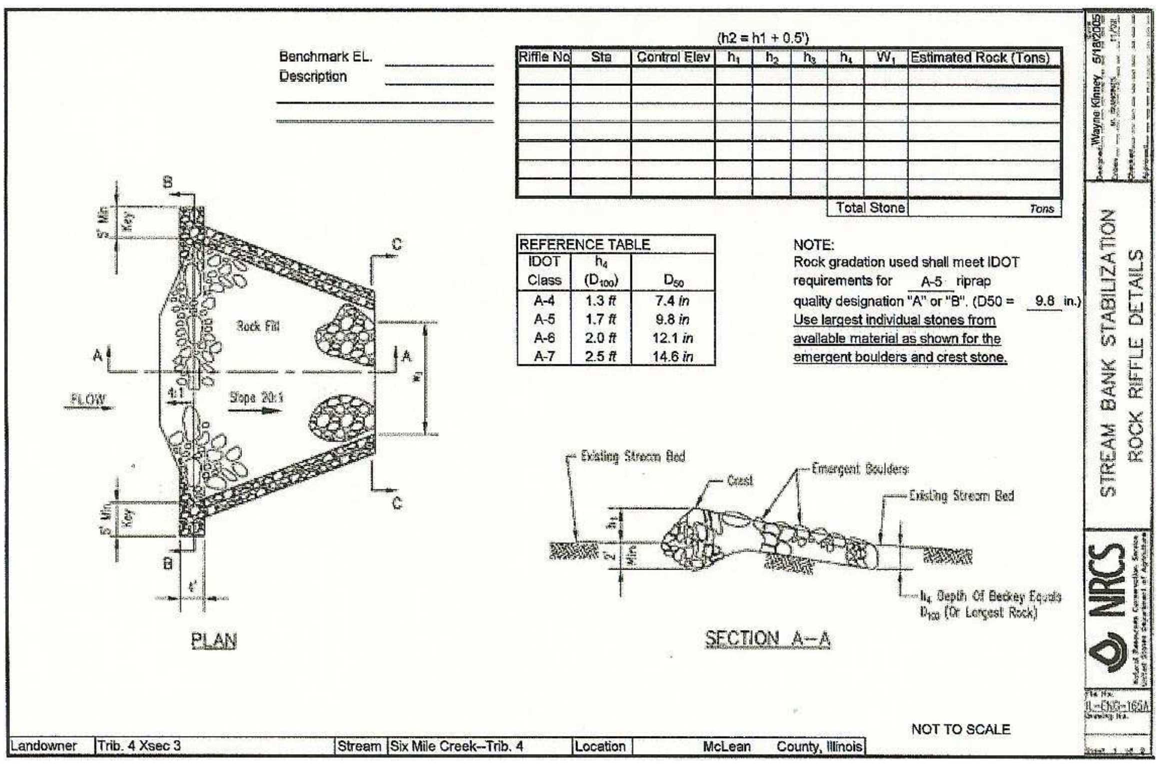


NRCS Standard Drawing of Stone Toe Protection

Rock Riffle Grade Control (RR): (Fig. below) Use of loose rock grade control structures at the “natural” riffle locations in a stream will create or enhance the “riffle-pool” flow sequence found in natural channels. In stable systems this alternating “riffle-pool” sequence dissipates the energy in the stream and allows the streambanks to remain stable with little or no appreciable lateral movement. By installing RR in an incised channel, the riffles will raise the water surface elevation resulting in lower effective bank heights, which increases the bank stability by reducing the tractive force on the banks.

Research has found that stable streams have a riffle every 5 to 7 bankfull widths and that at this natural spacing the stream is still able to transport the sediment generated in the watershed. This is crucial because failure to be able to transport sediment would result in the channel filling with sediment and losing its capacity. Such stable streams therefore have a well developed floodplain at the one to two year return interval discharge rate. Thus the flows larger than this go “out-of-bank” and dissipate excess energy over a wide floodplain, allowing the banks to remain stable and intact.

In Lake Bloomington watershed only Big Slough East has significant need for rock riffles. Rock riffles are also recommended for some tributaries to Money Creek, however these are smaller drainage areas and the total impact to Lake Bloomington is small from these sites.



NRCS Standard Drawing for Rock Riffle Grade Control

Destratification

The destratifier is presently responsible for reducing the amount of phosphorus held in the deep zone of the lake. We would expect that the effectiveness of the destratifier would continue. The destratifier increases the oxygenated zone from 16 ft to 30 ft. in the entire volume of the lake. The oxygenated zone has approximately 70% less phosphorus than the anoxic zone.

Agricultural Practices

There are several Agricultural BMP's that are proven to reduce sedimentation, nitrate and phosphorous levels. They include nutrient management developed by TSPs (Technical Service Providers) based on proven recommendations that manage the amount, form, timing and placement of nutrients, so nutrients are available for plants and least likely to leave the farm. Other non-structural practices that can benefit the streams, Lake Bloomington and overall environment are no-till and strip-till on cropland areas and filter strips, and riparian buffers along field borders, windbreaks and streams. Structural practices that can reduce nutrient inputs include wetlands, grassed waterways, grade stabilization structures and drainage water management.

Wetlands are a Best Management Practice (BMP) that is proven to reduce nitrate and phosphorous levels entering lakes and streams. Wetlands in the watershed near agricultural lands that intercept tile drainage are a practical and simple tool to improve water quality. The logistics of siting wetlands that have tile outletting into them are challenging in many locations, while the cost of wetland installation can be considerable. Landowners are not always receptive to implementing wetlands because of production mindsets to drain cropland and the long term loss of production cropland to ag wetlands.

Urban practices

Lawn Chemical Application

There are several straightforward solutions to the use of lawn chemicals in the Lake Bloomington Watershed, particularly in the "shoreland buffer," the very sensitive strip of land along the edge of the lake.

- Rely exclusively on fertilizers with no phosphorous and shift from the use of synthetic, fast-release N fertilizers to slow-release synthetics or organic fertilizers.

- Shift from pure cool-season turfgrass lawns to mixed clover-turfgrass lawns by overseeding existing lawns with white clover.
- Reduce the amount of lawn through conversion of sections of grass to rain gardens and/or beds of wildflower and native grasses. Rain gardens or swales and berms would be particularly helpful along sloping shoreline and between downspouts and the lake.
- Rain barrels would also help to reduce downspout flows into the lake.
- Go entirely native, especially along the shoreline buffer along the water's edge. All turfgrass could be replaced with sedges, native grasses, wildflowers, groundcovers, shrubs and trees.

Implementation strategies/Alternatives

Riparian Implementation:

Lakeshore developed areas implementation strategies

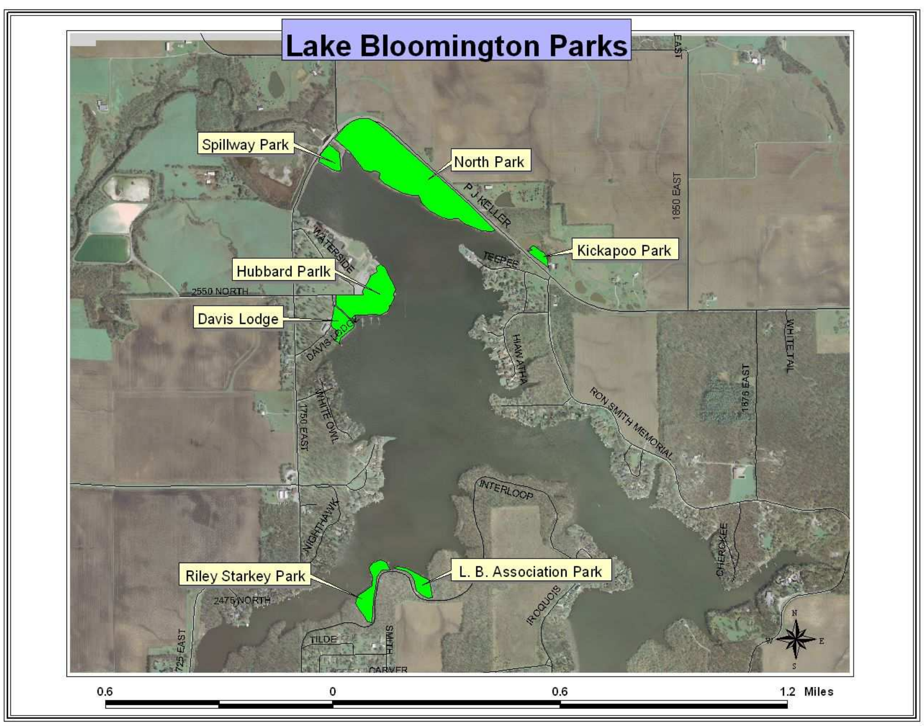
Use North Park, Riley Starkey, and Association Park, as the equivalent of agricultural experiment stations to develop examples of best practices landscaping for the environmentally sensitive shores of Lake Bloomington. North Park could play a particularly important role in experiments with a shoreland buffer of prairie grasses and wildflowers. We also need to determine whether there is a temperate region equivalent to vetiver grass that could be planted directly into the bare soil in the steep banks. Vetiver grass has an extensive record of success in land reclamation projects in the tropics and semi-tropics, so a temperate climate equivalent would greatly assist in efforts to stabilize steep banks with exposed soil.

The sun burnt areas of both North Park and Association Park can be used for experimentation with white clover/turf grass mixes. The parks can also allow demonstrations of berm and swale rain gardens, and trials of dry, shade tolerant groundcovers (e.g, Adonis amurensis, Epimedium, Pulmonaria saccharata, Symphytum grandiflorum, Vinca). Better yet, go native and use various prairie/woodland sedges (Carex jamesii, Carex, pensylvanica, Carex bicknellii) and woodland groundcovers and plants, such as sharp-lobed hepatica (Hepatica acutiloba), prairie smoke (Geum trifolium), flowering spurge (Euphorbia corellata), etc., to cover the presently barren, erosion-prone soil.

After experiencing successes in the pocket parks and the Keller Park, turn the grounds of the Davis Lodge into a model of ecologically sound lakeside landscaping. Among other things, this would likely involve:

- Creating swales and berms along sloping areas of lake frontage with water-loving prairie grasses, sedges, and wildflowers planted in the swales. Swales and berms function in a manner analogous to buffer strips between agricultural land and streams (Hemenway 2000:83-86). These “rain gardens” would capture any run off and filter the water before it reaches the lake (Bannerman and Considine 2003).

- Reducing the total area given over to lawn grass by converting sections of the grounds to native grasses, sedges, and wild flowers. This will demonstrate the beauty and elegance of native plants that require *neither fertilizer nor water* (Nowakowski 2004; Burell 1999: 56-57, 112-113, 117, 120,156-157,190-191198-199,282-291) while increasing habitat for bees, butterflies, and birds (Lewis 1999; Stein 1993; Tufts 1993).
- Transform the remaining grass lawn to a mixed clover/grass turf . As noted, a clover/grass turf needs neither fertilizer nor pesticides, requires considerably less or no watering, and will remain refreshingly green when exclusively grass turfs turn dusty tan.
- Encourage lakeside residents to convert their lawns to mixed clover/turfgrass and to adopt some variant of the Yard Smart and/or Wildlife Habitat programs sponsored by the Ecology Action Center of Normal (ECA-1, 2007). Successful experiments at the pocket parks can serve a strong research and educational tool and a model of best management practices, as can some of the residences along the lake. Organize a yard tour of the transformed parks, grounds of the Davis Lodge, and willing lakeside residents who have already adopted ecologically sound, non-polluting practices in their landscapes.



Once successful examples of mixed clover/turf grass lawns exist, create incentives for the use of best management practices and disincentives for the use of fertilizers with phosphorus, fast-release sources of N (e.g., urea, ammonium nitrate, ammonium sulfate, liquid fish solutions), and pesticides (e.g., "weed 'n feed" mixes); encourage non-pesticide fertilizers with slow-release sources of N (coated ureas, urea formaldehyde); and create incentives for the use of slow-release organic fertilizers (corn gluten pellets, soy, etc.).

Lakeshore Erosion Implementation

Due to the steep, high banks, and extreme fluctuations in water levels, biotechnical means of shoreline stabilization were excluded from consideration. The recommended alternative selected in the 2005 Study, based upon cost and impact upon near shore woodland cover is Stone Toe Protection (STP) which when applied along the eroding sections to an elevation of 721.5 will provide the stability needed to protect the base of the bank and prevent any additional recession of the bank line. The STP will be placed at a distance from the eroding bank to allow for the bank to be sloped on a 2:l slope and vegetated by balancing the cuts and fills so that no material need be transported to or from the site.

This alternative has the advantage of allowing initial placement of the STP from the top bank before any earthwork begins, drastically reducing the opportunity for lake contamination. The use of STP also places the maximum volume of stone at the base of the slope where erosion is most severe. This provides additional safety and effectiveness to the use of STP as there is sufficient stone to launch into any area that may erode on the lake side of the STP and still maintain protection of the shoreline. The disadvantage of this treatment is the volume of stone needed and the loss of vegetation along the top bank.

The advantages STP treatment are:

1. No net loss of lake volume as excavated volume will exceed the volume displaced by STP.
2. Reduced volume of material needed from top bank to create 2: 1 slope.
3. Preservation of more existing vegetation on top bank.
4. Lake levels normally reach the level needed each year to make this alternative

feasible.

5. Construction during low lake levels will keep contamination to an absolute minimum as no equipment will need to be in the water for construction.

6. STP can be placed prior to excavating lake bed to prevent silt from re-entering the lake.

7. The 12 to 15 foot bench along the lake side of the STP for equipment operation will prevent any excessive undercutting of the STP by equipment operators or future erosion.

8. Cost is reduced while preserving the advantage of durability and long term protection with little need for maintenance.

9. Cut slope above 721.5 can be easily vegetated and maintained to provide a natural looking bank that will be aesthetically pleasing.

10. Excavation in the lake will reduce the area of shallow water which will enhance the aquatic habitat within the lake. Additional enhancements within the deepened water areas can be added during construction as recommended by the IDNR Fisheries Biologist.

The recommended treatment is applicable to all sites and discussions with Richard Twait, Superintendent of Water Purification, indicate that fluctuations in Lake Bloomington during normal operations will provide ample opportunity for installation during low water periods. The choice of Stone Toe Protection is recommended primarily because of the additional durability and safety of the design.

Streambank Erosion Implementation

Brief Narrative of Stream Segments and Treatment Recommendations:

While there is significant streambank erosion in the Lake Bloomington Watershed, it is not as critical nor as severe as that found in the Evergreen Lake Watershed. Money Creek and its tributaries lack evidence of widespread systematic stream instability. This makes the treatment recommendations easier to apply in that there are no negative consequences to making channel improvements in a random piecemeal manner as landowner interest may dictate. With no system wide problems, there is little danger of stream channel protection projects being negatively impacted by changes in the channel characteristics and adjustments taking place upstream or downstream. There are a few exceptions to this generalization where Rock Riffle grade controls have been recommended, however these sites are relatively small and the degradation is not severe, nor rapid, therefore many opportunities are available to work in and around these sites with willing landowners.

Money Creek and Big Slough East should be the top priority for streambank stabilization with the highest priority given to sites rated with “severe” erosion closest to Lake Bloomington. Second priority would be “severe” erosion sites on tributaries to Money Creek.

Money Creek

No active degradation is occurring and no significant degradation has occurred in the past. Lateral bank protection is only needed in eroding areas where the channel is meandering by undercutting existing banks causing bank slumping. Use of Stone Toe Protection (STP) at 0.75 ton per foot is the general recommendation.

Tributary 1A

No inventory or recommendations will be made because information concerning this tributary is not available.

Tributary 1B (1,320 feet)

This is a very small tributary draining only about 30 acres. There is however a significant degradation problem about midway on this tributary. Use of Rock Riffle grade control or a traditional waterway or dry dam would be alternatives to treat this segment.

Tributary 1C (2,640 feet)

The lower end of this tributary has been extensively channelized in the past with one segment having been moved several hundred feet by cutting through a high ridge. Since the drainage area is only 1.4 sq. miles the existing channel in this reach has developed a small floodplain to reach CEM stage 6, i.e. it is stable with an active floodplain. Treatment recommendations are limited to STP where lateral migration is occurring.

Tributary 1D (2,376 feet)

The lower end of the tributary has been extensively modified and there is some evidence of downcutting from just above the confluence with Money Creek to a point approx. 0.25 mile upstream. This lower segment would be benefited by Rock Riffle Grade control structures. Above this point only STP is needed for lateral migration control.

Tributary 2A (2,640 feet)

This tributary is degrading on the lower 0.25 mile above Money Creek and would benefit from Rock Riffle Grade control structures. The area is heavily wooded and access will be difficult. Above the actively degrading section only STP for lateral migration is recommended.

Tributary 2B (1,848 feet)

This tributary has minor degradation problems on the lower 0.35 mile above Money Creek. A combination of Rock Riffle Grade controls and STP is recommended for this segment. Above this reach the channel is well maintained and no treatment is recommended.

Tributary 4 (2,904 feet)

This is a direct tributary to Lake Bloomington with a very steep gradient on the lower 0.5 mile above the lake. A combination of Rock Riffle Grade control structures and STP is recommended for this segment. Above this reach the channel is well maintained and no treatment is recommended.

Tributary 5A (15,576 feet)

This tributary drains the village of Towanda. Between Towanda and Lamplighter Subdivision the channel has been "cleaned and shaped" in the fall or winter of 2005/2006. This segment is completely devoid of vegetation and was a potential source of large sediment loads during the spring of 2006. A significant headcut exists at the north edge of the subdivision, however it appears that there are plans to continue with the "cleaning and shaping" through the subdivision.

The recent channel work makes it difficult to determine the future needs of this segment; however use of STP will certainly be required to halt lateral migration through the entire inventoried reach. It is possible that Rock Riffle grade controls will also be needed after construction and an inspection of the area has been completed.

Tributary 6A (4,480 feet)

This is a well maintained "open drainage" ditch with sloped and maintained sideslopes. No treatment recommendations are made for this segment.

Tributary 6B (4,224 feet)

This tributary has no degradation problems, therefore the recommendation is to use STP only where lateral migration is occurring.

Tributary 9A (10,296 feet)

This is a well maintained "open drainage" ditch with a heavy stand of Reed Canarygrass. No treatment recommendations are made for this segment.

Big Slough East (25,080 feet)

This is a direct tributary to Lake Bloomington and there is some degradation occurring midway between Road 2350 North and the Lake. The recommendation is to use Rock Riffle Grade control and STP below Road 2350 North and STP only above Road 2350 North for lateral migration.

Big Slough 2 (7,392 feet)

This is a tributary to Big Slough East with no degradation. STP for lateral migration only is the recommended treatment.

Big Slough West (6,705 feet)

This is also a tributary to Big Slough East with no degradation. STP for lateral migration only is the recommended treatment.

Destratification

On June 20, 1996, destratifier units were placed on the bottom of Lakes Bloomington and Evergreen. The units are designed to maintain adequate dissolved oxygen levels in the lakes. The City of Bloomington installed the units as part of its overall lake management program. The Illinois State Water Survey Office of Water Quality Management recommended the system.

Dissolved oxygen is an extremely important substance in lakes. Dissolved oxygen (D.O.) is essential for fish and other organisms to survive. Lake water can gain D.O. through the release of oxygen by algae and other submerged aquatic plants. Another major source of oxygen transfer occurs at the lake surface, where oxygen from the atmosphere can diffuse into the water.

Oxygen can be consumed in lakes by fish and other organisms, by algae and other plants when no light is present, by the decomposition of organic matter, and by oxygen demanding substances. Decaying matter in the sediments of the lake bottom can also cause D.O. levels to drop. In the lower levels of a lake, oxygen can be consumed faster than it can be replaced, and the D.O. levels can drop to zero.

Without D.O. in the bottom levels of lakes, compounds can be released by the lake sediments which can cause excessive growth of algae and can cause taste and odor problems in drinking water. The part of a lake where no dissolved oxygen is present is called the *anoxic zone*.

Like most constructed lakes in the Midwest, Lake Bloomington and Evergreen Lake develop anoxic zones during the summer months. As the summer progresses, the anoxic zone grows and undesirable compounds, including phosphorus, concentrate. The anoxic zone is prevented from mixing with the oxygen rich upper layer of the lakes by a sharp difference in temperature (called a thermocline) between the two layers. The depth at which the thermocline forms is a function of lake morphometry and energy transfer from the wind during the spring months, and can range from 12 to 18 feet from the surface of the lake.

In the fall, the upper layers of the lakes cool down. When the temperature of the upper layer approaches the temperature of the bottom layer, the entire lake can mix (*lake overturn*). The oxygen demanding compounds, the taste and odor causing compounds, and the nutrients that can cause excessive algae are then released into the entire lake. This is the time when taste and odor problems most often occur in drinking water.

The destratifiers provide uniform temperature and oxygen only to the depths at which they are deployed. The destratifier at Lake Bloomington is deployed near the water intake structure at a depth of 35 feet. As a result, depths greater than 35 feet will form an anoxic zone.

In order to arrive at a crude, conservative, estimate of internal loading of phosphorus due to anoxic conditions in the lake and to estimate the load reduction due to destratification, several assumptions were made. The first assumption was that all of the phosphorus loading from anoxic release of P occurs during fall overturn. The second assumption was that elevated P concentrations only occur in an anoxic zone extending two feet above the sediment surface, with chemical precipitation and other processes keeping P concentrations near background levels in zones extending greater than 2 feet above the sediment. The Total P concentration for the bottom 2 foot layer for October 2005 was estimated as the average of the concentrations for the 1 foot and 3 feet samples (0.32 mg/l P).

Using the depth volume relationship developed in the Hanson Engineering sedimentation survey of 1999, 0-2ft above the sediment surface water volumes were calculated for each 2 foot depth increment and multiplied by the 0.32 mg/l total P concentration. The pounds of phosphorus contained in each 2 foot “ring” were then summed for a total of the pounds of phosphorus in the anoxic zone of the lake.

For the October, 2005, samples, the calculated mass of phosphorus was 147 pounds. If the destratifier was not operating and the anoxic zone started at 15 feet, the calculations would result in a mass of 797 pounds of phosphorus. The P load reduction from the destratifier would then be approximately 650 pounds per year. The destratifier operated on an intermittent basis over the last few years. The unit operated continuously during the summer of 2007.

Wetlands

The City of Bloomington has been concerned with high nitrate concentrations (at or near the 10ppm EPA limit) in drinking water for several decades. The following excerpts from Rutherford and Twait (2005) (Title: Source Water Protection and Watershed Management:

A Rural and Water Supply Perspective,Governor’s Conference on the Management of the Illinois River System, October 2005) describe some of actions the City and cooperating agencies have taken to deal with the nitrate problem.

Examination of the existing historical nitrate data shows that the highest nitrate levels came after the drought of 1988-89. High levels of nitrates, due to lack of uptake by crops, accumulated in the soil and leached out quickly with the first significant rainfall after the drought. Low water levels provided little dilution for the high nitrate runoff entering the reservoirs. Future droughts may result in similar conditions.

City staff had assumed that the nitrate problem was mainly related to agricultural fertilizer. Other possible sources included onsite waste system discharges from villages and homes within the watershed and from residences around Lake Bloomington. Relative contributions of the various possible sources needed to be determined before any possible solutions could be implemented.

In 1992, the City asked the SWCD and Watershed Conservationist to locate sites and get permission to sample from different locations in the Money Creek watershed. Money Creek is the main tributary to Lake Bloomington. Samples were collected and analyzed for nitrate by City staff from drainage tile outlets, surface runoff, and from various points along Money Creek.

The sampling program expanded in 1993, when the City entered into an agreement with Dr. Ken Smiciklas, of the College of Agriculture at Illinois State University, to study the nitrate problem. Students from ISU collected samples from the expanded sites and delivered them to the water treatment plant for analysis. The results from the sampling program showed that the most of the nitrates entering Lake Bloomington came from field tiles (1). The City resumed sampling responsibilities in 2003.

In order to keep the watershed stakeholders involved and informed about the study, Professor Aaron Moore, also of the College of Agricultural at Illinois State University, sent out a semi-annual newsletter. He also performed annual surveys of the farm operators throughout the watershed for their current and intended farming practices, including details of their proposed nitrogen fertilizer application. Group meetings with people from the watershed have also been held to answer their questions and give them information about the study.

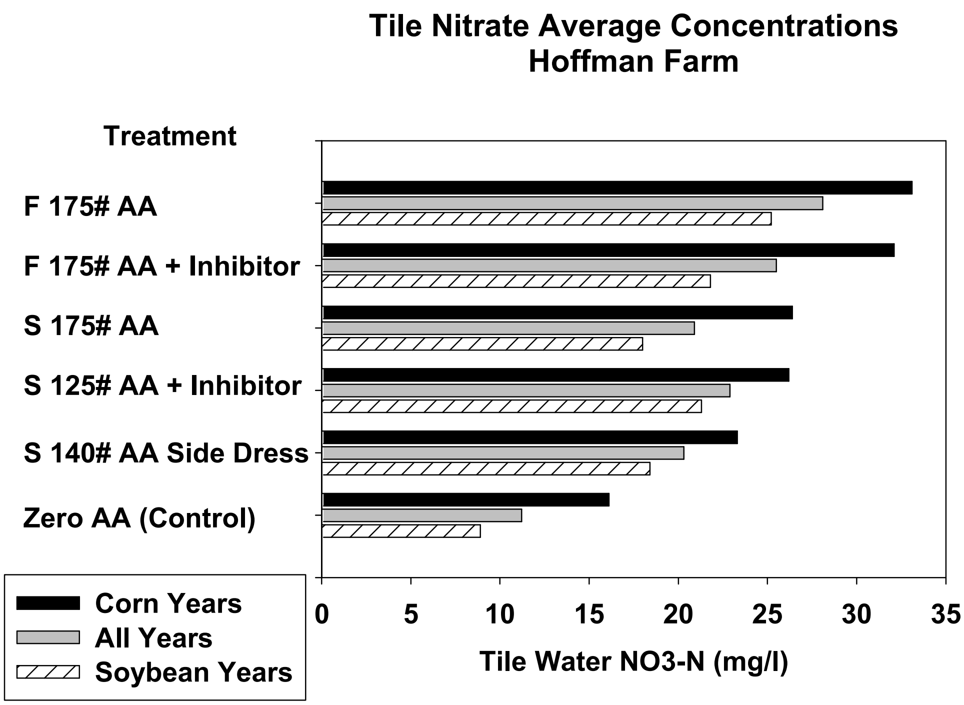
The next phase of with the study with Illinois State University was to determine if different agricultural practices could help reduce the amount of nitrates leaving the fields through the drainage tiles. In early spring, 1997, the City, with the McLean County Soil and Water Conservation District and ISU, installed individual tile drainage networks for six 5-acre test plots in a farm field next to City property at the upper end of Lake Bloomington. The test plots were developed on a privately owned field that was previously only minimally tiled.

The City entered into an agreement with the landowner and farm operator to continue the traditional corn/soybean planting rotation, but to vary the timing, rate, and use of nitrification inhibitors on individual test plots. The treatments are fall application of anhydrous ammonia, one field with and one field without inhibitor, spring applications with and without inhibitor, one post emergent side dress application, and a control plot which receives no anhydrous ammonia. Nitrate concentrations in tile drainage from each of the fields are measured, along with harvest quantities and plant conditions.

So far, the clearest results are that fields with fall application of anhydrous ammonia experience higher nitrate losses than from spring applications. Yields are drastically reduced from the field where no ammonia is applied. Since weather patterns exert such a large effect upon crop growth and harvest, and corn is only planted every other year, the City will continue to work with the landowner and farm operator on the study to get a better idea of the effects of soybean nitrogen fixation and carryover and the effectiveness of inhibitors on productivity and nitrate losses.

A third part of the City's study is to determine if there are natural ways to remove nitrates from the water between the discharge points of field tiles and the intakes for the Water Treatment Plant. In conjunction with the tile study, another study was started with Dr. Dave Kovacic of the Department of Landscape Architecture at the University of Illinois. Dr. Kovacic is studying the use of created wetlands nitrate removal and removal of other nutrients. Dr. Kovacic has done similar studies in other areas of Illinois and has documented 36% nitrogen removals from wetlands. He has also documented that buffer or filter strips alongside tributary streams can remove another 9% of the nitrogen from the water that flows across the strips (Kovacic, D.A., and Mark B. David, Lowell E. Gentry, and Karen M. Starks. 1999. Use of Constructed Wetlands to Reduce Nitrogen and Phosphorus Export From Agricultural Tile Drainage. Journal of Environmental Quality.).

City property along Money Creek adjoins the private land containing the experimental tile fields. Experimental wetlands were constructed on the City property in the fall of 1997. Tile flow from the experimental fields and surface flow from the fields is directed into the wetlands through control structures equipped with flow monitors and samplers. By knowing the exact quantity and quality of the water coming into the wetlands as well as the quantity and quality of water leaving the wetlands, the effectiveness of the wetland in removing nitrates can be determined. By knowing the exact area of agricultural land draining into the experimental wetlands, size requirements



for additional wetlands can be determined. The wetlands were shown to be effective in removing both nitrogen and phosphorus from the inflowing drainage.

Kovacic, et.al.,2006 (Kovacic, David A., Richard M. Twait, Michael P. Wallace, and Juliane M. Bowling. 2006. Use of created wetlands to improve water quality in the Midwest – Lake Bloomington case study. Ecological Engineering 28 (2006) 258-270) determined that nitrogen was reduced by 36% in the wetlands, and 53% of the total phosphorus entering the wetlands was retained. Much of the P retention was due to sedimentation within the wetlands.

Agricultural Implementation:

Agricultural implementation plans are those most commonly practiced in proactive Midwestern agricultural areas. These practices are:

- Nutrient Management - Managing the amount, source, placement, form, and timing of the application of plant nutrients and soil amendments
- No-till and strip till - Managing the amount, orientation and distribution of crop and other plant residue on the soil surface year round while limiting soil disturbing activities to only those necessary to place nutrients, condition residue and plant crops.
- Riparian Forest Buffer - An area of predominantly trees and/or shrubs located adjacent to and upgradient from watercourses or water bodies
- Contour Buffers - Narrow strips of permanent, herbaceous vegetative cover established across the slope and alternated down the slope with parallel, wider cropped strips
- Field Border - A strip of permanent vegetation established at the edge or around the perimeter of a field.
- Field Windbreaks - Linear plantings of single or multiple rows of trees or shrubs or sets of linear plantings
- Wetlands - The rehabilitation of a degraded wetland or the reestablishment of a wetland so that soils, hydrology, vegetative community, and habitat are a close approximation of the original natural condition that existed prior to modification to the extent practicable.
- Developing Incentives – New and innovative practices that may be forthcoming to address current and future conservation needs.
- Grade Stabilization Structure - A structure used to control the grade and head cutting in natural or artificial channels.
- Grassed Waterway - A natural or constructed channel that is shaped or graded to required dimensions and established with suitable vegetation
- Conservation Cover - Establishing and maintaining permanent vegetative cover to protect soil and water resources.
- Prescribed Grazing - The controlled harvest of vegetation with grazing or browsing animals, managed with the intent to achieve a specified objective
- Drainage Water Management - The process of managing the water table elevation and the timing of water discharges from surface and subsurface agricultural drainage systems.

Conservation programs available to producers include the Federal programs such as Conservation Reserve Program (CRP),), Environmental Quality Incentives Program (EQIP), Wildlife Habitat Incentive Program (WHIP), and the Wetlands Reserve Program (WRP). Federal and state partnerships such as the Conservation Reserve Enhancement Program (CREP) and state and locally administered programs such as the Stream bank Stabilization and Restoration Program (SSRP) and Conservation Project Practices (CPP)

Urban Implementation:

Monitoring System

Another issue stemming from urban runoff is that there is very little monitoring of this runoff. An increased monitoring system is needed to pinpoint problem areas in the urban areas so further plans can be developed.

The primary purpose of the Urban Monitoring program is to measure contributions in runoff quantity and quality emanating from the urban development sites within the Money Creek watershed. Storm water runoff from urban and urbanizing areas is recognized as a cause of water pollution. Seven locations along Money Creek and its tributaries would monitor the effects of urban and suburban effects on the watershed.

Education and public awareness

This control measure will target homeowners, restaurateurs, industry and the general public. An informed and knowledgeable community is crucial to the success of storm water management. As the public becomes aware of the personal responsibilities expected of them and others in the community, including the individual actions they can take to protect or improve the quality of area waters, a greater compliance with the storm water program will result. The plan has two major initiatives: the formation of partnerships and the use of educational materials.

The Ecology Action Center and other educational resources, such as the SWCD, U of I Extension Office, and McLean County, will provide program information, give residents an opportunity to share resources and participate in activities and events in regard to local environmental issues: greenways, bikeways, natural conservation areas, recycling and water quality issues. Education topics might include the benefits of recycling and opportunities for enhancing greenways. The educational materials will include, but will not be limited to, the following:

Brochures

- Alternative information sources (websites, bumper stickers, posters etc.)
- A library of educational materials
- Summer camp/club programs
- Portable Storm Water Informational Display/Exhibit

The public education program will use a variety of strategies in which to reach a diverse audience. Mass media campaigns will use a mix of media to generate a watershed message to our audience. Our local strategies will use television and radio ads, including multilingual posters.

The school education program will target school age children. The programs will teach students the water cycle, the watershed, the benefits of composting and storm water runoff. In addition, Project WET training classes will be held by Heartland Community College for educators in district 540.

The education effort would target homeowners about proper septic system maintenance, proper disposal of used motor oil, chemicals pesticides and household products. As noted by the IEPA, septic systems are a potential source of non-point source phosphorus loading. A long range solution to failing septic systems is connections to a municipal sanitary sewer system. Installation of a sanitary sewer will reduce existing nutrient sources by replacing failing septic systems and will allow development without further contribution of phosphorus loads to Lake Bloomington. Costs for the installation are generally paid over a period of several years (average of 20 years) instead of forcing homeowners to shoulder the entire cost of installing a new septic system. In addition, costs are sometimes shared between the lake community and the utility responsible for treating the wastewater generated from replacing the septic tanks. The planning process is involved and requires participation from townships, cities, counties, lake associations, and citizens.

Support by the citizenry is crucial to the success of storm water management. The measure will involve all socio-economic groups. The public participation program is a key component of the public education measure. Broader public support in the development and decision making process will minimize potential legal challenges.

Public Participation/Involvement

Public meetings will provide an opportunity to discuss various viewpoints and provide input concerning appropriate storm water management policies and practices.

Community cleanup projects for local streams, riparian corridors, trails, highways, streets, open space and parks will be targeted.

Recycling programs will be enhanced**.** The largest pollutant components in our storm drains and water bodies will be identified. A recycling program will be modified to target the largest pollutant components.

Both Bloomington and Normal have established storm water phone hotlines to aid enforcement authorities in the identification of polluters.

"Adopt a Storm Drain" program, will offer individuals and groups an opportunity to monitor what is entering through our waterways.

Storm water inlet stenciling programs in both Bloomington and Normal have been initiated to help raise community awareness.

A watershed oversight committee comprised of agency officials, residents, and property and business owners will be organized to provide input and address concerns and questions that may arise with new policies, programs and improvements.

Rural communities and rural subdivisions in the watershed will be included in educational programs and implementation planning. Rural communities will be encouraged to adopt sediment, erosion control and stream bank buffer ordinances like those of the nearby urban areas and the county at large.

Illicit Discharge Detection/Elimination

The illicit discharge detection measure will involve both municipal staff and citizens. Each jurisdiction will locate illicit discharge problems areas through public complaints, visual screening and dry weather screening methods. The program will work to detect and eliminate illicit discharges.

The local Geographic Information System (GIS) will be used to map the location of all storm sewer outfalls and all the waters that receive storm water discharges. The GIS will also allow the input of citizen complaints and dry weather screening and monitoring data.

Construction Site Runoff Control

It is recognized that construction sites can deposit a significant amount of silts and sediments in a short period of time. The City of Bloomington has adopted and the Town of Normal will adopt an Erosion and Sediment Control (ESC) Ordinance to reduce construction pollutants in its storm water runoff. (Appendix IV) The ordinance will require that land disturbance of 5,000 square feet or more will be regulated. It requires developers, builders or owners to submit a plan that contains measures to reduce soil erosion and practices to control sediments. Additionally, ESC requires the submittal of construction plans prior to ground being broken. Once a plan is reviewed and approved, staff will endeavor to ensure that the ESC plan is followed. The ordinance then requires the developer, builders or owners to install and maintain those specified measures and practices agreed to in the plan. Sites may be inspected for compliance and if found lacking, an inspector may issue a permit violation, stop work order, fine or other measure to ensure compliance.

McLean County is considering a separate erosion control ordinance apart from the Manual Practice of the Subdivision Ordinance, but does not have one at this time. (Manual Practice Ordinance can be found in Appendix VI)

Post Construction Runoff Control

Both the City of Bloomington and the Town of Normal propose to address the post-construction runoff with structural and non-structural management practices. The controls seek to reduce the amount of impervious cover, by increasing natural land set aside for conservation and to use pervious areas for more effective storm water management. The Town of Normal has looked at a variety of ways to increase green spaces. For example, Normal has new landscaping requirements for parking lots.

Jointly the County, the City and the Town are developing a Stream Buffer Ordinance for developing areas, which includes, but is not limited to, the 100-year flood plain. (Appendix IV)

Structural management practices shall include the use of wet and dry retention basins, which will principally be used in the urban environment. Programs for designers and developers will provide information on proper design and the overall need for retention basins.

Pollution Prevention/Good Housekeeping

- Pollution prevention/good housekeeping measures for municipal operations program goal is to reduce pollutant runoff from municipal operations. The vehicle maintenance program requires that all city-owned vehicles be regularly inspected to eliminate the amount of oil, grease, and fluid leaks.
- Street sweeping has become more frequent in high traffic areas.
- A program for the inspection of storm drains has been developed.
- An Integrated Pest Management program (IPM) will be developed and offered. The program will train municipal employees on current best management practices for pest management. Lawn pesticide application classes will be offered to municipal employees and city residents.

Septic System Improvements

Septic tanks generally remove 20% to 30% of the influent phosphorus (Lombardo, 2006). Crites and Tchnobanoglous (1998) reported average septic tank effluent concentrations of 68 mg/l total Nitrogen (as N) and 16 mg/l total phosphorus (as P). The amount of nutrients delivered to a lake or stream from an onsite system depends greatly on the type and condition of the septic tank effluent dispersal system.

Leach (or seepage) fields disperse the septic tank effluent through the soil column, ultimately reaching the water table or seep into a lake or stream. Phosphorus is removed through absorption to the soil or through the formation of mineral precipitates. Ideally, all of the phosphorus is removed in the seepage field, but many factors influence the system's effectiveness.

The amount of water that can flow through a particular soil type over time is referred to as the soil's hydraulic conductivity. The lower the hydraulic conductivity, the larger the seepage field area is required. Most of the soils surrounding Lake Bloomington have very low hydraulic conductivity, necessitating seepage field sizes that cannot be accommodated within the small lots leased by the City.

Hydraulic conductivity can decrease over time through compaction of the soil by foot and vehicle traffic, through clogging of the pore spaces in the soil by precipitates or from solids carryover from a malfunctioning or overloaded septic tank, and other factors. When the loading rate exceeds the hydraulic conductivity, the soil becomes saturated and the septic tank effluent can flow upwards to the soil surface or flow horizontally along preferential flow paths. The horizontal flow can discharge into a stream or lake if the failing system is close to the waterbody. The Onsite Wastewater Treatment Systems Manual (USEPA, 2002) discusses soil properties and design considerations for seepage systems.

Sand filters remove 10-20% total phosphorus and 18-33% total nitrogen from the septic tank effluent. Health Department regulations require chlorination of sand filter effluents, which helps to remove microbial contamination and can remove some ammonia nitrogen through the process of breakpoint chlorination. The City of Bloomington requires a 50 foot gravel effluent receiving trench prior to discharge. The effect of the trenches on reducing nutrient loading is not known.

Estimating Phosphorus and Nitrogen Loading by Onsite Systems

Several assumptions are necessary in order to estimate the nutrient loads from the onsite waste systems in the Lake Bloomington watershed. First, the systems closest to the lake deliver their entire nutrient load to the lake. Second, 25% of the seepage field systems deliver partially treated septic tank effluent to the lake (Lindsay Knitt, Farnsworth Group, personal communication, 2007). This relatively high percentage was chosen due to the low hydraulic conductivity of the soils, the close proximity of many of the leach fields to the lake, and the observation of nutrient rich effluent at the base of many of the shoreline protection systems during low water periods.

Water usage values and house occupancy was estimated using USEPA system design numbers (70 gallons per day per person equivalent and 3.5 person equivalents per home). Average septic tank effluent concentrations of 68 mg/l total nitrogen and 16 mg/l total phosphorus, along with the water usage figures listed above, were used to estimate the nutrient loading per household prior to treatment by the dispersal systems. Total nitrogen loading was estimated at 50.6 pounds per year and total phosphorus at 11.9 pounds per year per household before secondary treatment.

The 402 homes closest to the lake, 249 with seepage fields and 153 with sand filters, were included in the loading analysis. The residences with sand filters were estimated to contribute 5,200-6,400 lb/year total N and 1,500-1,700 lb/year total P.

Additional assumptions were made for the loading estimates for failed or short circuited seepage fields. First, no removal of nitrogen occurs in a failed seepage system and phosphorus removal can range from zero to eighty percent. Using those assumptions, seepage field loadings are estimated at 3,150 lb/yr total N and 150-740 lb/yr total P.

Combined, nutrient loading to Lake Bloomington from onsite waste systems is estimated at 8,400-9,500 lb/yr total N and 1,600-2,400 lb/yr total P. These loadings represent around 1% of the required N reduction and 23.4-35.5% of the required total P loading reductions.

The loading estimates can be refined by using actual water consumption data and by sampling a representative number of onsite waste system effluents over time. Loadings from failed or short circuited seepage systems will be more difficult to detect and measure.

This analysis utilizes numbers that likely result in an overestimate of the actual contribution from septic systems at Lake Bloomington. For example, we suspect that both the water usage and house occupancy (number of person equivalents per dwelling) values are less than the USEPA figures used. For example, neither the number of homes used as weekend and/or vacation and/or summer-only residence nor the number of older, childless residents are factored into the numbers used. These factors are expected to lower the final loading contribution estimate. A future site-specific assessment incorporating these factors is needed to provide a more precise site-specific estimate.

Cost Summary

Riparian Erosion Control Costs

Priority Shoreline Protection Areas:

Based on the erosion classes assigned during the shoreline erosion inventory the highest priority sites would be those in Erosion Class 6. These sites represent less than 12% of the unprotected shoreline, but produce nearly 60% of the sediment generated annually by shoreline erosion on Lake Bloomington. The Class 6 sites also represent by far the most cost effective treatment areas with the cost of a ton of soil saved at $151.37 for treatment or $3.03 per ton over a 50 year life of the shoreline protection. The next highest priority would be Erosion Class 5 and so on until all erosion classes are treated. There is limited benefit to treating the 50% of Lake Bloomington shoreline in Class 1 that produces only 3% of the annual sediment contribution from shoreline erosion. The table below shows the cost estimate per foot of bank treated for each Erosion Class and also the cost per ton of soil saved by Erosion Class.

Summary of Treatment Costs by Erosion Class

ESTIMATED COST OF ALTERNATIVE #6 FOR EACH EROSION CLASS							
Erosion Class	Total Length (ft.)	Total Tons Soil Erosion Annually	% Total Shoreline Erosion	Total Cost	Cost per Foot	Cost per Ton Soil	Cost per ton soil over 50 yr. life
1	27,962	114.5	3.03%	$316,364.00	$11.31	$2,763.00	$55.26
2	10,790	266.5	7.05%	$287,880.00	$26.68	$1,080.23	$21.60
3	3,256	235.6	6.23%	$148,616.00	$45.64	$630.80	$12.62
4	4,356	504.3	13.34%	$203,298.00	$46.67	$403.13	$8.06
5	2,670	413.9	10.94%	$134,404.00	$50.34	$324.73	$6.49
6	6,546	2246.9	59.42%	$340,110.00	$51.96	$151.37	$3.03
Totals	55,580	3781.7	100.00%	$1,430,672.00			

Table 16 Summary of Estimated Cost by Erosion Class

The Erosion Classes as defined reflect the severity of the erosion, but severity does not necessarily correlate well with treatment cost. This is mainly due to the fact that the lateral recession rate is a large factor in determining the Erosion Class, but the bank height and water depth at the shore are much larger factors in determining treatment cost. In Lake Bloomington the water depth near the shore does not vary a great deal.

The 2005 Study predicts approximately 3800 tons of sediment are generated annually in Lake Bloomington shoreline erosion. Nearly 60% of the sediment generated is coming from less than 12% (1.2 miles) of the unprotected shoreline classified as Class 6 Erosion. While study methods differ, the prediction of 3800 tons annual is very close to the 3950 tons predicted by Roger Windhorn, NRCS Resource Soil Scientist, in 1998.

Thus the study methods and assumptions made in the 2005 study seem to produce results consistent with earlier methods, yet provide a more detailed analysis of sites which will enable the City of Bloomington to direct resources where the most benefit will be achieved. By treating the Class 6 Erosion sites this study shows that nearly 60% of the sediment can be stopped by treating only 12% of the shoreline at an estimated cost of $340,000. If taken over the expected 50 year life of the shoreline protection the cost per ton of soil is only $3.03, while other less severely eroding sites have per ton cost 2 to 18 times higher. Erosion Classes 4 and 5, the next classes in order of severity can be treated for $338,000 to stop an additional 24% of the sediment produced by shoreline erosion; however the cost per ton saved will increase by about 250% to $7.60 per ton over the 50 year lifespan.

The recommended alternative is estimated cost of approx. $135,000 to treat the 2900 ft. of bank along the park area and roadway immediately East of the spillway. The average cost per foot is $46.55.

The cost of Armor Stone Breakwaters with Transitional Wetlands is approximately $60.00 per linear foot(IDNR, Outdoor Highlights, 7/07). The cost is comparable but higher than the traditional shoreline protection method recommended in the 2005 Study. In addition, the Armor Stone Breakwaters alternative can be installed at normal water levels, eliminating the need for significant draw-downs which can negatively impact recreational activity and reduce the City’s on-hand water supply.

Streambank Stabilization Cost Estimates

LAKE BLOOMINGTON STREAM TREATMENT									
Preliminary Estimates of Quantities and Cost for Treatment									
Stream Segment	Length (feet)	Alt. No.	STP (feet)	Quantity Stone (tons)	Estimated Cost	Riffles (no.)	Quantity Stone (tons)	Estimated Cost	Total Cost Segment
Money	129,879	1	71975	53980	$1,619,400.00	0	0	$0.00	$1,619,400.00
Trib 1B	1320	1	260	130	$3,900.00	6	300	$9,000.00	$12,900.00
Trib 1C	2640	1	650	325	$9,750.00	0	0	$0.00	$9,750.00
Trib. 1D	2376	1	520	260	$7,800.00	5	500	$15,000.00	$22,800.00
Trib. 2A	2640	1	730	365	$10,950.00	8	560	$16,800.00	$27,750.00
Trib. 2B	1848	1	875	438	$13,140.00	6	500	$15,000.00	$28,140.00
Trib. 4	2904	1	290	145	$4,350.00	8	560	$16,800.00	$21,150.00
Trib. 5A	15576	1	1055	530	$15,900.00	0	0	$0.00	$15,900.00
Trib. 6A	4480	1	0	0	$0.00	0	0	$0.00	$0.00
Trib. 6B	4224	1	410	205	$6,150.00	0	0	$0.00	$6,150.00
Trib. 9A	10296	1	0	0	$0.00	0	0	$0.00	$0.00
Big Slough East	25080	1	4535	2725	$81,750.00	14	1400	$42,000.00	$123,750.00
Big Slough 2	7392	1	685	411	$12,330.00	0	0	$0.00	$12,330.00
Big Slough West	6705	1	1465	880	$26,400.00	0	0	$0.00	$26,400.00
Totals	**217,360**		**83450**	**60394**	**$1,811,820.00**	**47**	**3820**	**$114,600.00**	**$1,926,420.00**
Estimates based on Stone Cost of $30.00 per ton delivered and installed									

Agricultural BMP Costs

The cost summary for agricultural related practices would be just under $1.3 milion over a fifteen year period from all funding sources. Much of the funding is government supported with landowner costs ranging from a stipend payment to a 50-90% cost share with the land owner, depending on the program.

Program	Current average per year	Cost	Goal	Total Cost
Nutrient Management	10,000 acres	$12 per acre	15,000 acres per year	$540,000
No-Till and Strip-Till on cropland		$15 per acre,	6,000 acres	$90,000
Filter Strips	213 acres	$50 per acre, (10 Year) $75 per acre, (15 years)	150 acres 50 acres	$7,500 $3,750
Riparian Forest Buffers	6 acres	$200 per acre	5 acres	$1000
Contour Buffers		$50 per acre	10 acres	$500
Field Border	31.3 acres	$60 per acre	30 acres	$1,800
Windbreaks	9.7 acres	$50 per acre	10 acres	$500
Wetlands	12 acres	$3000 per acre	20acres	$60,000 (cost share)
Developing Incentives		$200 per acre	5 acres	$1000
Grade Stabilization	One Block Chute	Concrete Block Chutes- $6000 per unit Pipe Drops- $4000 per unit	10 units 30 units	$180,000 (75/25 cost share)
Grassed Waterways	39.8 acres	$2000 per acre	1100 acres	$220,000 (75/25 cost share)
Conservation Cover	68 acres	$200 per acre (10 year)	100 acres	$200,000
Prescribed Grazing	60 acres	$25 per acre (3 years)	100 acres	$7,500
Drainage/ Water Management		$30 per acre (3 years)	100 acres	9,000

Urban Cost

Urban Program Costs

On April 17, 2006 the Normal Town Council adopted an ordinance establishing a storm water utility fee payable by all property owners within the Town of Normal to generate funds to meet the regulatory requirements, goals and objectives of the storm water management plan. It is estimated that nearly $1.7 million in new annual revenue will be generated to offset cost to fully implement the storm water management plan.

Cost to implement the storm water management plan for those areas within the Town of Normal and the Lake Bloomington watershed will be included within the Town of Normal's overall storm water utility budget.

Initial one time costs:

Cost of the Urban Monitoring program would include a capital investment in monitoring equipment and an agreement with a university based research entity to perform data gathering, management and analysis, in addition to water collection.

Projected out for a five year program, the costs would be as follows:

INITIAL COSTS	ANNUAL COSTS	OVER 5 YEARS
Stream Flow Monitors- 7 @ $6,000 = $42,000	Supplies: $14,000	Initial Costs: $67,000
Samplers-7 =$25,000	Research Assistant: $12,000	Annual Costs for Five years- $310,000
	Usage and maintenance= $36,000	
Total: $67,000	Total: $62,000	Total: $377,000

Other urban alternatives include building a sewage treatment lagoon cluster system for the Lake Bloomington community and developed areas north of the Town of Normal incorporated areas. This alternative would cost over $9,000,000. A second alternative would be to connect the Lake Bloomington and suburban developments to the existing Bloomington Normal Water Reclamation District. This alternative would be over $10,000,000. The specific details of these two alternatives can be found in the Farnsworth plan in Appendix V.

Total costs for all suggested implementations	
Riparian	$ 5,410,350
Agricultural	$ 635,950
Urban (without alternative sewer systems)	$ 377,000
Total	$ 6,423,300

Selection of Implementation Strategies/Alternatives

The majority of the following implementation strategies will represent start dates for ongoing programs. Detailed strategies for implementation are found in the Implementation section of this plan.

The timeline for implementation (**pending funding**) is as follows:

Riparian Area :

Shoreline/streambank stabilization

- Development of updated streambank stabilization survey- 2010
- Development of headcut area survey- 2010
- Design of headcut stabilization- ongoing
- Lakeshore stabilization-
  - Plans for lakeshore stabilization-2009
  - Construction begins phase 1 (class 6)- 2010
- Streambank stabilization- 2011
- Headcut construction completed – 2011
- Inspection of construction on Tributary 5A- south edge of Towanda drainage area- 2008

Destratification

- Presently ongoing.

Wetlands-

- Identify potential partnerships- 2008
- Survey and inventory- 2008
- Site selection and planning – 2009
- Construction begins- 2011

Lake Parks BMPs

- Identify rain garden potential sites-2008
- Rain gardens construction -2009-11
- Start removal of invasives- 2008
- Start native plantings- 2008

Urban Area:

Public Education/Outreach

- Educational programs

  - Lake Bloomington specific programs - 2008
  - General public programs-2008

Public Participation/Involvement

- Storm water hotline (Normal) - 2007
- Expansion of storm water inlet stenciling program - 2008
- Formation:
  - Watershed(s) implementation committee - 2008

Illicit Discharge Detection/Elimination

- Continue GIS mapping of storm sewer outfalls- (begun 2007)

Construction Site Runoff Control

- Erosion & Sediment Control Ordinance (ESC) - 2008
- (ESC) permit & inspection program (Normal) -2008
- Explore possibility of County-wide ESC permit & inspection program- 2008

Post Construction Runoff Control

- Stream Buffer Ordinance - 2008

Pollution Prevention/Good Housekeeping

- Continue enhanced street sweeping program
- Continue storm drain inspection program
- Begin to install stream gauging/sampling stations- 2008
- Continue Integrated Pest Management certification for public employees.

Construction of sewer linkage from Lake Bloomington to BNWRD

- Alternative long range plan

Septic system inspection and replacement -

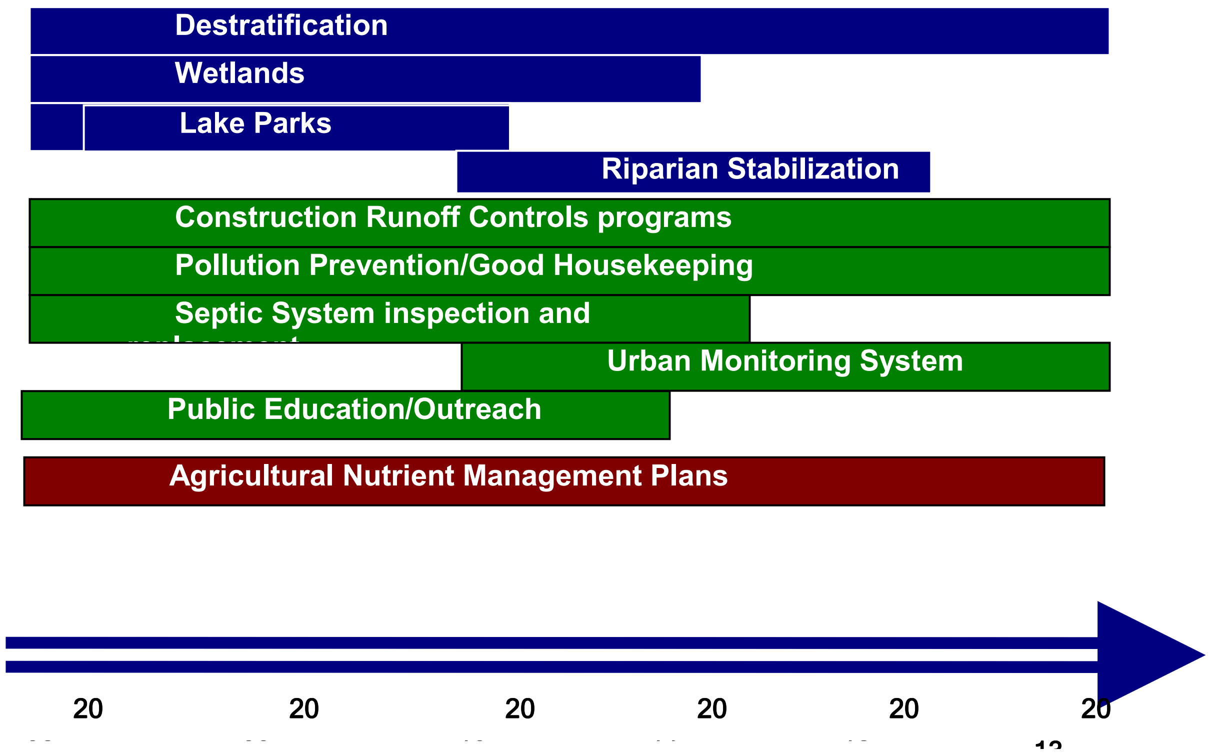
- Inspection and replacement for lease transfers- 2008
- Inspection for new construction- 2008
- Investigation of other BMPs used at other lake communities -2008

Agricultural Area:

Continue nutrient management- 2008

- No-Till and Strip-till on cropland-
- Filter Strips-
- Riparian forest buffers-
- Contour buffers-

- Field borders-
- Windbreaks-
- Developing landowner incentives-
- Grade stabilization program-
- Grassed waterways



Lake Bloomington Watershed Management Plan Timeline

Measuring Progress/Success

There are several plans already in the watershed which will record changes in the Lake Bloomington watershed after these plans are completed.

A secondary issue stemming from urban runoff is that there is very little monitoring of this runoff. An increased monitoring system is needed to pinpoint problems in the urban areas so further plans can be developed.

The primary purpose of an urban monitoring program is to measure contributions in runoff quantity and quality emanating from the urban development sites within the watershed. Storm water runoff from urban and urbanizing areas is recognized as a cause of water pollution.

The program would monitor flow, total Phosphorous(TP) and total Suspended Solids (TSS) contributions from the urban area, measured by analyzing flow-weighted composite samples, with frequency to be determined. Additional grab samples would be obtained for defined events.

Monitoring of storm water quality and quantity would be conducted as urban development progresses. In addition to quantifying the contribution from the urban area to the watershed, it could also provide important information on the differences between the addition of new traditional or "environmentally sensitive" development sites to each tributary. Information from this project could be shared with other communities through ongoing technical assistance and training programs administered by the NRCS, IEPA, and other agencies and organizations.

Aerial flights for mapping purposes to integrate the area into a GIS data grid will allow pinpoint changes to be monitored, especially in highly erosional areas.

A major component to the overall success of this plan is the appointing of an intergovernmental commission to oversee all watershed issues that affect McLean County. This committee will include representatives of all municipalities and community members to oversee the coordination, implementation, and updating of this and any other watershed plans as required.

Appendix I- Committee members

Lake Bloomington Planning Committee

Committee Chair:
Brian Brakebill, City of Bloomington

Co-Chair:
Bill Wasson, McLean County Parks and Rec

Secretary:
Judy Wilson, McLean County SWCD

Technical Writer:
Janet Beach Davis, Heartland Community College

Members:

Jill Mayes, City of Bloomington/Lake Bloomington
Rick Twait, City of Bloomington/Lake Bloomington
Kyle Haynes, City of Bloomington/Lake Bloomington
Jim Nelson, Association of Illinois Soil & Water Conservation Districts
Mike Hall, Town of Normal
Jennifer Sicks, McLean County Regional Planning
Rick Nolan, McLean County Regional Planning
Michelle Covi, Ecology Action Center
Caroline Wade, Illinois State University
William Rau, Illinois State University
Angelo Capparella, John Wesley Powell Audubon Society
Mary Jo Adams, Mackinaw River Partnership
Ken Browning, Lake Bloomington Homeowner's Association
Arnie Sepke, Lake Bloomington Homeowner's Association
Jeff Tracy, McLean County Highway Department
Mike Callahan, B/N Water Reclamation District
Randy Stein, B/N Water Reclamation District
Mark Beach, B/N Water Reclamation District
Bob Carter, B/N Water Reclamation District
John Hendershott, McLean County Health Department
Jim Rutherford, McLean County Soil & Water Conservation District
Kent Bohnhoff, Natural Resource Conservation Service
Jody Rendziak, Natural Resource Conservation Service
Randy McCormack, Natural Resource Conservation Service
Mike Garthaus, Illinois Department of Natural Resources
Maria Lemke, The Nature Conservancy
Tom Guth, Landowner/operator
Scott Clement, Landowner/operator
Greg Kelley, Landowner/operator
Terry Giannoni, Money Creek Township

Lake Bloomington Technical Advisory Committee

Chairman:
Rick Twait, City of Bloomington/Lake Bloomington

Co-Chair:
Mary Jo Adams, Mackinaw River Partnership

Members:

Brian Brakebill, City of Bloomington
Bill Wasson, McLean County Parks and Rec
Jill Mayes, City of Bloomington/Lake Bloomington
Kyle Haynes, City of Bloomington/Lake Bloomington
Mike Hall, Town of Normal
Angelo Capparella, John Wesley Powell Audubon Society
Janet Beach Davis, Heartland Community College
Rick Nolan, McLean County Regional Planning
Phil Dick, McLean County Building and Zoning
Darryl Coates, Illinois Department of Natural Resources
Mike Garthaus, Illinois Department of Natural Resources
Jim Nelson, Association of Illinois Soil & Water Conservation District
Linda Olson, McLean County Farm Bureau
Brian Lambert, McLean County U of I Extension
Joe Bybee, Illinois Department of Agriculture, Bureau of Land and Water
Jody Rendziak, Natural Resources Conservation Service
Kent Sims, Natural Resources Conservation Service
Keith Eichorst, Natural Resources Conservation Service
Kent Bohnhoff, Natural Resources Conservation Service
Randy McCormack, Natural Resources Conservation Service
Jim Rutherford, McLean County Soil & Water Conservation District
Judy Wilson, McLean County Soil & Water Conservation District
Maria Lemke, The Nature Conservancy
Bob Carter, B/N Water Reclamation District
Caroline Wade, Illinois State University
Bob Fish, Myers, Inc.
Ken Browning, Lake Bloomington Homeowner's Association
Arnie Sepke, Lake Bloomington Homeowner's Association
Larry Troyer, Landowner/operator
Terry Giannoni, Money Creek Township

Appendix II- References

Bannerman, Roger and Ellen Considine. 2003. "Rain Gardens: A How-To Manual for Homeowners." Madison, WI: University of Wisconsin-Extension. http://learningstore.uwex.edu/pdf/GWQ037.pdf

Burrell, C. Colston. 1999. *Perennial Combinations.* Emmaus, PN: Rodale Press.

Ecology Action Center (ECA-1). 2007. "What is the YARD SMART Certification Program?" Normal, IL. http://www.ecologyactioncenter.org/yard-smart/

Forman, R.T.T. and L.E. Alexander. 1998. Roads and their major ecological effects. Annual Review of Ecology and Systematics. 29:207-231.

-

Hemenway, Toby. 2000. *Gaia's Garden: A Guide to Home-Scale Permaculture.* White River Unction, VT: Chelsea Green Publishing Company.

Herkert, J.R., D.W. Sample, and R.E. Warner. 1993. Habitat establishment, enhancement, and management for forest and grassland birds in Illinois. Illinois Department of Conservation, Natural Heritage Technical Publication No. 1.

ISWS Communication to City of Bloomington, Sedimentary Report 1952.

Kinney, Wayne. Assessment of Sediment Delivery and Stream Conditions in the Lake Bloomington Watershed. March 2006.

Kovacic, David A., Richard M. Twait, Michael P. Wallace, and Juliane M. Bowling. 2006. Use of created wetlands to improve water quality in the Midwest – Lake Bloomington case study. Ecological Engineering 28 (2006) 258-270

Lake Bloomington TMDL; stage 1 plan. TetraTech Em, Inc. November 2006.

Lake Bloomington Watershed: Watershed Plan Environmental Assessment, U.S. Department of Agriculture (Soil Conservation Service), Illinois Department of Agriculture (Division of Natural Resources), McLean County Soil and Water Conservation District, City of Bloomington, Illinois. 1991

Lake Bloomington Shoreline Erosion Study. Midwest Streams. 2005.

LBA- Lake Bloomington Association Website http://www.lakebloomington.com/.

Lewis, Alcinda. 1999. *Butterfly Gardens.* Brooklyn, NY: Brooklyn Botanic Garden.

Mackinaw River Area Assessment, Volume 1. Illinois Department of Natural Resources. 1997

Mackinaw River Watershed Plan, The Nature Conservancy. 1996

Nowakowski, Keith G. 2004. *Native Plants in the Home Landscape.* Urbana-Champaign, IL: University of Illinois Extension.

Stein, Sara. 1993. *Noah's Garden: Restoring the Ecology of Our Own Back yards.* Boston: Houghton Mifflin.

Swanson, T. Turrentine, and T.C. Winter. 2003. Road Ecology: Science and Solutions. Island Press, Washington, D.C.

Tufts, Craig. 1993. *The Backyard Naturalist.* Vienna, VA: National Wildlife Federation.

Appendix III- RAP-M

Appendix IV- Stormwater Ordinance

Appendix V- Lake Bloomington Sewage Management Report

Appendiv VI- Manual of Practice of the Subdivision Ordinance

Appendix VII- Public Comments