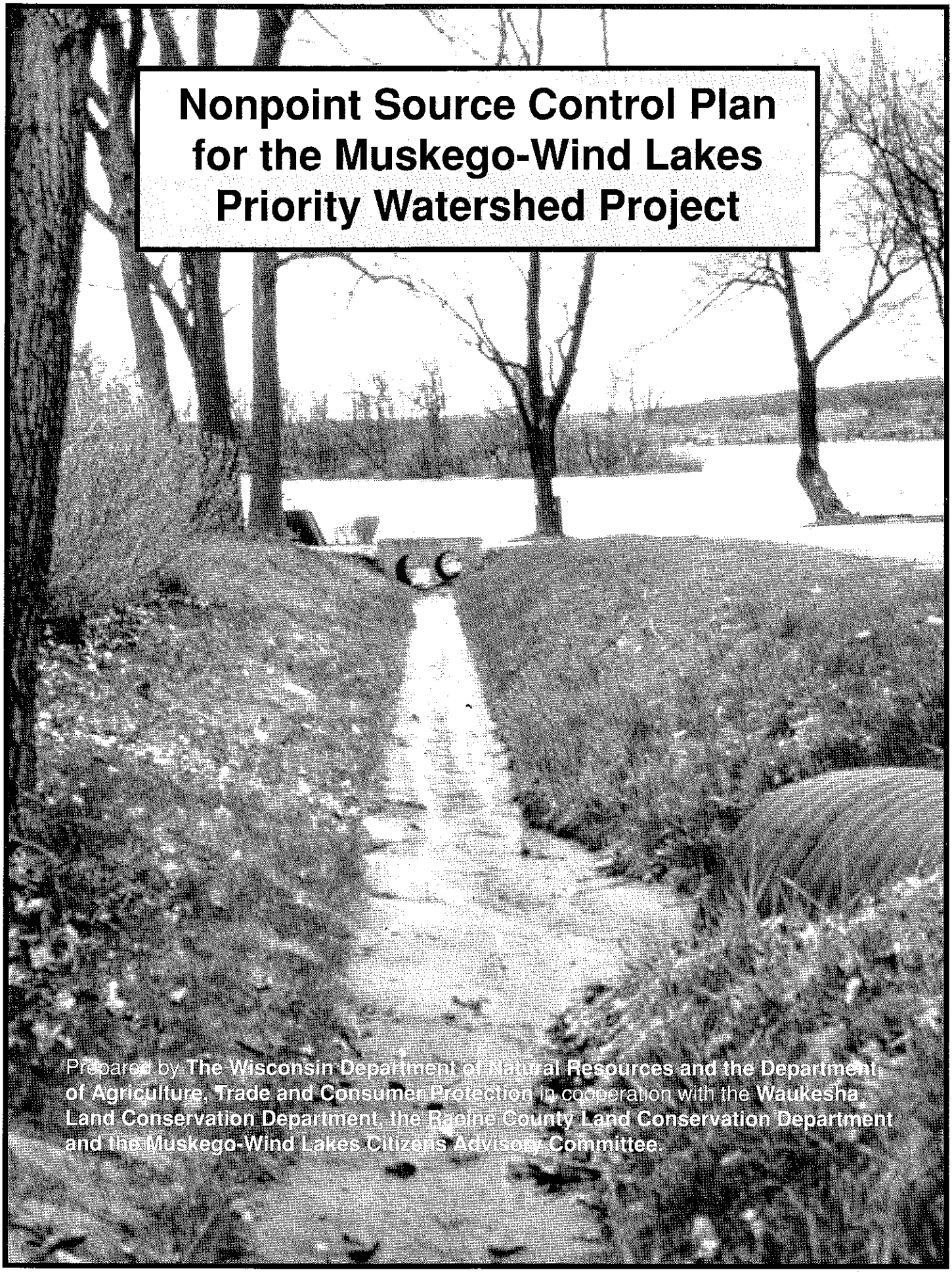
Nonpoint Source Control Plan for the Muskego-Wind Lakes Priority Watershed Project



Prepared by **The Wisconsin Department of Natural Resources and the Department of Agriculture, Trade and Consumer Protection** in cooperation with the **Waukesha Land Conservation Department, the Racine County Land Conservation Department and the Muskego-Wind Lakes Citizens Advisory Committee.**

Watershed Plan Organization Information

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1994

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Keith Foye, Chief, Soil and Water Section

Nonpoint Source Control Plan for the Muskego-Wind Lakes Priority Watershed Project

The Wisconsin Nonpoint Source Water Pollution Abatement Program

October 1993

This Plan Was Cooperatively Prepared By:

The Wisconsin Department of Natural Resources
Wisconsin Department of Agriculture, Trade and Consumer Protection
and
The Waukesha County Land Conservation Division,
The Racine County Land Conservation Department and
The Muskego-Wind Lakes Citizens Advisory Committee

Publication WR-375-94

For copies of this document please contact:

Department of Natural Resources
Bureau of Water Resources Management
Nonpoint Source and Land Management Section
P.O. Box 7921
Madison, WI 53707

The Department of Natural Resources acknowledges the Environmental Protection Agency's Region V Office for their involvement in the partial funding of this activity through Section 319 of the Water Quality Act.

Watershed Plan Credits

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Mr. Leonard Pilak, Secretary, Big Muskego/Bass Bay Lake District
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Ms. Kathleen Krosnicki, State Assembly
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Mr. Arthur Takishian, Little Muskego Lake Association
Mr. Paul Gorelik, Bass Bay Association
Ms. Dorian Sullivan, Linnie Lac
Mr. Ray Lange, Farm Representative
Mr. Richard Rehberg, Racine County Board
Mr. Ken Hahn, Waukesha County Board
Mr. Frank DeAngelis, Waukesha County Board
Ms. JoAnn Gillespie, Country Wetlands Nursery
Ms. Barabara Zacher, New Berlin City Council
Mr. David Taube, Muskego City Council

WISCONSIN
DEPT. OF NATURAL RESOURCES
George E. Meyer
Secretary

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

101 South Webster Street
Box 7921
Madison, Wisconsin 53707
TELEPHONE 608-266-2621
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January 7, 1994

James Luebke, County Board Chair
Waukesha County Office Building
500 Riverview Avenue
Waukesha, WI 53188

Dear Mr. Luebke:

I am pleased to approve the Muskego-Wind Lakes Priority Watershed Plan prepared through the Wisconsin Nonpoint Source Water Pollution Abatement Program. This plan meets the intent and conditions of s. 144.25, Wisconsin Statutes, and Chapter NR 120, Wisconsin Administrative Code. The plan has been reviewed by the Department of Agriculture, Trade and Consumer Protection. I am also approving the plan as an amendment to the Fox River (Illinois) Areawide Water Quality Management Plan.

I would like to express the Department's appreciation to the Waukesha County staff that participated in preparing the plan. We look forward to assisting Waukesha County and other units of government in the watershed in implementing the plan.

Sincerely,

George

George E. Meyer
Secretary

cc: Dale Shaver - Waukesha Co. LCD
Ruth Johnson - SED
Dave Jelinski - DATCP
Becky Wallace - WR/2
Cindy Hoffland - CA/GEF 1
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January 7, 1994

Jean Jacobson
Racine County Board Chair
6119 Heg Park Road
Wind Lake, WI 53185

Dear Ms. Jean Jacobson:

I am pleased to approve the Muskego-Wind Lakes Priority Watershed Plan prepared through the Wisconsin Nonpoint Source Water Pollution Abatement Program. This plan meets the intent and conditions of s. 144.25, Wisconsin Statutes, and Chapter NR 120, Wisconsin Administrative Code. This plan has been reviewed by the Department of Agriculture, Trade and Consumer Protection. I am also approving this plan as an amendment to the Fox River (Illinois) Areawide Water Quality Management Plan.

I would like to express the Department's appreciation to the Racine County staff that participated in preparing this plan. We look forward to assisting Racine County and other units of government in the watershed in the implementation of the Muskego-Wind Lakes Priority Watershed Plan.

Sincerely,

George

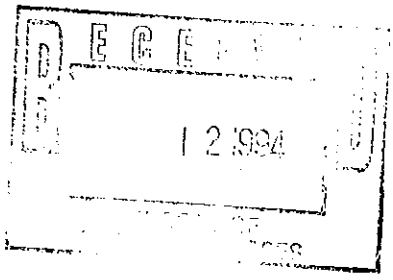
George E. Meyer
Secretary

cc: Charles Seeger - Racine Co. LCD
Ruth Johnson - SED
Dave Jelinski - DATCP
Becky Wallace - WR/2
Cindy Hoffland - CA/GEF 1
Kent Taylor - WR/2

State of Wisconsin
Department of Agriculture, Trade and Consumer Protection

Alan T. Tracy, Secretary

801 West Badger Road • PO Box 8911
Madison, WI 53708-8911



January 10, 1994

Becky Wallace - Chief
Nonpoint Source Section
Wisconsin Department of Natural Resources
101 S. Webster, WR2
Madison, WI 53707

Dear Becky:

The Department of Agriculture, Trade and Consumer Protection has received and reviewed the "Nonpoint Source Control Plan For The Muskego - Wind Lakes Priority Watershed".

Our staff made comments on chapter 3, 4, and 5. These comments have been incorporated into the plan. We agree with the improvements.

We look forward to assisting DNR and the Waukesha County Land Conservation Committee in implementing the project.

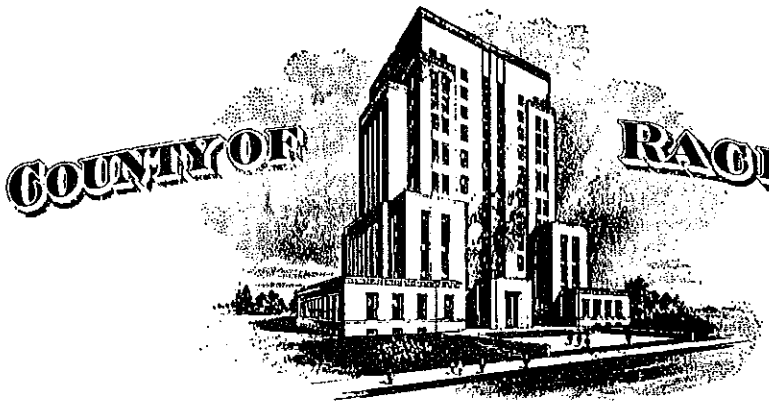
Please contact Sue Porter at 273-6205 if we can be of any further assistance in moving the project to implementation.

Sincerely,

Keith Foye

Keith Foye - Chief
Soil and Water Resources Management Section

cc: Dale Shaver Waukesha County Land Conservation Dept.
Chuck Seeger Racine County Land Conservation Dept.



COUNTY CLERK
JOAN C. RENNERT

730 Wisconsin Avenue
RACINE, WISCONSIN
53403

PHONE 414-636-3121
Racine County Courthouse Toll Free
1-800-242-4202

TO WHOM IT MAY CONCERN:

I, Joan C. Rennert, County Clerk in and for the County of Racine, State of Wisconsin, do hereby certify that the attached is a true and correct copy of a resolution adopted by the Racine County Board of Supervisors on November 9, 1993.

Joan C. Rennert
Racine County Clerk

County Seal

October 28, 1993

RESOLUTION NO. 93-158

RESOLUTION BY THE PLANNING AND DEVELOPMENT COMMITTEE AUTHORIZING THE APPROVAL OF THE NONPOINT SOURCE CONTROL PLAN FOR THE MUSKEGO/WIND LAKES PRIORITY WATERSHED PROJECT

To the Honorable Members of the Racine County Board of Supervisors:

BE IT RESOLVED by the Racine County Board of Supervisors that Racine County hereby approves "A Nonpoint Source Control Plan for the Muskego/Wind Lakes Priority Watershed Project" dated October, 1993 prepared by the Wisconsin DNR and the Department of Agriculture, Trade and Consumer Protection. A copy of said plan is on file with the County Clerk and a summary of said plan is attached hereto as Exhibit "A".

BE IT FURTHER RESOLVED by the Racine County Board of Supervisors that the County Clerk send a certified copy of the adopted resolution to the Wisconsin Department of Natural Resources, Bureau of Water Resource Management, P.O. Box 7921, Madison, WI 53707, Attention Mr. Kent Taylor.

Respectfully submitted,

PLANNING & DEVELOPMENT COMMITTEE

1st Reading 10-28-93

2nd Reading 11-9-93

BOARD ACTION
Adopted yes
For
Against
Absent

VOTE REQUIRED: Majority

Prepared by:
Corporation Counsel

Peter L. Hansen, Chairman

Richard G. Rehberg, Vice-Chairman

John R. Hansen, Secretary

Betsy Georg

Henry Kuhns

Frank N. Miller

Keith Tschumper

Daniel M. Finley
County Executive

Waukesha COUNTY

OFFICE OF COUNTY EXECUTIVE

RECEIVED
DEC 21 1993
OFFICE OF THE SECRETARY

December 17, 1993

Mr. George E. Meyer
Secretary
Wisconsin Department of Natural Resources
101 S. Webster Street
Box 7921
Madison, WI 53707

Dear George:

We are pleased to inform you that the Waukesha County Board of Supervisors overwhelmingly approved the Nonpoint Source Control Plans for the Muskego-Wind Lakes and Upper Fox River Priority Watersheds at their December 14, 1993 meeting. Copies of the resolutions are attached for your reference.

The approval of these plans provides an excellent opportunity for several municipalities to cooperatively embark on a water quality improvement initiative. We look forward to continued work with your agency to achieve the water quality goals set forth in these documents.

Sincerely,

Daniel M. Finley
County Executive

cc: Gloria McCutcheon, Director, DNR-Southeast District
Rebecca Wallace, Chief, Nonpoint Source Section, DNR-Madison
John Toshner, Director, Department of Environmental Resources
Dale Shaver, Manager, Land Conservation Division

Attachments

515 West Moreland Boulevard
Waukesha, Wisconsin 53188-2428
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Fax: (414) 548-7913
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APPROVAL OF THE NONPOINT SOURCE POLLUTION CONTROL PLAN FOR THE MUSKEGO-WIND LAKES WATERSHED

WHEREAS on November 19, 1991, the Waukesha County Board adopted resolution 146-47 to accept the Muskego-Wind Lakes Priority Watershed Project, and

WHEREAS the Muskego-Wind Lakes Citizen Advisory Committee has prepared and approved a nonpoint pollution control plan for the watershed, and

WHEREAS the objective of the Muskego-Wind Lakes Watershed Plan is to achieve optimum biological and recreational uses and control nonpoint pollution in the Muskego-Wind chain of lakes and tributary streams, and

WHEREAS the Plan provides grant assistance to participating landowners and municipalities for installing nonpoint pollution control practices and instituting water quality improvement programs.

NOW THEREFORE BE IT HEREBY RESOLVED by the Waukesha County Board of Supervisors that the report entitled "A Nonpoint Source Control Plan For The Muskego-Wind Lakes Priority Watershed," be adopted, a copy of which is on file in the County Clerk's Office and adopted by reference, as a guide for the future implementation of the provisions, suggestions and recommendations contained in the plan.

REFERRED ON:	FILE NUMBER:	REFERRED TO:
10/26/93	148-R-040	LU

TABLE OF CONTENTS

List of Tables

Page

List of Maps

List of Figures

List of Appendices

SUMMARY

Introduction

The Muskego-Wind Lakes Watershed is a 40.9 square-mile drainage area located in Waukesha, Racine, and Milwaukee counties, Wisconsin (see map 1). About 15,000 people live in the watershed. It includes parts of six governmental jurisdictions. Land uses in the watershed are about 80 percent agricultural and 20 percent urban, the urban areas mostly concentrated around a chain of five lakes. The watershed is part of the Fox (Illinois) River Basin.

The Muskego-Wind Lakes Watershed was designated a "priority watershed" in 1991 under the Wisconsin Nonpoint Source Water Pollution Abatement Program. It is one of 60 priority watersheds statewide, encompassing more than 4 million acres for which the clean-up and protection of water resources through control of nonpoint sources of pollution is a priority for the Department of Natural Resources (DNR).

Nonpoint source pollution is carried in storm water runoff from farm fields, streets, parking lots, barnyards, construction sites and other sources that cannot be easily traced to a single point such as a municipal or industrial wastewater discharge. Nonpoint source pollution in the Muskego-Wind Lakes Watershed has degraded many of the streams and all of the five principal lakes, including Linnie Lac, Bass Bay, Little Muskego, Big Muskego and Wind Lakes.

Nonpoint sources in the Muskego-Wind Lakes Watershed include eroding agricultural and commercial horticultural lands, eroding streambanks and roadsides, runoff from livestock wastes, erosion from developing urban areas, runoff from established urban areas, and in-stream and in-lake sediment deposition. Pollutants from nonpoint sources are carried to the lakes with rainfall runoff, snow melt, and seepage. Principal pollutants of concern include sediment, nutrients, bacteria, urban toxic materials such as heavy metals, oils and grease, and excessive storm water flow.

Water Quality

The Muskego-Wind Lakes watershed contains about 48 miles of tributary streams draining to 3,520 acres of lakes. Lakes are the dominant surface water features of the watershed. Perennial and intermittent streams drain the headwaters.

Bass Bay, Little Muskego and Wind Lakes have the potential to support a balanced warm water sport fish community and full body contact recreation. Linnie Lac and Big Muskego Lake have limited biological and recreational uses because of depths too shallow to support long-term sport fish populations, swimming and some types of boating. Big Muskego Lake has significant potential to support improved wildlife populations. All of these lakes are only partially meeting, or not meeting, their full potential uses.

In general, recurring water quality problems include loss of aquatic habitat, excessive aquatic plant and algae growth, low dissolved oxygen, and high bacteria levels. Pollutants that originate, at least in part, from rural nonpoint sources include sediment, nutrients, and fecal material. In urban areas, the list of problems and pollutants is expanded to include contaminated sediments and toxicity in surface waters from heavy metals, and destabilization of stream hydrology caused by increased stormwater runoff and loss of stream base flows.

Loss of habitat caused by channelized streams and disturbed lakeshore areas is prevalent in most urbanized areas of the watershed. Most of the urban streams have been dredged or straightened and in some cases lined with concrete. Most lake shorelines in built up areas have been modified by shoreline stabilization structures.

Wetlands have been greatly reduced, but are still some of the most valuable natural resource features in the watershed. Their principal values include wildlife habitat, fish spawning, reduction of runoff and flood flows, and removal of pollutants. Existing wetlands comprise about 3,000 acres, or 11 percent of the watershed.

Nonpoint Pollution Sources

Rural Nonpoint Sources

Rural nonpoint pollution sources in the Muskego-Wind Lakes Watershed include cropland erosion, commercial horticulture erosion, streambank erosion, and to a lesser extent, farm animal waste.

The portion of the total annual delivery of sediment attributed to croplands and nurseries in the watershed is shown in table 3-14. Approximately 45 percent of the sediment delivered to the lakes comes from these sources. Watershedwide, about 3,100 tons of soil are washed into lakes and streams annually from eroding croplands.

Streambanks along 12 miles of perennial and intermittent streams in the watershed were surveyed. The survey results are shown on table 3-6. The most extensive streambank erosion in rural areas occurs in the Linnie Lac Tributaries and totals more than 120 tons per year.

Within the Muskego-Wind Lakes Watershed, 17 barnyards were inventoried and ten are considered to have potential to contaminate surface waters. Ninety-seven percent of the

phosphorus and other pollutants attributed to these barnyards is discharged from five of them. Only two of the barnyards require pollutant reductions deemed "critical" to meeting project goals.

Urban Nonpoint Sources

About 20 percent of the Muskego-Wind Lakes Watershed is in urban land uses. Much of it is located in the more densely populated northern two thirds of the watershed. Principal urban nonpoint sources include construction site erosion, streambank erosion, and runoff from established urban areas such as commercial, residential, and industrial lands.

Pollutants found primarily in runoff from existing urban areas include heavy metals (lead, copper, zinc, cadmium or chromium) and toxic organic chemicals (PCBs, aromatic hydrocarbons, esters and many others). Other substances in urban runoff that are also contained in runoff from rural areas include sediment, nutrients, bacteria and other pathogens, and pesticides. Pollution from urban areas will increase as new areas are developed.

Runoff from new urban development is a major source of nonpoint pollution. Construction of buildings, roads, and utilities disturbs large areas, exposing large amounts of soil to erosion. Without adequate controls, construction site erosion can wash soil, nutrients and debris onto road surfaces and sidewalks, clog storm sewers, smother fish spawning areas and promote weed and algae growth in lakes and streams.

Runoff from urban areas also affects stream hydrology. This occurs as runoff volume increases over a short period of time, creating large increases in stream peak flows and flow volumes. When compared to natural streams, these flows dramatically increase during rain storms and decrease below normal levels between rain storms. This produces "flashy" streams with characteristics which limit animal life and recreational uses.

Shorelines and streambanks along most of the lakes and streams in the urbanized portions of the watershed were surveyed. The most extensive areas of erosion caused by urban runoff exist along Muskego Creek, O'Leary Tributary and Denoon School Tributary.

Urban land uses are the principal sources of many toxic pollutants, including lead, zinc and copper. Within the urban areas, land uses most important in producing these pollutants include commercial and small industrial, and medium-high density residential areas. Construction site erosion has been the most significant urban sediment source, and is expected to remain so unless aggressive controls are implemented. Eroding construction sites account for 42 percent of the sediment delivered to lakes and streams in the Muskego-Wind Lakes Watershed. Runoff from established urban areas is another source of sediment, and will become increasingly important as cropland erosion and construction sites decline.

Trends

Tables 3-10 and 3-12 show the estimated sediment load from all urban nonpoint sources in the Muskego-Wind Lakes watershed under year 1985 and year 2010 conditions, assuming no increase in the current level of runoff pollutant control. Sediment loads can be expected to increase by between 20 and 35 percent in the urbanizing portions of the watershed during the twenty-five year period. The increase is due primarily to anticipated runoff and construction erosion associated with new urban development.

Pollution Reduction Goals

Water quality and aquatic habitat investigations were conducted as part of the planning effort for the Muskego-Wind Lakes Watershed Project. The results indicate that significant reductions are needed for several key pollutants in order to achieve the watershed project's water quality objectives.

Overall a 55 percent reduction in sediment loading is the designated goal needed to improve the aquatic habitat in nearly all lakes and streams in the watershed. This level will eventually reduce the amount of sediment in the stream bottoms and enhance their ability to support healthier and more diverse aquatic communities.

In addition, a 67 percent overall reduction in phosphorous loading to the lakes and streams is the designated goal needed to reduce the prevalence of nuisance algae growth.

Another important means for improving water quality in the Muskego-Wind Lakes and their tributaries is to reduce the concentrations of heavy metals and other toxic materials in urban runoff. No specific goals have been established for reduction of these pollutants because it is assumed that targeted sediment reductions will adequately address concerns about metals and other urban toxics which, in part, adhere to sediment particles.

Management Actions

This plan prescribes best management practices (BMPs). BMPs are actions or structures that are needed to control nonpoint pollution sources to the levels described above. State funding is available to help offset the expense of installing these practices and managing the local nonpoint source control program recommended in this plan.

Financial assistance is available from the nonpoint source program for a variety of activities. Landowners, land renters, counties, cities, towns, sewage and sanitary districts, and lake management districts are eligible for the financial assistance available through this project. In urban areas, state funds help support:

- Structural BMPs such as those described in Chapters IV and V.
- Activities related to developing and/or amending water quality provisions in construction erosion control ordinances and storm water management ordinances.
- Staff for drafting and enforcing local ordinances controlling construction site and storm water runoff, and implementing supplementary street sweeping programs.
- Staff or contracts with consultants to develop storm water management plans and design and inspect BMPs.
- Information and education programs.

In rural areas, state funds provide assistance for:

- Installing BMPs.
- Providing local government staff support to contact landowners and help them design and install BMPs.
- Information and education programs.

Participation in watershed projects is voluntary. Projects are implemented by local units of government, such as cities, towns, counties and lake management districts. The DNR and the Department of Agriculture, Trade and Consumer Protection (DATCP) review the progress of local units of government and provide them with assistance throughout the life of the project. The DNR monitors improvements in water quality resulting from the control of nonpoint sources.

The following is an overview of both urban and rural management actions needed to meet water quality goals in the Muskego-Wind Lakes Watershed.

Urban Management Program

The urban management program has three elements, including construction erosion control, existing urban area control, and planned urban area control.

Construction Site Erosion

About 900 acres of new urban development is expected in the watershed over the next 18-20 years. Improved staffing and enforcement of construction erosion control ordinances is needed in Waukesha County, New Berlin, Muskego, and Norway. Racine County needs to adopt an ordinance.

Existing Urban Areas

The control program for existing urban areas is based on the pollution reduction goals for urban toxic materials, as indicated by lead and other heavy metals.

Approximately 2,866 acres, or 55 percent, of the existing urban area are targeted for nonpoint source control. Possible urban nonpoint source controls include wet detention ponds, infiltration devices, street sweeping, and good housekeeping practices. If wet detention and street sweeping are used, nearly 11 acres of wet detention ponds need to be constructed, and over 94 curb miles of more intensive street sweeping per year is recommended.

Planned Urban Areas

Nearly 1,200 acres of planned urban areas will need stormwater controls over the next 20 years. The construction of about 10 acres of wet detention ponds is one alternative for reducing nonpoint source pollution from these areas. Alternatively, infiltration devices, including grassed swale drainage and redirection of rooftop drain pipes to grassed areas, can be used in selected areas. This will provide additional benefits in moderating urban stream flow, and will decrease the amount of detention needed.

Streambank Erosion Control

For purposes of this watershed plan, all streambank erosion controls are part of the rural management program described below.

Core Elements of the Urban Management Program

The core elements of the urban nonpoint source control program applicable to local units of government include basic measures that can be implemented without further study. Adopting a community specific core program is the first step in the implementation process. Communities will need to commit within the first three years of the project to implement the core program. This is a requirement to receive technical and financial assistance through the priority watershed project.

The basic elements of the core program are:

- Strengthen and enforce existing construction erosion control ordinances to be consistent with the model developed jointly by the Wisconsin League of Municipalities and the DNR. Construction erosion control practices should be consistent with the standards and specifications in the "Wisconsin Construction Site Best Management Practice Handbook."

- Develop and implement a community specific program of urban "housekeeping" practices which reduce urban nonpoint source pollution. This may include a pollution awareness campaign, adoption of ordinances regulating pet wastes or changes in the timing and scheduling of leaf collection.

- Implement an information and education program consistent with the elements described in Chapter Six of this plan.

Segmented Elements of the Urban Management Program

The segmented elements of the urban nonpoint source program include those requiring site specific investigations prior to implementation. Best management practices implemented under this portion of the program likely will include wet detention ponds, infiltration devices, streambank erosion controls and other maintenance activities such as street sweeping for reducing urban nonpoint source pollution.

Detailed studies will include engineering feasibility and other site specific investigations for existing and new development. The results will determine the best means for reducing urban nonpoint sources in a specific community by more site specific application of the plan's recommendations.

The basic elements of the segmented program are:

- Adopt and enforce a storm water management ordinance consistent with the state's model stormwater ordinance under preparation.

- Develop, as needed, management plans for planned urban development. These plans will identify the type and locations of urban BMPs.

- Conduct detailed engineering studies to determine the best means to implement site specific nonpoint source control measures for existing urban areas. This element will consider structural urban practices such as detention and supplementary street sweeping.

- Design and install structural BMPs as described in the state's draft stormwater manual for existing urban areas with complete, detailed engineering studies.

Rural Management Program

The rural management program has three elements: streambank erosion control, cropland erosion control and barnyard runoff control.

Streambank Erosion Control

Fourteen sites in the watershed are targeted for streambank erosion control practices. These sites account for about 6,900 feet of eroding streambank and about 63 percent of the sediment load delivered from streambank sources.

Cropland Erosion Control

About 2,000 acres of croplands are targeted for sediment and phosphorus control practices. These practices are expected to control about 1,800 tons of sediment or about 60 percent of the total sediment load delivered from croplands.

Barnyard Runoff Control

Five of 17 barnyards are targeted for management practices. They represent 97 percent of the potential pollution delivered to surface waters from this source.

In-Lake Nutrient Inactivation: Wind Lake and Bass Bay are targeted for alum treatments, provided that other nonpoint sources are controlled adequately in advance (as determined by the DNR).

Easements for Wetland Restoration, Critical Area Stabilization and Shoreline Buffers: More than 1,600 acres are eligible for acquisition of easements.

Costs

The total estimated cost of carrying out the recommendations presented in this plan for rural and urban areas is about $8 million. This cost will be shared by individual landowners, the State of Wisconsin through its Nonpoint Source Water Pollution Abatement Program, and local units of government. Table 5-11 summarizes the estimated costs for major project components and shows how these costs would be incurred by the major project participants.

Rural Costs

Carrying out the project in rural areas will cost approximately $1.3 million. Principal cost components include: local staffing to work with landowners in planning and designing best management practices, capital costs for installing best management practices, and purchase of land easements in key areas.

Costs would be borne primarily by the nonpoint source program, which would cover about 80 percent of the total cost. The state support would cover virtually all of the costs associated with local staffing and purchase of easements, and nearly 70 percent of the capital practice installation costs. Individual landowners would cover the remaining 20 percent of the total cost for rural areas. In addition, landowners are responsible for all practice maintenance costs.

Urban Core Program Costs

Existing Urban Areas

The nonpoint source program would fund about 60 percent of the costs of increasing local enforcement and administrative staff for construction erosion control for the eight-year project period. The state would cover all costs associated with these activities for an initial five-year period. During this time, local governments are expected to set up a fee structure or other sources of revenue to fund ordinance enforcement when grant funds are no longer available. The continuation of these activities by local units of government would constitute about 40 percent of the total costs for this component, or $60,000 over the remaining three years of the project.

Planned Areas

Carrying out core activities in planned urban areas will cost about $490,000. Principal cost components include measures needed to control construction site erosion over the eight-year project period. Costs incurred would be primarily for the installation of best management practices to control construction site erosion, and local staffing to administer and enforce erosion control ordinances.

Urban Segmented Program Costs

Existing Urban Areas

It will require an estimated $5 million to carry out segmented activities in existing urban areas. Principal costs would include engineering, construction, and maintenance of wet detention ponds or some other urban structural practices that provide equivalent levels of pollution control, a supplementary schedule for street sweeping, and staff to prepare detailed engineering feasibility studies for identifying the locations, types and sizes of practices. All of these elements except maintenance of BMPs are state cost-shared at 50 to 100 percent.

Although the capital cost of constructing wet detention ponds in existing urban areas is an estimated $70,000 per acre of pond, other components such as the purchase of land and re-routing storm sewer pipes where needed can increase the total costs dramatically.

Overall, about 60 percent of the total costs for this component would be covered by the state through the nonpoint source program, and about 40 percent would be paid for locally. The state share would cover several items.

- Assistance for preparing detailed engineering site feasibility studies to locate and select urban structural practices includes 100 percent of the costs incurred by additional staff who are required in order to prepare these studies.

- Assistance for installing urban structural practices such as wet detention ponds includes 100 percent of the practice design costs and 70 percent of the capital cost for installation of urban structural practices (land purchase costs and storm sewer work are not included, however).

- Assistance for starting a supplementary street sweeping schedule includes 50 percent of the staff costs of supplementary sweeping for a five-year period.

It is intended that local units of government would cover the remaining costs associated with installing urban structural practices, including maintenance, and continuation of the supplementary street sweeping activities past the initial five-year period. However, a part of the local government share could be paid for by landowners who install practices on private property.

Planned Urban Areas

It will require an estimated 1.1 million to carry out segmented activities in planned urban areas. Costs would be incurred primarily for preparation of stormwater management studies for areas of new development, and for the engineering and capital costs required to install urban structural practices.

More than 95 percent of these costs would be borne by individual landowners and developers to cover the engineering and capital cost of practice installation. In addition, these parties would be responsible for supporting the cost of practice maintenance. About five percent of the cost for this component would be covered by the Nonpoint Source Program, through its support for costs associated with the preparation of stormwater management studies and ordinances.

Information and Education

Costs of this component are shown in table 1 and are explained in Chapter Six of the watershed plan.

Project Implementation

Project implementation is scheduled to begin in late, 1993. The first three years of implementation is the period in which rural participants sign cost-share agreements. Cost-share recipients have five years for practice installation. This results in an eight-year project period. In urban areas, practices may be added to agreements throughout the eight-year project period, provided that the municipality conducts its core activities.

Information and Education

An information and education program will be conducted throughout the project period. The Waukesha and Racine County Land Conservation Departments (LCDs), local units of government, and the UW-Extension staff have overall responsibility for the program. The program includes:

- A media campaign to inform the public about nonpoint source pollution and what they can do to reduce this type of pollution.
- More intensive educational activities, such as meetings, workshops, tours and demonstration projects for landowners and local government officials who must adopt new pollution control techniques.
- Newsletters, fact sheets, exhibits, and slide or video programs for lakeshore homeowners, local government officials, community groups, and concerned citizens to inform them about watershed activities, implementation processes, and pollution control methods.
- Educational activities and service projects for students to inform them about water resource issues and help them develop a conservation ethic.

Further Information

If you want more information about the Muskego-Wind Lakes Priority Watershed Project or a copy of the watershed plan contact one of the following:

Nonpoint Source Program Coordinator
Department of Natural Resources
P.O. Box 7921
101 S. Webster St.
Madison, WI 52707-7921
(414) 263-8500

Urban Water Quality Education Specialist
University of Wisconsin-Extension
1304 S. 70th St. Suite 228
West Allis, WI 53214-3154
(414) 475-2881

CHAPTER ONE
Plan Purpose and Legal Status

The Muskego-Wind Lakes Watershed was designated as a "priority watershed" in 1991 under the Wisconsin Nonpoint Source Water Pollution Abatement Program. Map 1 shows the location of the Muskego-Wind Lakes Watershed. It is one of 60 watersheds statewide where clean-up and protection of water resources through control of nonpoint sources of pollution is a priority for the DNR.

Each priority watershed project is guided by a plan prepared cooperatively by the DNR, the DATCP, and local units of government. The priority watershed plan assesses nonpoint and other sources of water pollution and identifies best management practices needed to meet specific water resource objectives. The plan guides implementation of these practices to improve water quality.

Nonpoint Source Water Pollution Abatement Program

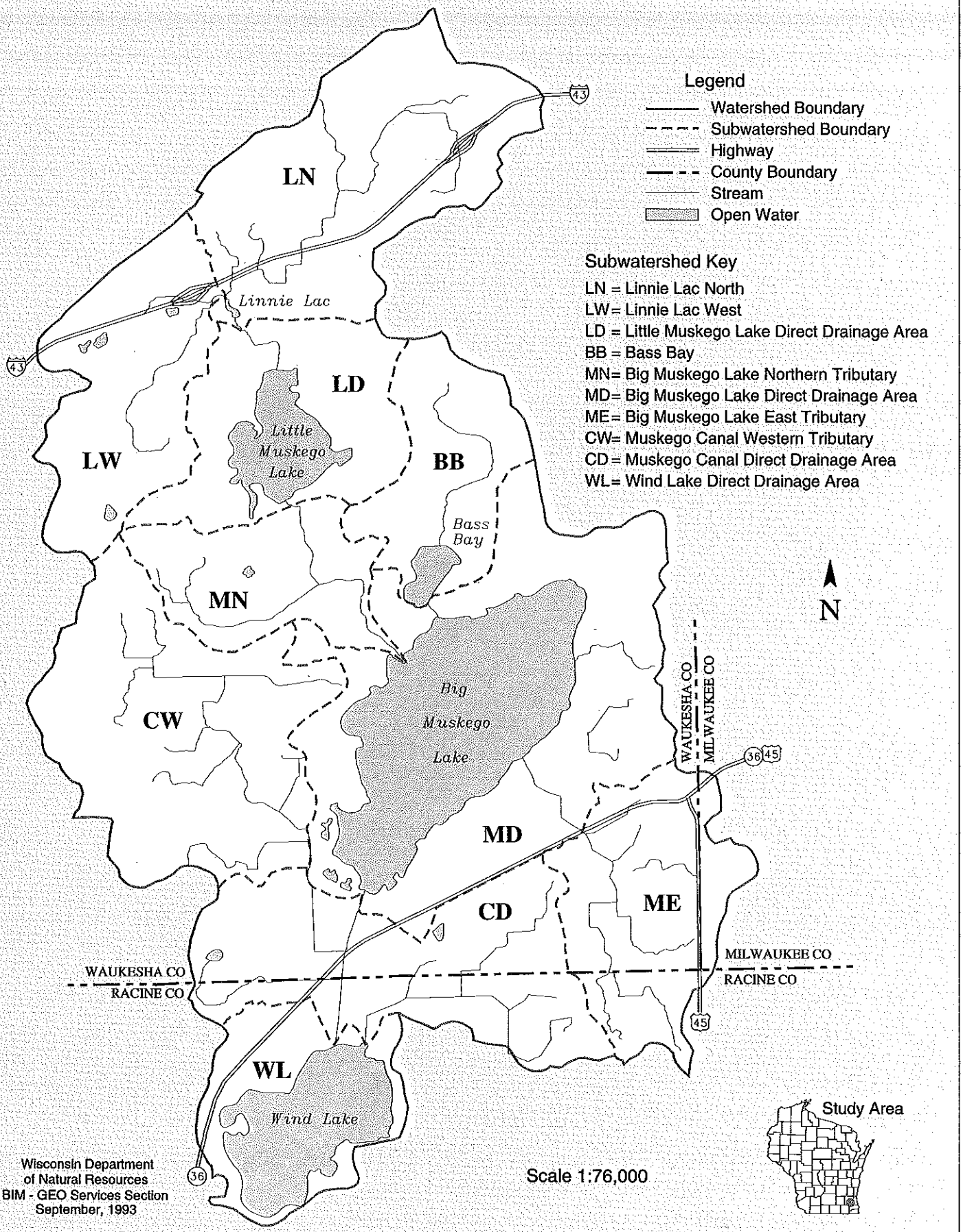
The Nonpoint Source Water Pollution Abatement Program was created in 1978 by the State Legislature. Its goal is to improve and protect the water quality of streams, lakes, wetlands, and groundwater by reducing pollutants from urban and rural nonpoint sources. Nonpoint sources include: eroding agricultural lands, eroding streambanks and roadsides, runoff from livestock wastes, erosion from developing urban areas, and runoff from established urban areas. Pollutants from nonpoint sources are carried to the surface water or groundwater through the action of rainfall runoff, seepage, and snowmelt.

The following is an overview of the Program.

> The Program is administered by the DNR and the DATCP. It focuses on critical hydrologic units called priority watersheds. The program is implemented through priority watershed projects for which a plan has been prepared.
>
> Local units of government implement the plan. Water quality improvement is achieved through voluntary implementation of nonpoint source controls (best management practices) and adoption of ordinances. Landowners, land renters, counties, cities, villages, towns, sanitation districts, metropolitan Sewerage Districts, regional planning commissions, and lake management districts are eligible to participate.

Map 1

Muskego - Wind Lakes Priority Watershed



Wisconsin Department
of Natural Resources
BIM - GEO Services Section
September, 1993

Technical assistance is provided to aid the design of best management practices. State cost-share assistance is available to offset the cost of installing these practices. Informational and educational activities are implemented to encourage participation.

Priority Watershed Project Planning and Implementation Phases

Planning Phase

The planning phase of the project began in 1992. Planning included the following information gathering and evaluation procedures:

- Determine the conditions and uses of lakes and streams.
- Inventory types of land uses and severity of nonpoint sources impacting streams and lakes.
- Evaluate the types and severity of other factors which may be affecting water quality. Examples include discharges from wastewater treatment and in-lake nutrient recycling.
- Determine levels of nonpoint source control and measures necessary to improve and/or protect water quality.
- Prepare and gain approval for a priority watershed plan documenting the above evaluations, implementation procedures, and costs.

Implementation Phase

The implementation phase will begin following review of the draft priority watershed plan, a public hearing, and approval by the DNR and local units of government. Public review during plan development occurred primarily through the efforts of the Citizens Advisory Committee and the Watershed Project Team, including its working groups.

During the implementation phase:

- DNR enters into local assistance agreements with local units of government with implementation responsibilities identified in the plan. These agreements provide funds necessary to maintain the resources and staff required for plan implementation.

- In the rural portions of the watershed, eligible landowners are contacted by staff of the Waukesha County Land Conservation Division and the Racine County Land Conservation Department to determine their interest in voluntarily installing best management practices identified in the plan. A small number of landowners in the Milwaukee County portion of the watershed may also be contacted.

  In the urban portions of the watershed, local units of government are contacted by the DNR or its designee to discuss in more detail their required actions to implement plan recommendations.

- Cost-share agreements for rural practices are signed by the landowner and the county, outlining the practices, costs, cost-share amounts, and a schedule for installation of management practices. In urban areas a similar process is used. Some agreements for urban practices are signed by the local unit of government and the DNR. In some cases the agreements will be between local units of government and private landowners. All practices are scheduled for installation up to five years from the date an agreement is signed.

Legal Status of the Nonpoint Source Control Plan

The Muskego-Wind Lakes Priority Watershed Plan was prepared under the authority of the Wisconsin Nonpoint Source Water Pollution Abatement Program described in Section 144.25 of the Wisconsin Statutes and Chapter NR 120 of the Wisconsin Administrative Code. It was prepared under the cooperative efforts of DNR, DATCP, the Waukesha County Land Conservation Division, the Racine County Land Conservation Department, other local units of government, and the Citizens Advisory Committee.

This watershed plan is the basis for the DNR to enter into cost-share and local assistance grants with agencies responsible for implementation and will be used as a guide to implement measures to achieve desired water quality conditions. In the event that a discrepancy occurs between this plan and the statutes or the administrative rules, or if the statutes or rules change during implementation, the statutes and rules will supersede the plan.

Comprehensive water quality management plans pertaining to the Fox River Basin have been developed by the Southeastern Wisconsin Regional Planning Commission (SEWRPC). SEWRPC and the DNR recently completed a lake management plan for Wind Lake and other lake management plans are being developed within the watershed. These reports recognize the importance of reducing nonpoint sources to achieve improved water quality in the lakes and streams of the Muskego-Wind Lakes Watershed.

This priority watershed plan must be approved by Waukesha County, Racine County, and the DNR before it may be fully implemented. This watershed is covered under the adopted Areawide Water Quality Management Plan for Southeastern Wisconsin prepared by the SEWRPC. Consequently, the DNR will request that the SEWRPC recommend that the priority watershed plan be approved as an amendment to the adopted Areawide Water Quality Management Plan for Southeastern Wisconsin.

Relationship of the Nonpoint Source Control Plan to the Integrated Resource Management Strategy

The DNR has designed and implemented an approach to natural resource management called "integrated resource management." It uses the nonpoint source control program as the foundation for coordinating other DNR environmental quality (solid waste, wastewater, water regulation and zoning, water resources management, water supply) and resource management (fisheries, forest management, parks and recreation, and wildlife and endangered resources management) efforts.

This Priority Watershed Plan meets the requirements of Section 144.25 of the Wisconsin Statutes. This statute requires the DNR to develop "an integrated resource management strategy to protect or enhance fish and wildlife habitat, aesthetics, and other natural resources" for priority watersheds.

Relationship of the Nonpoint Source Control Plan to the Federal Storm Water Discharge Permit Program

The Federal Water Quality Act plays an important role in improving water quality in the Muskego-Wind Lakes Watershed. Amendments to the Act, approved in 1987, required large cities, major industries, construction activities of 5 acres or more and potentially other municipalities to apply for a National Pollutant Discharge Elimination System (NPDES) permit for the discharge of pollutants from separate storm water sewer systems. These permits (called WPDES in Wisconsin) are similar to those issued by the DNR for public and private wastewater treatment plants and industrial dischargers of wastewater.

The DNR, in accordance with regulations issued by the U.S. Environmental Protection Agency (EPA), has responsibility for implementing this permit program. The amendments to the Act require pollutants in municipal storm water discharges to be controlled to the "maximum extent practicable." Many of the probable permit requirements overlap with the management actions specified in this plan for improving water quality in the watershed. For example, adequate enforcement of construction site erosion control ordinances are specifically mentioned in the regulations and are identified in this nonpoint source plan as a critical component of the sediment control strategy. Implementation of the priority watershed plan will likely meet this and many other permit requirements.

Importantly, the nonpoint source plan calls for management actions not required in the storm water management program, including stabilization of eroding stream banks. Similarly, the permit program will likely require activities beyond the nonpoint source plan including water quality monitoring of selected storm sewer outfalls by the permittee and adoption of

municipal ordinances to control storm water discharges from lands associated with industrial activities.

The coordinated implementation of the storm water permit program and this nonpoint source control plan will help ensure that the water quality objectives for the Muskego-Wind Lakes and its tributaries will be achieved. Specific information on the relationship between implementing these two programs is presented in Chapters IV and V.

Plan Organization

The remainder of this plan is divided into the following chapters:

CHAPTER TWO, "General Watershed Characteristics," is an overview of the cultural and natural resource features with respect to planning and implementation efforts for the priority watershed project.

CHAPTER THREE, "Water Resources Conditions, Nonpoint Sources, and Water Resource Objectives," characterizes the existing and potential biological and recreational uses of surface waters. The results of the nonpoint source inventories and evaluations and water resource goals and objectives are set.

CHAPTER FOUR, "Nonpoint Source Control Needs," identifies the level of urban and rural nonpoint source control needed to meet the water resource objectives and identifies the decision criteria and the nonpoint sources eligible for funding under the priority watershed project.

CHAPTER FIVE, "Implementation Program," describes the means by which local units of government administer the project, estimates a local assistance and management practice cost-share budget, and identifies technical and financial assistance available to local units of government through the project.

CHAPTER SIX, "Information and Education Program," presents the methods used to publicize and promote the priority watershed project in order to obtain the highest level of participation among landowners and units of government in the watershed. It describes the elements, costs, and responsible parties needed to carry out the information and education component.

CHAPTER SEVEN, "Integrated Resources Management Program," presents guidelines for integrating other resource management programs, organizations and activities into the watershed project.

CHAPTER EIGHT, "Project Evaluation," discusses the means for assessing the amount of nonpoint source control gained through installation of best management practices.

CHAPTER TWO
General Watershed Characteristics

The Muskego-Wind Lakes Watershed is a 40.9 square mile drainage area located in Waukesha, Racine and Milwaukee counties, Wisconsin. It is located near the southwestern edge of the Milwaukee metropolitan area and drains to the Fox River which flows in a southerly direction into northeastern Illinois.

Land use and topography change significantly throughout the watershed. The northern one-half of the watershed is hilly and dominated by urban residential subdivisions and planned unit developments. The southernmost areas of the watershed are flatter and generally used more for agriculture. Wetlands and other poorly drained lands are common throughout the watershed but most occur in the southern two-thirds of the watershed. Moreover, much of the land that is suitable for building is under increased development pressure.

The watershed drains runoff to a chain of five lakes. Little Muskego and Wind Lakes are surrounded by year-round and summer residences where recreational uses of the lakes flourish. Big Muskego Lake, the largest on the chain, is shallower with shoreline areas that are poorly drained and mostly dominated by emergent vegetation. Therefore, settlement around the main part of Big Muskego Lake has been limited to a few shoreland residences, most occupying areas around Bass Bay. Linnie Lac is a small impoundment that collects storm water from the northernmost portion of the watershed. The Muskego-Wind Lakes Watershed, divided into ten smaller subwatersheds for study purposes, is shown in map 1. The following is a brief overview of the watershed's cultural and natural resource features important in planning a nonpoint source pollution control effort. Additional descriptive information is contained in A Management Plan for Wind Lake, Racine County (SEWRPC and DNR, 1991).

Cultural Features

Civil Divisions

The Waukesha County portion of the watershed encompasses 35.3 square miles or 86 percent of the drainage area. This portion of the watershed contains parts of two municipalities including the city of Muskego and the city of New Berlin.

The Racine County portion of the watershed encompasses 5.2 square miles or 13 percent of the drainage area. Part of the town of Norway is located within the drainage area. Only one percent of the watershed is within Milwaukee County in the city of Franklin.

Table 2-1 and map 2 show the areal extent of each municipality within the Muskego-Wind Lakes Watershed.

Table 2-1. Civil Divisions in the Muskego-Wind Lakes Watershed

Civil Division	Acres	Percent of Watershed	Percent of Civil Division Within Watershed
City of Franklin Milwaukee County	270	1.0	1.2
Town of Norway[1] Racine County	3,314	12.7	14.4
City of Muskego[2] Waukesha County	18,376	70.2	79.7
City of New Berlin Waukesha County	4,210	16.1	17.8
TOTAL	26,170	100.0	-

[1]Includes seven acres in the town of Raymond
[2]Includes four acres in the town of Vernon

Source: SEWRPC

Population Size and Distribution

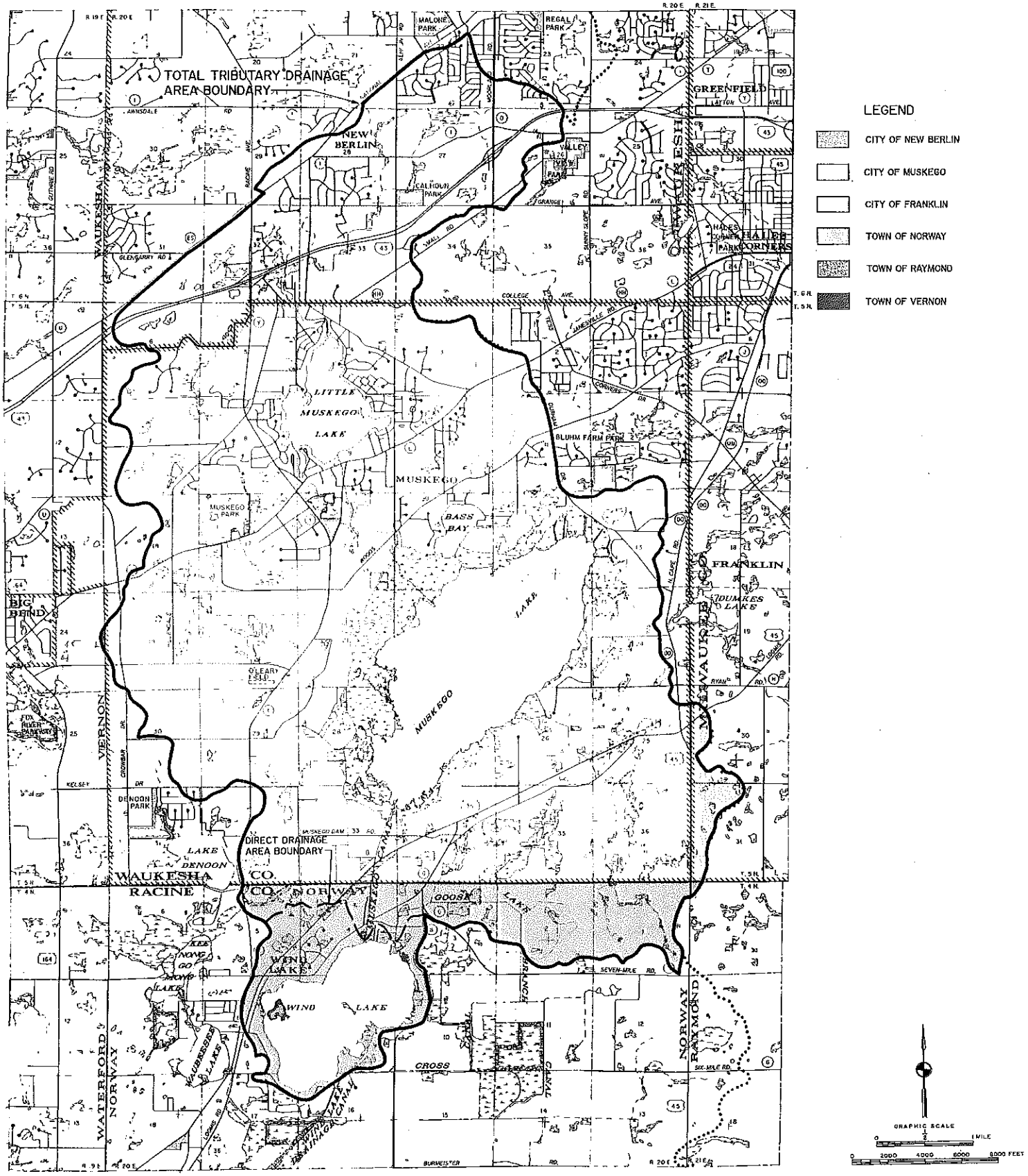
The 1985 population in the Muskego-Wind Lakes Watershed was estimated to be 15,130 persons. The population of the watershed increased by 52 percent from 1960-1985. However, in the same period, the population of the direct drainage area specific to Wind Lake declined by 24 percent (390 fewer persons).

Although regional and watershed specific trends suggest that the population will increase by more than 20 percent over the next 20 years, the population in the Racine County portion is expected to decrease by roughly 5 percent. On the whole, a trend towards a decrease in household size will result in a significant increase in the amount of urban development.

Land Uses

Table 2-2 summarizes existing land uses in the watershed. Rural land uses comprise more than 32 square miles or 80 percent of the drainage area. The predominant rural land uses are agricultural and other open lands, occupying 20 square miles or 50 percent of the

MAP 2
CIVIL DIVISIONS OF THE MUSKEGO-WIND LAKES WATERSHED



Source: SEWRPC.

watershed. The remaining rural land uses include wetlands and surface water, which together cover 10 square miles or 25 percent of the watershed. Woodlands occupy about 2 square miles or 5 percent.

Table 2-2. Land Uses Within the Muskego-Wind Lakes Watershed

Land Use Category		Acres	Percent of Total
Urban	Residential	3,183	12.2
	Commercial	134	0.5
	Industrial	88	0.3
	Governmental/Institutional	168	0.6
	Transportation/Utilities	1,233	4.7
	Recreational	376	1.4
	Subtotal	5,182	19.8
Rural	Woodlands	1,361	5.2
	Wetlands	2,996	11.4
	Surface Water	3,550	13.6
	Agriculture/Other Open Land	13,081	50.0
	Subtotal	20,988	80.2
	TOTAL	26,170	100.0

Source: SEWRPC

Urban land uses currently occupy over 8 square miles or 20 percent of the watershed. Low to medium density residential development is the predominant urban land use, covering about 5 square miles or 62 percent of the urban area. The remainder includes transportation and utilities, recreational, governmental and institutional, industrial, and commercial land uses.

Future urbanization, including conversion to residential, commercial, industrial, highway, and governmental and institutional land uses is expected to occur throughout the watershed. These land uses will increase by about 18 percent (1.4 square mile increase) from 1985 to 2010. Most of this urbanization will occur in the northern half of the watershed.

Municipal and Industrial Point Sources of Water Pollution

There are no known point source discharges of wastewater from municipal or industrial water treatment facilities in the Muskego-Wind Lakes Watershed. However, from 1967 to 1984 the Muskego Sewage Treatment Plant discharged phosphorus-enriched effluent at levels nearly ten times that of upstream background levels to Big Muskego Lake during frequent malfunctions of the plant. Consequently, phosphorus concentrations increased in the bottom sediments of Big Muskego Lake and resuspension of those sediments continued to affect water quality in Big Muskego and Wind Lakes many years after the treatment plant was shut down. In 1984,

the sewage treatment plant was abandoned and the wastewater diverted to the Milwaukee Metropolitan Sewerage District system which serves most of the population of the watershed.

Sanitary Sewer Service

Sanitary sewer service is available throughout the urban areas of the Muskego-Wind Lakes Watershed. More than 80 percent of the watershed's population receives service from the Milwaukee Metropolitan Sewerage District which discharges to the Milwaukee Harbor Estuary. Wastewater generated by the remainder of the watershed residents is disposed of by private on-site systems.

Water Supply Service

Water supplies used in the Muskego-Wind Lakes Watershed are obtained from both municipal and non-municipal groundwater sources and municipal systems providing water service from Lake Michigan. There are three principal aquifers lying beneath the watershed from which groundwater is obtained. Water obtained from these aquifers is either pumped from privately owned wells, or is obtained by municipal pumping facilities.

Natural Resource Features

Climate

The frequency, duration and amount of precipitation influences surface and groundwater quality and quantity, soil moisture content, runoff characteristics, and the physical condition of surface waters. Precipitation events throughout the watershed are most frequently moderate in duration and quantity. An event is defined as a distinct period when precipitation is equal to or greater than 0.1 inch. Approximately 50 events per year occur in the watershed.

The watershed's annual precipitation is an average of 33 inches. The driest months are December, January, and February, with an average of 1.70 inches, 1.44 inches, and 1.08 inches of precipitation, respectively. These are also the months of greatest snow accumulation, when more than 30 inches or 68 percent of the average annual snowfall occurs. The wettest months are June, July, August, and September when more than 15 inches, or 47 percent of the average annual rainfall takes place. Most runoff occurs in March, April, and May when soil is either frozen or saturated.

Topography

Topographic relief in the watershed ranges from 1,042 feet above sea level in the northern and western portions of the watershed to about 770 feet above sea level at the Wind Lake Canal. The physiographical terrain is defined by rolling moraines in the north with flatter, wetter areas to the south. Surface drainage networks are sometimes poorly connected, causing several areas of the watershed to be internally drained. In addition, lack of relief in the southeasternmost areas of the watershed combined with an extensive tile drainage network makes delineation of minor subwatersheds difficult.

Soils

The most common soil associations occurring in the watershed are the Morley-Beecher-Askum and the Montgomery-Martinton-Hebron-Saylesville Associations. The erosion potential of these soils is based on their texture, structure, organic matter content, permeability, slope, and position on the landscape. All are susceptible to erosion.

The Morley-Beecher-Askum soils are well drained to poorly drained and have silty clay or silty clay loam subsoils. They are formed in thin loess and the underlying clay loam or silty clay loam glacial till on ridges and knobs. These soils are nearly level to gently sloping, and they occupy low, very broad ridges that are dissected by drainageways and depressions. Soils of the Montgomery-Martinton-Hebron-Saylesville Association are poorly drained to well drained soils that have subsoils of clay to clay loam and are formed in silty clay or silty clay loam sediments in old lake basins.

A minor soil association present in the lower portions of the watershed includes the Houghton-Palms-Adrian Association characterized by very poorly drained organic soils in depressions on old lake beds and on floodplains. For more detailed soils information, refer to the USDA Soil Surveys available at the county land conservation offices.

Surface Water Resources

Lakes

Lakes are the major surface water features within the drainage area. Lakes and impoundments within the watershed total about 3,500 acres or 13 percent of the watershed area. The land area to lake area ratio is about 6:1.

With the exception of Bass Bay, each of the lakes shown in table 2-3 have water control structures. These provide some degree of flood control and recreational benefit, but prolific weed and algae growth and degraded water quality conditions have progressively impaired recreational uses in all of the lakes. The water control structures prohibit upstream migration of forage and game fish and limit navigation.

Table 2-3. Lakes in the Muskego-Wind Lakes Watershed

Lake	Area (acres)	Mean Depth (ft)	Max Depth (ft)	Tributary Area (mi^2)
Linnie Lac	5	4	6	8.2
Little Muskego	506	14	65	11.5
Bass Bay	104	11.5	23	2.4
Big Muskego	1966	2.6	4.0	28.3
Wind	936	9.6	52	40.9

Source: SEWRPC

Streams

Perennial and intermittent streams have a combined length of about 48 miles. Calhoun Creek, Jewel Creek, Muskego Creek, Muskego Canal and several other tributary streams form the principal perennial streams in the watershed. A number of intermittent streams flow only when there is runoff or when groundwater discharge is present. Intermittent waterways generally form the headwaters of the perennial streams.

Many of the perennial and intermittent streams have been extensively modified through channelization and impoundment. Where channelization has occurred, habitat for fish and aquatic life has been severely degraded. Several of the tributary streams have been concrete lined for flood control purposes. Where concrete channelization has occurred, habitat has been completely destroyed. Perennial streams in the watershed are listed in table 2-4.

Table 2-4. Perennial and Intermittent Streams of the Muskego-Wind Lakes Watershed

Subwatershed	Stream	Perennial (mi)	Intermittent (mi)	Total (mi)
LN	Beloit Road Tributary	1.54	1.32	2.86
	Calhoun Park Tributary	0.00	2.56	2.56
	Calhoun Park Tributary (N)	0.00	0.87	0.87
	Summit Tributary	0.00	0.59	0.59
	Linnie Lac Tributary (N)	0.00	0.55	0.55
LW	Linnie Lac Tributary (NE)	0.00	0.65	0.65
	Linnie Lac Tributary (W)	1.70	0.55	2.25
LD	Jewel Creek	0.43	0.00	0.43
BB	Bass Bay Tributary	0.00	2.21	2.21
MN	Muskego Creek	2.37	0.00	2.37
	O'Leary Tributary	0.00	2.37	2.37
	County Park Tributary	0.00	0.49	0.49
CW	Muskego H.S. Tributary	0.00	1.14	1.14
	Woods Road Tributary	0.00	2.09	2.09
	Muskego Tributary (SW)	1.89	1.54	3.43
	Hillendale Tributary	0.00	0.83	0.83
	Harriberry Tributary	0.00	0.55	0.55
	Denoon School Tributary (N)	0.00	1.18	1.18
	Denoon School Tributary (S)	0.00	1.58	1.58
MD	Muskego Tributary (NE)	0.00	0.87	0.87
	Ryan Road Tributary	0.00	1.14	1.14

Table 2-4. Continued

Subwatershed	Stream	Perennial (mi)	Intermittent (mi)	Total (mi)
ME	Durham Tributary	0.00	0.59	0.59
	Loomis Road Tributary	0.00	0.43	0.43
	Aero Estates Tributary	0.00	0.75	0.75
	Union Church Tributary	0.00	2.92	2.92
	Union Church Tributary (SE)	0.00	2.96	2.96
CD	Oak Grove School Tributary	0.00	1.58	1.58
	Muskego Canal Tributary (NW)	1.38	0.00	1.38
	Muskego Canal Tributary (SW)	0.00	1.58	1.58
	Muskego Canal	1.18	0.00	1.18
	Goose Lake Canal	3.79	0.00	3.79
	TOTAL	14.28	33.89	48.17

Source: DNR

Many streams with natural embankments tend to be heavily overgrown with dense woody vegetation, particularly in the rural areas of the watershed. This condition may limit the stream's wildlife potential and results in minor flow modifications where logs and debris accumulate in the channels.

Wetlands

Wetlands are some of the most valuable natural resource features in the watershed. They provide wildlife habitat, fish spawning areas, recreation, flood control and removal of pollutants. They comprise about 3,000 acres, or 11 percent, of the watershed. An additional 4,100 acres have been converted from wetlands to farmlands by artificial drainage.

Groundwater Resources

Groundwater is contained in one of four aquifers underlying the surface of the watershed--the sand and gravel aquifer, the Niagara (dolomite and limestone) aquifer, the sandstone aquifer, and the crystalline basement rock complex. An aquifer is an underground rock or soil

formation that stores water and conveys it to wells, lakes, and streams. Aquifers in the Muskego-Wind Lakes Watershed are listed here in order of depth below the surface.

Sand and Gravel Aquifer

The sand and gravel aquifer is comprised of surface material deposited from glacial ice that covered the watershed approximately 10,000 years ago. These deposits, which are generally 100 to 200 feet deep, are unconsolidated soil material with physical and chemical characteristics different from agricultural soils.

Groundwater in these deposits occurs and moves in the void spaces among the grains of sand and gravel. It is locally important as a source of groundwater for both public and private use where there are relatively thick saturated unconsolidated deposits. The potential for contamination is high because of the shallow depth to groundwater and permeability of the deposits.

Niagara Aquifer

The Niagara aquifer occurs beneath the sand and gravel formation. It was deposited approximately 400 million years ago and is up to 400 feet thick. It consists of the Niagara dolomite formation and is underlain by a confining layer of shale (Maquoketa shale). Dolomite is a brittle rock similar to limestone which contains groundwater in interconnected cracks and voids. The Maquoketa shale is derived from impermeable clays and prevents water from moving between the Niagara dolomite and the deeper aquifers. Most potable water used in the watershed comes from this formation. The potential for contamination is moderate.

Sandstone and Dolomite Aquifer

The sandstone and dolomite aquifer occurs beneath the Niagara formation in deposits between 425 and 600 million years old. It consists of sandstone and dolomite bedrock between 400 and 600 feet thick characterized by materials with variable water-yielding properties. In eastern Wisconsin, most users of large quantities of water tap this deep aquifer to ensure an adequate supply. In areas where the Maquoketa shale underlies the dolomite aquifer the potential for contamination is low.

Crystalline Bedrock Aquifer

The crystalline bedrock aquifer is located beneath the sandstone and dolomite aquifer in formations more than 600 million years old. This aquifer is not a primary source of water in the watershed. Most of the deposits are very dense crystalline rock which normally yield small amounts of water. Fractures in the crystalline structured rocks store water but the quality and reliability of this water source and the extreme depth restrict its use.

Environmental Corridors

Areas within southeastern Wisconsin having the highest concentrations of natural, recreational, historic, aesthetic and scenic resources are called environmental corridors. These areas normally include such things as lakes, rivers, streams, wetlands, woodlands, prairies, wildlife habitat areas, wet and poorly drained soils, rugged terrains, and areas of high relief as well as outdoor recreation sites, historic and archaeological sites, and natural and scientific areas.

Primary and secondary environmental corridors and isolated natural areas have been identified by the DNR and the SEWRPC for the Muskego-Wind Lakes watershed (SEWRPC, 1991). These areas contain primarily wetlands, woodlands, and surface water and comprise approximately 12 square miles, or about 30 percent of the watershed. Preservation of these areas is important for improving water quality in this watershed and the Fox River Basin.

Natural Area Sites

Natural areas are identified statewide by the Wisconsin Scientific Areas Preservation Council and the DNR's Bureau of Endangered Resources. These areas are within environmental corridors and isolated natural areas. They are tracts of land or water which exhibit pristine pre-settlement conditions and/or contain unique plant and animal communities.

Natural areas are classified in one of three categories: statewide or greater significance, county-wide or greater significance, and local significance. In the Muskego-Wind Lakes watershed, only Muskego Park, owned and managed by Waukesha County, has been designated a state natural area.

Endangered Resources

The status and locations of rare species are tracked by the Wisconsin Natural Heritage Inventory of the DNR's Bureau of Endangered Resources. Included are those that are listed by the U.S. Fish and Wildlife Service and by the State of Wisconsin.
The term "endangered" refers to species in jeopardy of extirpation or extinction based on scientific evidence. In the Muskego-Wind Lakes watershed, the striped shiner (Luxilus chrysocephalus) and the Forster's tern (Sterna forsteri) are classified as endangered.

"Threatened" species are those that appear likely to become endangered in the foreseeable future based on scientific evidence. The redfin shiner (Lythrurus umbratilis), the red-shouldered hawk (Buteo lineatus) and the great egret (Casmerodius albus) are listed as threatened.

In addition, some species merit the status of "special concern". These include species about which some problem of abundance or distribution is suspected but not yet proven. The purpose of this category is to focus attention on certain species before they become endangered or threatened. Included are the pugnose minnow (Opsopoeodus emiliae) and the lake chubsucker (Erimyzon sucetta).

CHAPTER THREE
Water Resources Conditions, Nonpoint Sources and Water Resources Objectives

This chapter discusses the type and extent of rural and urban nonpoint pollution sources in the Muskego-Wind Lakes Watershed and identifies their observed impacts on lakes and streams. It also sets forth water quality improvement objectives for Little Muskego Lake, Big Muskego Lake, Wind Lake, Bass Bay and Linnie Lac and their tributaries. These objectives determine the level of nonpoint source pollution control recommended by the plan and become the basis for the pollution control strategy presented in Chapter Four, "Nonpoint Source Control Needs."

The chapter is divided into three sections. The first is a watershed overview, presenting results of the land resources inventory and the water resources appraisal. The second section compares the impacts of each pollutant source for each subwatershed. Finally, the third section presents the water resources objectives and pollution reduction goals to be achieved through the nonpoint source program.

Watershed Overview

Surface Water Conditions

The perennial and intermittent tributary streams in the watershed were classified by the DNR according to their potential to support recreational, fish, and aquatic life uses (refer to map 3). The classifications also assess each stream's capability to support these uses assuming that cultural limitations, such as point and nonpoint pollution sources are reduced or eliminated. The streams were classified using the State's stream classification system and supporting water quality criteria contained in Chapters NR 102, 104, and 106 of the Wisconsin Administrative Code.

As shown in table 3-1, there are approximately 11.4 miles of perennial streams with the potential to support warm water forage fish communities and approximately 4.7 miles of streams which could support warm water sport fish such as northern pike, smallmouth bass and bluegill. Currently, however, because of the influence of development, agriculture and

persistent pollution, 57 percent of these streams are not meeting their full biological or recreational potential.

Little Muskego Lake, Big Muskego Lake, Wind Lake and Bass Bay were classified using a standard measurement of lake water quality called trophic state index (TSI). The TSI is an indicator of the degree of eutrophication or nutrient enrichment of a lake and is based on measurements of water clarity, chlorophyll concentration, or total phosphorus concentration.

As shown in table 3-2, each of the lakes has a TSI within the range of about 49 to 75, indicating mildly eutrophic conditions in Little Muskego Lake to more severely eutrophic conditions in Big Muskego Lake. This suggests that nutrient and sediment degradation may impair some lake uses such as swimming and fishing. However, lake usage support is more difficult to define because of the variety of recreational uses and public perceptions. Therefore, it is difficult or impossible to classify a lake with respect to use impairment as is done with streams.

Water quality problems attributable to nonpoint sources are shown in table 3-3 and summarized below. Runoff from farm fields carries sediment, nutrients, pesticides and bacteria. Runoff from construction sites and other urban areas carries sediment, nutrients, metals, grease, oil, bacteria and assorted debris. Consequently, the lakes and streams become turbid, dissolved oxygen levels fall, and aquatic habitat deteriorates. To a limited extent, livestock waste in runoff from barnyard areas results in excessive ammonia, phosphorus and bacteria in lakes and streams, affecting fish and other aquatic life.

Drainage modifications such as ditching and channelizing of streams and wetlands has immediate and long-term detrimental effects on water chemistry, stream base flows, temperature, and fish and wildlife habitat. Channelized streams tend to have uniform velocities and substrates that are unsuitable for many forms of aquatic life, particularly during dry seasons and low flows when insufficient water depths limit aquatic habitat. Drainage of wetland areas has the effect of lowering water tables, reducing base flows in the stream and sometimes creating flooding problems downstream.

All of the lakes exhibit excessive aquatic weed and algae growth and provide abundant habitat for carp and bullhead. Warming of lake temperatures, periodic low dissolved oxygen levels and discharge of organic matter are other conditions impairing fish habitat. Turbidity in the lakes and channels is intensified by relatively high numbers of bottom-feeding fish.

Past municipal wastewater discharges have contributed heavy organic nutrient loads to Big Muskego and Wind Lakes. Consequently, low dissolved oxygen levels and excessive weed and algae growth result. Currently, municipal wastewater is diverted outside of the watershed, but the impacts of past abuses have continuing effects as nutrients in bottom sediments are resuspended with each seasonal overturn. There are no known industrial wastewater discharges in the watershed. However, unintentional spills of toxic materials and inappropriate disposal of waste oil and other pollutants contribute to water quality problems.

Table 3-1. Summary of Aquatic Life and Water Quality Conditions for Streams in the Muskego-Wind Lakes Watershed.

Uses	Current Use Classification (miles)	Potential Use Classification (miles)	Supporting Highest Potential Use (miles)		
			Full	Partial	Not
CWSF	0	0	0	0	0
WWSF	3.55	4.73	2.37	2.36	0
WWFF	0	11.43	0	0	11.43
LFF	13.98	10.55	2.03	4.31	4.21
LAL	30.64	21.46	16.29	0	5.17
TOTAL	48.17	48.17	20.69	6.67	20.81

CWSF = Cold water sport fish and aquatic life communities
WWSF = Warm water sport fish and aquatic life communities
WWFF = Warm and cold water forage fish communities
LFF = Limited forage fish communities
LAL = Limited aquatic life

Table 3-2. Average Spring Phosphorus Trophic State Indices of Lakes in the Muskego-Wind Lakes Watershed.

Lake	Trophic State Index**				
	1988	1989	1990	1991	1992
Linnie Lac	N/A	N/A	N/A	N/A	N/A
L. Muskego	60	58	61	54	49
Bass Bay	68	64	68	N/A	53
B. Muskego	69	68	71	75	53
Wind	55	54	69	62	61

** Trophic State Index is a measure of lake water quality as determined by water clarity, chlorophyll or total phosphorus concentrations in the water column. Included are USGS and DNR Volunteer Lake Monitoring data. Higher numbers indicate nutrient enrichment and reduced water clarity. N/A = data not available

Table 3-3. Nonpoint Source Impacts on Streams in the Muskego-Wind Lakes Watershed

Subwatershed	Stream Name	Length (miles)	Water Quality Problem	Nonpoint Source Pollutants	Observed & Potential Sources
Linnie Lac North (LN)	Beloit Road Trib Segments 1-2	2.86	Loss of aquatic habitat Turbidity Low dissolved oxygen Potential toxicity	In-place pollutants Low flows Sediment Suspended solids Nutrients Metals Pesticides	Urban land Construction sites Cropland Ditches Streambanks
	Calhoun Creek Segments 3-4	3.43	Loss of aquatic habitat Turbidity Low dissolved oxygen Potential toxicity	Low flows Sediment Suspended solids Nutrients Metals Pesticides	Urban land Construction sites Cropland Nurseries Ditches Streambanks
	Summit Trib Segment 5	1.50	Loss of aquatic habitat Turbidity Low dissolved oxygen Potential toxicity	In-place pollutants Low flows Sediment Suspended solids Nutrients Metals Pesticides	Urban land Construction sites Cropland Ditches Streambanks
	Linnie Lac N Trib Segment 6	0.55	Loss of aquatic habitat Turbidity Low dissolved oxygen Potential toxicity	Low flows Sediment Suspended solids Nutrients Metals Pesticides	Urban land Construction sites Cropland Ditches Streambanks Highways
Linnie Lac West (LW)	Linnie Lac W Trib Segments 7-9	2.95	Loss of aquatic habitat Turbidity Low dissolved oxygen	Low flows Sediment Suspended solids Nutrients In-place pollutants	Urban land Construction sites Cropland Ditches Streambanks

Table 3-3. Continued

Subwatershed	Stream Name	Length (miles)	Water Quality Problem	Nonpoint Source Pollutants	Observed & Potential Sources
L. Muskego Direct (LD)	Jewel Creek Segment 10	0.43	Loss of aquatic habitat Turbidity Low dissolved oxygen Potential toxicity Streambank scour	Low flows Sediment Suspended solids Nutrients Metals Pesticides High flows	Urban land Construction sites Cropland Ditches Streambanks
Bass Bay (BB)	Bass Bay Trib Segment 11	2.21	Loss of aquatic habitat Turbidity Low dissolved oxygen Ammonia toxicity Other potential toxicity	Low flows Sediment Suspended solids Nutrients Fecal pathogens Metals Pesticides In-place pollutants	Urban land Construction sites Cropland Ditches Streambanks Animal lots
B. Muskego North (MN)	Muskego Creek Segment 12	2.37	Loss of aquatic habitat Turbidity Low dissolved oxygen Potential toxicity	Low flows Sediment Suspended solids Nutrients Metals Pesticides	Urban land Construction sites Cropland Ditches Streambanks Highways
	County Park Trib Segments 13-14	2.66	Loss of aquatic habitat Turbidity Low dissolved oxygen Potential toxicity	Sediment Suspended solids Nutrients Metals Pesticides In-place pollutants	Urban land Construction sites Cropland Ditches Streambanks Highways
B. Muskego Direct (MD)	Ryan Road Trib Segments 22 & 25	2.01	Loss of aquatic habitat Turbidity Low dissolved oxygen Potential toxicity	Sediment Suspended solids Nutrients Metals Pesticides	Urban land Construction sites Cropland Ditches Streambanks

Table 3-3. Continued

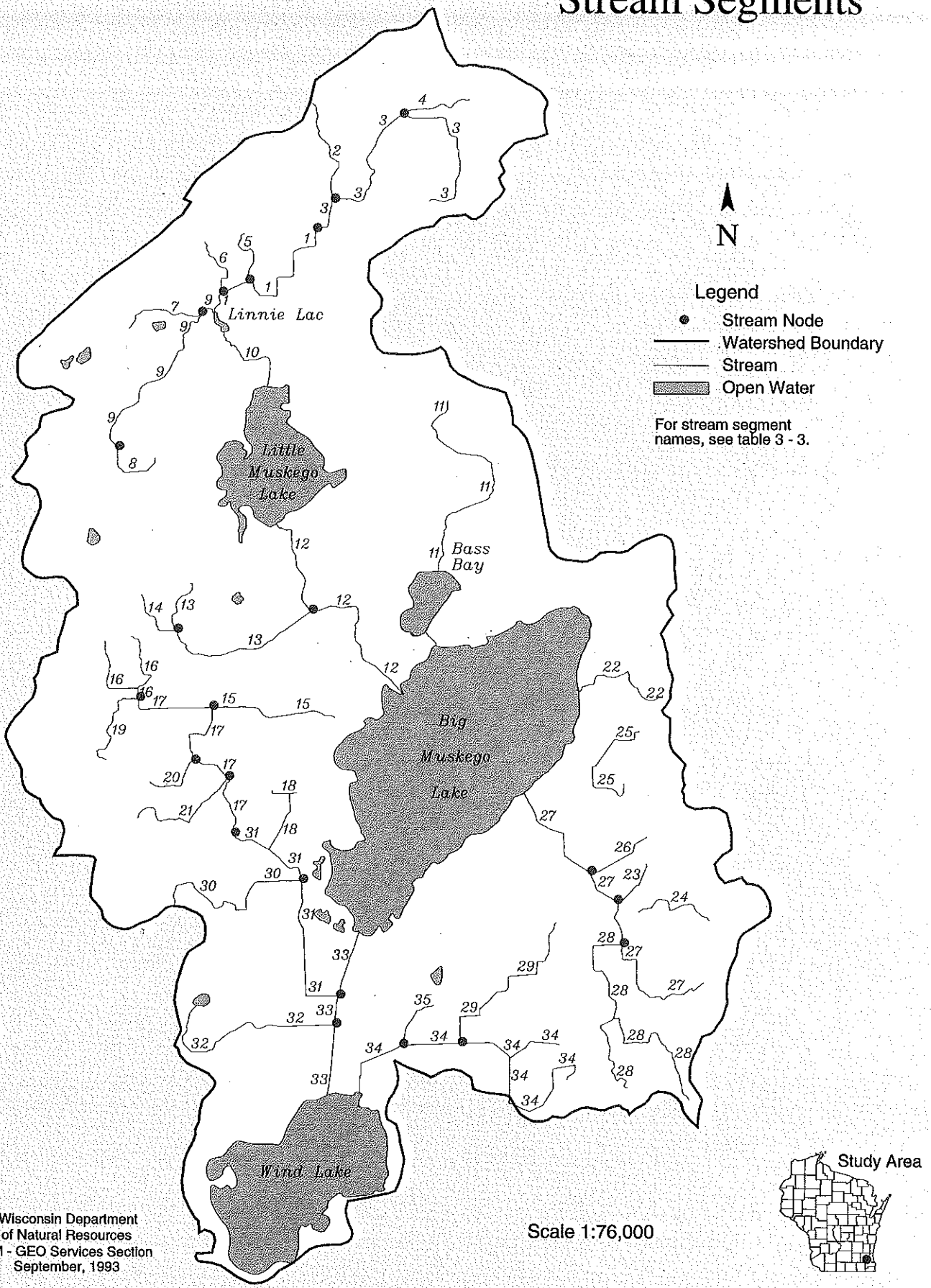
Subwatershed	Stream Name	Length (miles)	Water Quality Problem	Nonpoint Source Pollutants	Observed & Potential Sources
B. Muskego East (ME)	Loomis Rd Trib Segments 23-24, 26-28	6.90	Loss of aquatic habitat Turbidity Low dissolved oxygen Potential toxicity	Flow modifications Sediment Suspended solids Nutrients Metals Pesticides In-place pollutants	Urban land Construction sites Cropland Ditches Streambanks Degraded wetlands
Muskego Canal West (CW)	Muskego High Trib Segments 15-21, 30	10.8	Loss of aquatic habitat Turbidity Low dissolved oxygen Potential toxicity	Low flows Sediment Suspended solids Nutrients Metals Pesticides In-place pollutants	Urban land Construction sites Cropland Ditches Degraded wetlands Streambanks
Muskego Canal Direct (CD)	Muskego Canal Segments 29, 31-35	9.50	Loss of aquatic habitat Turbidity Low dissolved oxygen Potential toxicity	Low flows Sediment Suspended solids Nutrients Metals Pesticides In-place pollutants	Urban land Construction sites Cropland Animal lots Nurseries Ditches Highways Drainage tiles Carp

** Loss of aquatic habitat means loss of fish and invertebrate habitat.

Source: DNR

Map 3

Muskego - Wind Lakes Priority Watershed
Stream Segments



Wisconsin Department
of Natural Resources
BIM - GEO Services Section
September, 1993

While there are no municipal wastewater discharges within the Muskego-Wind Lakes Watershed, storm drainage discharges and construction site erosion are major concerns, especially in the developing areas of Muskego, New Berlin, and Norway. Street and parking lot runoff regularly contain acute toxicity levels for lead, zinc, copper and cadmium in studies done in Milwaukee and Madison (DNR, 1992).

Agricultural Nonpoint Pollution Source Inventory Results

Agricultural nonpoint sources include cropland erosion, nursery land erosion, animal lots, and winterspread manure. Collectively, these sources pose a serious threat to water quality, contributing to the degradation of lakes and streams in many reaches of the watershed. In these areas, croplands are the principal sources of sediment and nutrients flowing into the lakes. Agricultural nonpoint source pollution was identified and assessed in all of the subwatersheds where rural land uses occur. These sources are discussed below.

Agricultural Sediment and Phosphorus Delivery

Sediment adversely affects lakes and streams in many ways. It degrades habitat for fish and aquatic invertebrates which are important in the food chain. High sediment concentrations abrade fish gills making fish more susceptible to disease, fills in pools, and degrades fish spawning habitat. Suspended sediment also causes temperature fluctuations that can deplete the oxygen in a stream or lake.

Table 3-4 summarizes erosion rates, sediment delivery and phosphorus delivery from the 8,737 acres of rural land (6,027 acres of agricultural fields) that were inventoried. About 3,100 tons of eroded soil and 13,000 pounds of phosphorus are washed into lakes and streams annually from agricultural sources.

Table 3-4. Summary of Agricultural Sediment and Phosphorus Delivery for the Muskego-Wind Lakes Watershed.

Lake	Field Acres Inventoried for Total Tributary Area	Sediment Delivery		Phosphorus Delivery	
		Tons	Tons/Acre	Lbs.	Lbs./Acre
Linnie Lac	1,199	1,070	0.89	4,533	3.78
Little Muskego	1,397	1,149	0.82	4,937	3.53
Bass Bay	794	111	0.14	842	1.06
Big Muskego	3,209	645	0.20	1,530	0.48
Wind	6,027	165	0.03	1,059	0.18

Source: DNR

About 45 percent of the sediment and 35 percent of the phosphorus affecting lakes and streams in the watershed come from eroding cropland. Most of it originates on cropland with low rates of soil erosion. For example, more than half of the sediment delivered to surface waters from rural lands originates from croplands that are eroding at less than three tons/acre/year. This rate of erosion is very small, equivalent to about the thickness of a dime over the land surface.

Most of the sediment reaching lakes and streams (2,500 tons, or 80 percent) originates in the Linnie Lac North (LN), Muskego Canal Direct (CD), and Muskego Canal West (CW) subwatersheds. As the watershed continues to undergo development, cropland sediment and phosphorus delivery should decline. However, without measures to control storm water runoff and construction site erosion, the new urban areas will become alternate sources of pollution.

Manure Runoff and Phosphorus Delivery

Manure contains several components that adversely affect water quality and aquatic life. Manure entering a stream or lake decays, resulting in depletion of dissolved oxygen necessary for fish and aquatic life to survive. A byproduct of manure is ammonia. High concentrations of ammonia are toxic to fish and other aquatic life. The nutrients in manure, including nitrogen and phosphorus, also promote nuisance algae and weed growth in lakes and streams. Finally, the bacteria found in livestock manure is harmful to animals and humans that drink or come in contact with the water. The sources of manure in the Muskego-Wind Lakes watershed are runoff from barnyards and runoff from manure improperly spread on fields located close to streams or on steep slopes.

The Muskego-Wind Lakes watershed has 17 livestock operations. With only a few exceptions, the barnyards associated with these operations are not large sources of phosphorus and other water-born contaminants. Of the 17 barnyards inventoried, 11 drain to streams and lakes. Runoff from the remaining barnyards flows to internally drained areas overlain by deep soils.

As shown in table 3-5, an estimated 486 pounds, or 82 percent of the phosphorus attributed to barnyards, originates at the 11 barnyards draining to surface waters. One produces a high level of pollution and 4 produce medium quantities of pollution. The highest barnyard pollution loading occurs in the tributary areas of Little Muskego Lake (80 percent of total draining to surface waters), Muskego Canal (8 percent), and Bass Bay (12 percent) .

Some pollution (103 pounds of phosphorus, or 17 percent of the total barnyard load) originates at the six barnyards draining to closed depressions overlain by deep soils. These barnyards are not a significant threat to either surface or groundwater quality.

Table 3-5. Pollution Potential of Barnyard Runoff in the Muskego-Wind Lakes Watershed

Subwatershed	Number of Barnyards with Runoff[1]	Phosphorus Delivered to Internally Drained Sites (Lbs.)	Phosphorus Delivered to Surface Waters (Lbs.)[1]	Percent of Total Surface Water Phosphorus Load
Linnie Lac North (LN)	3	1	9	2
Linnie Lac West (LW)	1	0	380	78
Bass Bay (BB)	2	0	58	12
Big Muskego Direct (MD)	1	0	0	0
Big Muskego East (ME)	1	0	0	0
Muskego Canal West (CW)	5	91	25	5
Muskego Canal Direct (CD)	4	11	14	3
TOTAL	17	103	486	100

[1]Covered and confined livestock operations without runoff were not inventoried.
[2]Pollution potential was based on the mass load of total phosphorus, in pounds, delivered by runoff during average annual rainfall conditions.

Streambank Erosion

Streambanks along 12 miles of perennial and intermittent streams in the watershed were surveyed. These results are shown in table 3-6. The extent and severity of streambank erosion is significant (about 314 tons or 10 percent of total) but generally not a major water quality problem. Erosion was recorded for approximately 32,000 feet or 6 percent of streambanks in the watershed. Most of the erosion was located in the Linnie Lac and Big Muskego Lake tributaries. Channelization and upstream modifications appear to be the major causes.

Of the total length of eroding streambanks, 8,800 feet or 27 percent are adjacent to residential or developing urban lands. Seventy-three percent or 23,300 feet are associated with rural lands including cropland, pastures and woodlots. Only one eroding site showed evidence of cattle access to the stream.

Table 3-6. Streambank Erosion Inventory Results for the Muskego-Wind Lakes Watershed

Subwatershed	Stream Name & Segment(s)	Feet of Streambank Degraded	Sediment Released (Tons/Yr.)
Linnie Lac North (LN)	Beloit Road Trib Segments 1-2	4,260	66
	Calhoun Park Creek Segments 3-4	1,200	12
	Summit Trib Segment 5	1,900	10
Linnie Lac West (LW)	Linnie Lac NW Trib Segment 7	600	8
	Linnie Lac W Trib Segment 9	4,100	31
Little Muskego Direct (LD)	Jewel Creek Segment 10	400	6
Bass Bay (BB)	Bass Bay Trib Segment 11	2,000	20
Big Muskego North (MN)	Muskego Creek Segment 12	2,000	26
	O'Leary Trib Segment 13	2,800	52
Muskego Canal West (CW)	Muskego High Trib Segment 15	800	16
	Muskego SW Trib Segments 17-18	1,900	18
	Hillendale Trib Segment 19	600	5
	Henneberry Trib Segment 20	750	2
	Denoon School Trib Segment 30	3,600	5
Big Muskego Direct (MD)	Ryan Road Trib Segment 25	1,200	8
Big Muskego East (ME)	Union Church Trib Segment 27	1,600	11
Muskego Canal Direct (CD)	Muskego Canal Segment 33	2,400	18
TOTAL		32,110.0	314.000

Source: DNR

In some areas, pasturing of farm animals along streams results in trampled banks and wider, shallower streams which provide fewer pools for fish to feed and find cover. Loss of streambank vegetation also increases water temperature and reduces instream woody cover used by most fish species.

Occasionally, excessive streambank vegetation causes a loss of riparian habitat. Stream obstructions can block or redirect the flow and destabilize the banks, and monospecific stands of weedy vegetation that are characteristic of these areas are generally unsuitable for desired species of wildlife.

Lake shorelines in built-up areas of Little Muskego Lake, Big Muskego Lake, Bass Bay and Wind Lake were surveyed. Shoreline stabilization treatments varied. Most landowners used rock, concrete blocks, bricks, wood structures, steel walls or occasionally no treatment at all. None of the lakeshore areas surveyed exhibited severe or even moderate erosion potential. A few areas appeared to have sustained minor ice damage, but the overall nonpoint source impact from eroding lake shorelines is insignificant.

Urban Nonpoint Sources

Urban runoff carries a variety of pollutants to surface water. Some pollutants are specific to urban runoff while others are also found in runoff from agricultural areas. Pollutants found primarily in urban runoff include heavy metals (lead, copper, zinc, cadmium and chromium) and a large number of toxic organic chemicals (PCBs, aromatic hydrocarbons, esters and many others). Other substances in urban runoff that are also found in runoff from rural areas include sediment, nutrients, bacteria and other pathogens, and pesticides.

Runoff from urban areas also affects stream characteristics. For example, as pavement and rooftops prevent rainwater and snowmelt from soaking into the ground, water runs off the surface at a much higher rate. Streams crest at much higher levels than prior to urban development. Consequently, in some areas groundwater recharge is reduced and dry-weather stream flows decrease to below minimum levels needed to sustain fish and aquatic life.

In effect, urban runoff produces "flashy" streams with temperatures and chemical characteristics which limit animal life and recreational uses. Streambank erosion may increase as high and low flow extremes occur. Flooding of adjacent property may also occur, sometimes requiring channelization and/or lining with concrete to accommodate flood flows or prevent flood damage. This often destroys the natural stream system and speeds the transport of pollutants downstream.

In addition to these typical urban nonpoint sources, there are numerous other sources which need additional attention, including construction site erosion, in-place contamination, runoff from waste disposal sites and resource extraction industries. Each of these represent potential causes of lake use impairment.

All of these factors, many of which are addressed by WPDES storm water permit requirements, contribute in varying degrees to lake use impairment. The purpose of the urban nonpoint source inventory and analysis was to identify which causes (and related nonpoint sources) are critical constraints to achieving water quality goals and which are only minor contributors.

Urban nonpoint sources described below include runoff from existing urban areas, construction sites, and post-construction urban areas.

Existing Urban Areas

The delivery of urban pollutants to lakes and streams from existing urban areas depends on the types of urban land uses, the types of storm water conveyance systems, and urban "housekeeping" practices, including but not limited to street sweeping, yard waste collection, and waste oil recycling programs. Each factor is discussed below.

Urban Land Uses

Table 3-7 summarizes the type and extent of urban land uses for communities by subwatershed. Urban land uses as sources of pollutants in runoff are shown in table 3-8. Highways, commercial areas, and high density residential areas are the largest sources of sediment, lead, and zinc on a per acre basis. Medium density residential areas are less important sources of sediment and lead, but are significant sources of pesticides, bacteria, and household or automotive maintenance products dumped into ditches and storm sewers. Low density residential areas, particularly in the lakeshore areas, are important where the improper use and disposal of pesticides, fertilizers, and automotive maintenance products may occur.

The pollutants in urban runoff depend on the configuration of "source areas." Source areas—characterized by streets, parking lots, rooftops and lawn areas—are present in different proportions depending on the land use pattern. For example, residential areas contain more lawn area than commercial areas, while commercial areas have more rooftop, street, and parking lot surfaces. Lawns can be important sources of fertilizers and pesticides. Rooftop areas are important sources of zinc and atmospheric pollutants. Their connection to the storm drainage system may be direct or indirect, depending on the use of downspouts, grassed areas, drain tiles, etc. Streets are sources of significant amounts of lead, cadmium, sediment, and other pollutants, depending on their condition and the amount of traffic.

The types and amounts of pollutants transported by runoff depends on the way that pollutant-bearing surfaces are connected to the storm drainage system. For example, commercial parking areas and arterial streets, deliver the highest concentrations of lead, asbestos, cadmium, and street sediment because normally, these areas are drained by storm sewers that discharge to a lake or stream.

Table 3-7. Urban Land Uses for Subwatersheds of the Muskego-Wind Lakes Watershed: 1990

Sub-watershed	Municipality	Land Use in Acres								
		Residential Density			Com	Ind	Hwy	Inst	Urban Open Space	Total Acres
		Low	Med	High						
LN	New Berlin	172.5	505.4	0.0	16.0	0.0	44.6	0.0	513.7	1252.2
LW	New Berlin	25.0	0.0	0.0	0.0	0.0	11.9	0.0	0.0	36.9
	Muskego	195.0	0.0	0.0	0.0	10.0	5.9	0.0	17.0	227.9
LD	Muskego	822.9	107.7	33.0	33.5	14.0	0.0	45.1	612.7	1668.9
BB	Muskego	130.0	110.0	0.0	6.0	0.0	0.0	0.0	250.0	496.0
MN	Muskego	3.8	158.3	15.0	45.0	13.3	0.0	84.0	950.3	1269.7
MD	Muskego	180.0	0.0	0.0	0.0	0.0	0.0	0.0	370.0	550.0
ME	Muskego	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	10.0
CW	Muskego	0.0	18.0	0.0	0.0	0.0	0.0	0.0	0.0	18.0
CD	Muskego	17.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	20.0
	Norway	18.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	23.0
WL	Norway	0.0	253.0	0.0	5.0	2.0	0.0	71.0	2.0	333.0
	TOTAL	1,522.2	1,152.4	48.0	110.5	49.3	50.5	200.1	2,715.7	5,848.7

Source: DNR and SEWRPC

Table 3-8. Pollutant Generation Rates From Urban Land Uses

Land Use	Unit Area Load (pounds/acre/year)				
	Sediment	Phosphorus	Lead	Zinc	Other Concerns
Highways	880	0.9	5.5	2.1	volatile organics
Industrial	1,000	1.5	2.4	2.1	volatile organics
Commercial	1,000	1.5	2.7	2.1	volatile organics
Shopping Centers	440	0.5	1.1	0.6	volatile organics
High Density Residential	420	1.0	0.8	0.7	pesticides
Medium Density Residential	190	0.5	0.2	0.2	pesticides
Low Density Residential	10	0.04	0.01	0.04	pesticides
Parks	3	0.03	0.005	-	pesticides

Source: DNR

Urban "Housekeeping" Practices

Table 3-9 lists basic information concerning storm water conveyance systems and street sweeping practices for communities in the watershed. These factors affect the amount of pollutants from urban surfaces carried to lakes and streams by runoff. Street sweeping removes some of the particulate pollutants from street and parking lot surfaces before they can be transported to surface waters. Repeated street sweeping of commercial and industrial areas in the early spring provides the greatest benefit. Other sweeping is primarily cosmetic, and serves little to reduce urban pollutant loads.

Table 3-9. Grass Swale Drainage, Street Sweeping and Wet Ponds By Land Use For Municipalities in the Muskego-Wind Lakes Watershed

Municipality	Land Use	Acres	Percent Drained by Grass Swales	Infiltration Rate (in/hr)	Street Sweeping (sweepings/yr)	Wet Ponds
New Berlin	Residential	898	50	1	1	None
	Commercial	16	90	1	1	None
	Industrial	10	90	1.5	1	None
	Open Space	513	90	1.5	1	None
Muskego	Residential	1,614	90	1	1	Freedom Square** Lake Forest Plum Creek Lakewood Meadows
	Commercial	40	90	1	1	Pick 'N Save
	Industrial	37	100	1	1	None
	Open Space	2,183	100	1	1	Parkland Drive
	Institutional	117	90	1	1	None
Norway	Residential	253	90	0.5	0	None
	Commercial	5	100	0.5	0	None
	Industrial	2	100	0.5	0	None
	Open Space	519	100	0.5	0	None
	Institutional	67	100	0.5	0	None

** includes 10 acres commercial

Source: DNR

The potential for lawn care chemicals to be carried by runoff from shoreline areas and nearby drainageways to the lakes is a concern. Fertilizer residues can enrich the lakes with nutrients and promote algae growth. Use of low-phosphorus or non-phosphorus fertilizers is recommended for lawn areas.

Nonpoint Source Loadings

Existing urban land uses and their respective amounts and types of pollutant loads are shown in table 3-10. The greatest amount of urban land in the watershed is concentrated around Little Muskego Lake. In addition, the northernmost areas of the watershed have the greatest amount of medium to low-density residential development.

Table 3-10. Urban Land Use and Nonpoint Source Loads in the Muskego-Wind Lakes Watershed: 1990

Subwatershed	Urban Land Use		Sediment		Phosphorus		Zinc**	
	Acres	%	Tons/Yr	%	Pounds/ Yr	%	Pounds/ Yr	%
LN	1252	21.2	65.5	30.5	288.2	32.4	216.2	30.4
LW	265	4.5	5.1	2.4	20.4	2.3	27.6	3.9
LD	1669	28.3	36.7	17.1	150.8	16.9	130.9	18.4
BB	496	8.4	10.9	5.1	51.8	5.8	35.6	5.0
MN	1270	21.5	52.3	24.4	193.5	21.8	177.6	25.0
MD	550	9.3	0.8	0.4	10.5	1.2	5.8	0.8
ME	10	0.2	3.9	1.8	11.3	1.3	17.0	2.4
CW	18	0.3	1.6	0.7	7.2	0.8	3.5	0.5
CD	43	0.7	0.0	0.0	0.8	0.1	0.9	0.1
WL	333	5.6	37.8	17.6	154.2	17.4	95.4	13.4
TOTAL	5,906	100	215	100	889	100	711	100

** Zinc is used as an indication of metal loadings contributed from urban land uses.

Source: DNR

Four pollutants (sediment, phosphorus, zinc, and lead) were chosen to characterize the type and severity of urban nonpoint pollution. Four subwatersheds—Linnie Lac North (LN), Little Muskego Direct Drainage(LD), Big Muskego Lake North (MN), and Wind Lake Direct (WL)—contribute about 90 percent of the estimated sediment, phosphorus, zinc, and lead to lakes and streams coming from urban sources in the watershed.

Commercial and industrial areas have the highest unit/area/year pollutant loads, producing the most significant amounts of suspended solids, metals and other urban toxic pollutants. Medium density and multi-family residential areas also generate significant quantities of toxic pollutants. This occurs primarily because of the large impervious area these land uses

occupy. Medium to high density residential areas are also significant sources of sediment and phosphorus.

Construction Site Erosion and Sedimentation

Construction site erosion and sedimentation is a major water quality concern in the watershed. It can destroy aquatic communities in lakes and streams. It can cause reduced capacity of storm water conveyance systems resulting in localized flooding. Moreover, any water quality improvements occurring through implementation of nonpoint source control practices in downstream areas can be negated by construction erosion upstream.

Predicting rates of construction site erosion is difficult. On some sites, erosion rates exceeding 75 tons/acre/year can occur. This rate of erosion is greater than occurs on the most severely eroding croplands and more than 60 times the sediment loading rate from post-construction commercial and industrial areas. Often the close proximity of construction sites to storm sewers or other drainageways serving urban areas results in nearly all of the sediment being delivered to lakes and streams.

An analysis of construction site erosion in the Muskego-Wind Lakes watershed was conducted using land use inventory data provided by SEWRPC. The average annual amount of land under construction for the period 1985 to the year 2010 was estimated by quantifying historical changes in urban land use and projecting growth between 1985 to 2010. New development, totaling 920 acres, was estimated to occur at an average rate of about 37 acres annually (SEWRPC, 1991).

Average annual sediment loading to streams from construction erosion for 1990 to 2010 conditions was determined by multiplying the amount of land planned for development by an average of 30 tons per acre per year. This rate of erosion assumes the current level of on-site erosion and sediment control and is based on observed land development patterns and generalized climatic conditions. It is estimated that in the years between 1990 and 2010, construction erosion will contribute about 2,000 tons per year of sediment (about 50 percent of total from nonpoint sources) to lakes and streams in the watershed (Refer to table 3-14).

The potential impact of urban redevelopment on water quality is similar to that of construction activities on previously undeveloped land. Renovation of buildings and utilities can cause erosion and sedimentation. Although urban redevelopment projects will not necessarily increase the amount of urban surface area, they provide opportunities to install storm water management practices to treat runoff from both the redeveloped property and adjacent established areas.

Enforcing state and local ordinances can be an effective means to reduce construction site erosion and its adverse water quality impacts. In 1986, the DNR and the League of Wisconsin Municipalities cooperatively developed a model ordinance for the control of construction site erosion (DNR, 1987). It contains provisions for planning, designing, installing and maintaining erosion control practices. It also contains guidance for administering and enforcing the ordinance.

Each of the three municipalities in the watershed (Muskego, New Berlin, and Norway) has an ordinance for controlling construction site erosion and sedimentation. In addition, developers are governed by state regulations set forth by the Department of Industry, Labor and Human Relations (DILHR) for erosion control on sites with one and two family dwellings. Compliance with ordinance requirements has been inconsistent, and routine enforcement has been relatively ineffective. Some of the potential impediments to effective erosion control include:

- Developers sometimes perceive erosion control as an add-on cost and not a built-in cost of construction.
- DNR handbook standards are not always practicable. For example, sedimentation basin designs consume large areas where vacant land is scarce.
- Reviewers of erosion control plans and site inspectors are reluctant to exercise full enforcement authority or their authority is limited.
- Unnecessary grading and excavation is commonplace.
- Soil is routinely tracked onto roads because preventative measures are expensive and not a high priority for builders.
- Properly installed silt fences and straw bales are ineffective in controlling fine clay sediments.
- Courts are lenient on violators of the erosion control ordinance.
- The threat of law suits and litigation is usually what influences developers to take action to control erosion and sedimentation.
- Funds for hiring adequate inspection staff are generally not available.
- There is often confusion about who is responsible for installing erosion control practices.
- Local erosion control ordinances need revision.
- Some erosion control practices are cost prohibitive.
- Technical information is not readily available to contractors and developers.

The construction site erosion and sedimentation control strategy described in Chapter Four addresses the elements listed above. In addition, informational workshops will be scheduled to provide opportunities for problem-solving among developers, municipalities, concerned citizens and other units of government.

High priority items to improve compliance include more consistent issuance of citations and stop work orders including hiring of inspection staff to meet increased workloads, revisions of local ordinances that consider costs and performance standards, and more effective court action when ordinance violations occur.

Planned Urban Areas

Once construction of new highways and buildings is completed and excavated soils are stabilized, the newly established urban areas convey storm water at rates much higher than before development. Consequently, as areas urbanize, water quality problems can be worsened not only by the influence of typical urban pollutants but by increased storm water runoff as well.

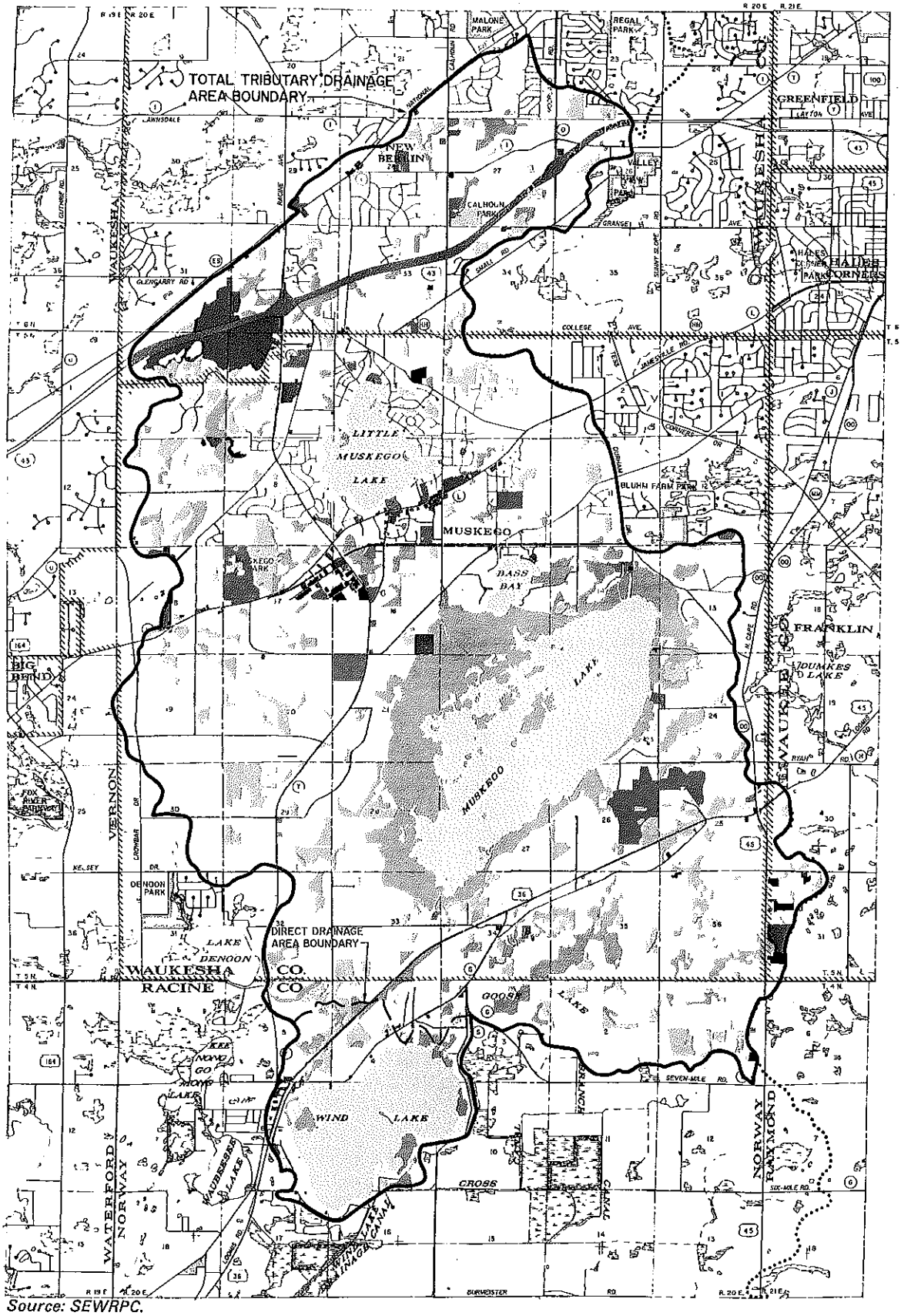
Map 4 shows the current land uses in the Muskego-Wind Lakes watershed as compared to map 5 which shows the extent of anticipated new development in the watershed. Table 3-11 shows the increase in urban land uses estimated to occur by the year 2010. Urban land uses are expected to increase by nearly 920 acres, or 18 percent by year 2010. The largest increases are anticipated to occur in the Linnie Lac West (LW), Linnie Lac North (LN), and Bass Bay (BB) subwatersheds (SEWRPC, 1991).

Table 3-11. Increases in Urban Land Use Within the Muskego-Wind Lakes Watershed: 1985 to 2010

Land Use Category	1985		Planned Increment		Year 2010	
	Acres	% of Total	Acres	% Change	Acres	% of Total
Residential	3,183	12.2	517	16.2	3,700	14.1
Commercial	134	0.5	62	46.3	196	0.7
Industrial	88	0.3	144	163.6	232	0.9
Governmental, Institutional	168	0.6	17	10.1	185	0.7
Transportation, Communication, Utilities	1,233	4.7	162	13.1	1,395	5.3
Recreational	376	1.4	18	4.8	394	1.5
TOTAL	5,182	19.8	920	17.8	6,102	23.3

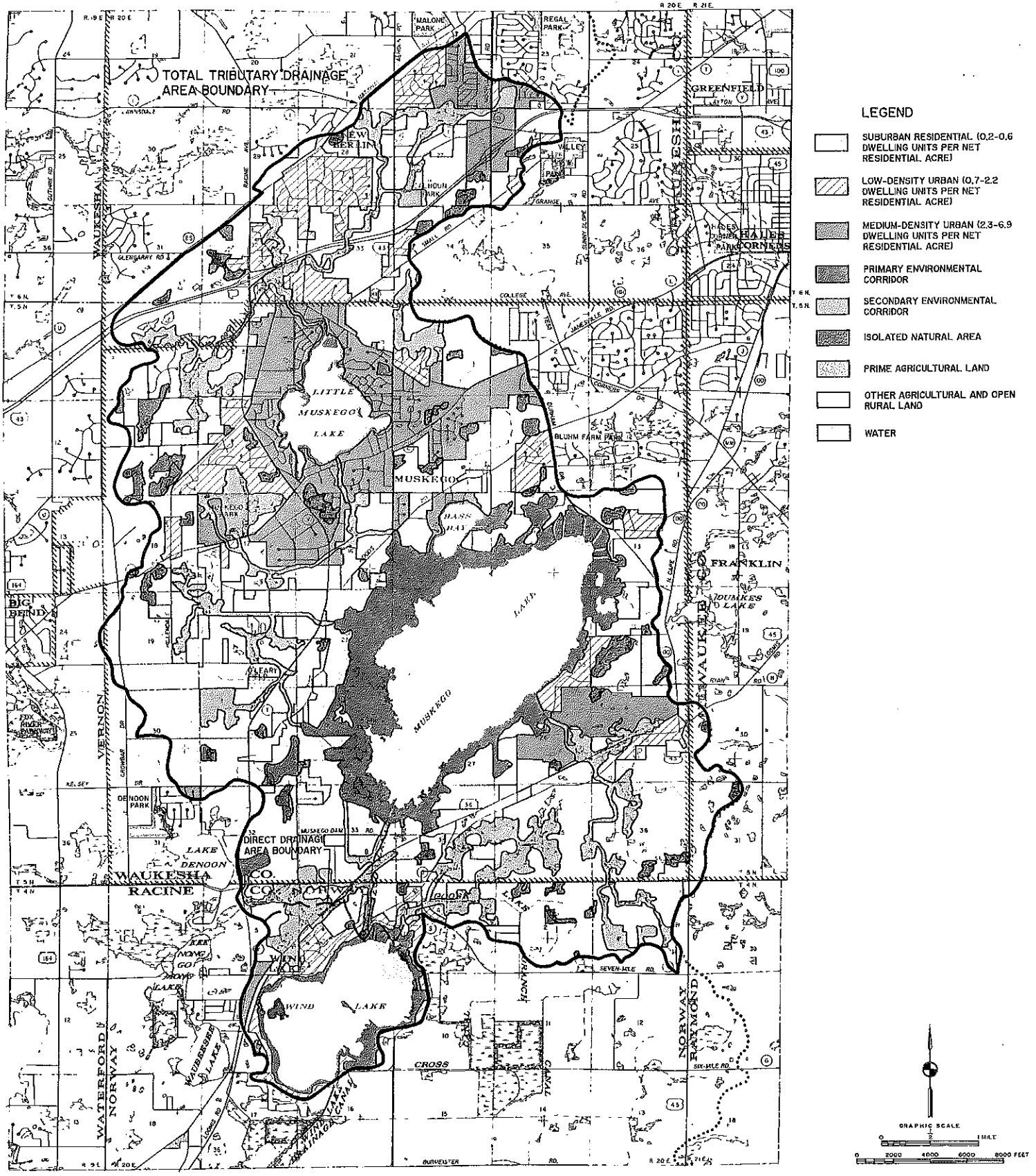
Source: SEWRPC

MAP 4
URBAN LAND USES IN THE MUSKEGO-WIND LAKES WATERSHED: 1985



Source: SEWRPC.

MAP 5
PLANNED 2010 URBAN LAND USES IN THE MUSKEGO-WIND



Source: SEWRPC.

Runoff from planned urban areas has the potential to further degrade lake and stream water quality unless storm water management controls are incorporated during development. Table 3-12 shows the estimated urban nonpoint source loading that will occur in the watershed if planned urban source areas are not controlled. Areas with the greatest increases are the Little Muskego Lake Direct (LD), Linnie Lac North (LN), Muskego Canal Direct (CD), and the Wind Lake Direct (WL) Subwatersheds.

Storm Water Management

Each county and municipality in the Muskego-Wind Lakes Watershed was surveyed regarding their current storm water management practices and policies. In most cases, local authorities do not require installation of storm water management practices through ordinance or policy. Exceptions include existing plans and limited ordinances that require storm water detention in some new development.

Both the cities of New Berlin and Muskego require curbs, gutters and storm sewers in most new developments except in the case of planned unit developments (see table 3-13). None of the communities require roof downspout connections to storm sewers. Of the communities surveyed, only Muskego requires storm water detention for new development.

Analysis of storm water management techniques shows that certain best management practices (BMPs), such as infiltration basins and storm water detention ponds, can significantly reduce sediment and other pollutant loadings to lakes and streams. Adoption of storm water management ordinances and use of storm water management practices will be a priority in the implementation of this plan.

Water Resources Goals and Objectives

The goals and objectives of this plan focus on achieving optimum biological and recreational uses in the Muskego-Wind Lakes and their tributary streams. They provide the basis for prescribing nonpoint source pollution control best management practices and the criteria by which water quality improvements will be evaluated when the project is completed.

The following goals and objectives statements are used in Wisconsin's stream classification system. Generally, the objective will be to "protect," "enhance," or "improve" the existing biological and recreational uses of a surface waterbody.

"Protect" is used for lakes and streams fully supporting their potential biological and recreational uses. Controlling nonpoint sources is necessary to assure that the resource quality is maintained. For example, if a stream is supporting a healthy warm water sport fish population, this objective seeks to protect that use.

Table 3-12. Urban Nonpoint Source Loads in the Muskego-Wind Lakes Watershed: 2010**

Subwatershed	Sediment		Phosphorus		Lead		Zinc	
	Tons/Yr	%	Pounds/Yr	%	Pounds/Yr	%	Pounds/Yr	%
LN	92.7	29.8	309.4	25.1	436.8	37.2	303.6	31.2
LW	5.1	1.6	20.4	1.7	23.1	2.0	27.6	2.1
LD	53.9	17.3	236.3	19.2	176.9	15.1	171.7	17.7
BB	26.7	8.6	131.9	10.7	61.4	5.2	74.2	7.6
MN	71.0	22.8	268.5	21.8	284.7	24.3	236.5	24.4
MD	12.4	4.0	66.6	5.4	25.2	2.1	30.8	3.3
ME	3.9	1.3	11.3	0.9	19.4	1.7	17.0	1.8
CW	1.6	0.5	7.2	0.5	3.4	0.3	3.5	0.5
CD	0.0	0.0	0.8	0.0	0.9	0.1	0.9	0.1
WL	44.0	14.1	181.2	14.7	140.9	12.0	108.9	11.3
TOTAL	311.3	100.0	1,233.6	100.0	1,172.7	100.0	974.7	100.0

** Assumes no increase in the level of nonpoint source control from 1990 conditions.

Source: DNR

Table 3-13. Summary of Selected Storm Water Management Practices/Policies for Local Units of Government in the Muskego-Wind Lakes Watershed.

Unit of Government		Are curbs, gutters and storm sewers required in new developments?	Is roof downspout connection to storm sewers required?	Is storm water detention in new development required?
County	Waukesha	No	No	No
	Racine	No	No	No
	Milwaukee	No authority	No authority	Yes[2]
City	New Berlin	Yes	No	No
	Muskego	Yes[1]	No	Yes
Town	Norway	No	No	No

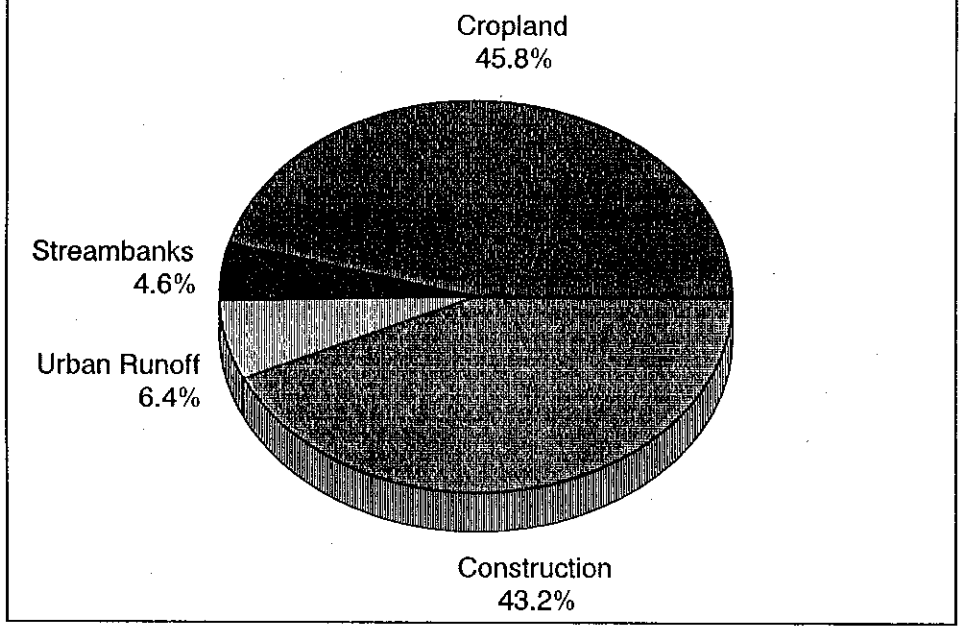
[1] Not required in planned unit developments (PUDs).
[2] As outlined in the Milwaukee Metropolitan Sewerage District (MMSD) Flood Control/Storm Water Drainage Plans.

Table 3-14. Sediment Sources in the Muskego-Wind Lakes Watershed

Lake	Total Tons	Cropland & Other Rural	Construction Erosion	Streambank Erosion	Urban Runoff
Linnie Lac	1,815	1,070	520	127	98
Little Muskego	2,314	1,149	880	133	152
Bass Bay	548	111	390	20	27
Big Muskego	1,907	645	1,030	117	115
Wind Lake	415	165	140	64	46
TOTAL	6,999	3,140	2,960	461	438

Source: DNR

Figure 1. Sources of Sediment in the Muskego-Wind Lakes Watershed



"Enhance" is used for lakes and streams that are moderately degraded and only partially meeting their potential biological and recreational uses. Controlling nonpoint sources is necessary to enhance water quality to support a healthier aquatic community. For example, nonpoint source controls may result in a more widely diverse and vigorous forage fish community by restoring lost habitat, even though natural conditions preclude the stream from ever supporting a warm water sport fish population.

"Improve" is used for lakes and streams that are severely degraded and not meeting their potential biological and recreational uses. In this case, nonpoint source controls can help achieve potential uses for the stream that cannot otherwise be attained. For example, nonpoint source controls may result in a stream moving from supporting a limited forage fish community to a healthy warm water sport fishery.

The water resource goals and objectives for the Muskego-Wind Lakes and their tributaries focus on providing environmental conditions which allow the watershed's lakes and streams to fully achieve their potential biological uses. In many cases other cultural factors that limit these water resources, such as point sources, channelization, dams, or limited public access, will also need to be addressed to see the full benefits of nonpoint source controls.

Water resources goals and objectives are presented below. The objectives will be met in a manner consistent with the protection of existing fish and wildlife habitat, including wetlands. In addition, opportunities will be sought to achieve nonpoint source pollution reduction goals in ways that enhance currently degraded fish and wildlife habitat, such as through the use of restored wetlands and shoreline buffers.

Lake Goals and Objectives

Linnie Lac

Because of the lake's small size, large watershed, shallow basin and accumulated sediments, nonpoint source pollution control alone will not substantially improve or restore water quality in Linnie Lac. Due to the advanced stage of eutrophication, aggressive in-lake management actions will likely be required to achieve water resource goals. These management alternatives are expensive, difficult to implement and currently not within the scope of the watershed program. They include deepening the lake, removing nutrient rich sediments, or removing the dam and creating a meandering stream.

Goals:

- Improve recreational and aesthetic value by decreasing the growth of nuisance algae and aquatic plants.
- Enhance fish and wildlife habitat.
- Reduce the outflow of sediments and nutrients to Jewel Creek.

Objectives:

- Reduce sediment load by 75 percent or greater.
- Reduce phosphorus load 60 percent.
- Stabilize the outflow structure to prevent excessive sediment loading to Jewel Creek.
- Achieve water quality goals:

    - 0.03 mg/l spring phosphorus concentration.
    - 10 μg/l summer average chlorophyll concentration.
    - 4.7 feet water clarity measurement.

Little Muskego Lake

The water resource goals and objectives for Little Muskego Lake call for substantial reductions in external sediment loading and, to a lesser extent, reductions in the external phosphorus loading. Based upon water quality data and measurements of nutrient enrichment of the lake, turbidity and excessive phosphorus are degrading water clarity. Phosphorus loading from watershed land uses appears to be greater than internal loading. The corresponding water resource goals include improving water clarity, reducing the potential for nuisance algae blooms and, in the long-term, reducing excessive aquatic plant growth.

Goals:

- Improve swimmable water by increasing water clarity.
- Improve recreational and aesthetic value by decreasing the growth of nuisance algae and aquatic plants.
- Enhance fish and wildlife habitat.

Objectives:

- Reduce sediment load by 75 percent or greater.
- Reduce sediment loading to shallow bays to preserve northern pike spawning areas.
- Reduce phosphorus load 60 percent.
- Protect/enhance existing functions of shoreland wetlands.
- Preserve undeveloped shorelines as water quality buffers and wildlife refuges.
- Achieve water quality goals:

    - 0.02 mg/l spring phosphorus concentration.
    - 5.6 μg/l summer average chlorophyll concentration.
    - 7.5 feet water clarity measurement.

Bass Bay

At present, the recreational value of the lake is only marginally impaired by water quality problems. However, fish and wildlife habitat is partially impaired by degraded water quality. Therefore, the water resource goals and objectives for Bass Bay call for improvements in fish and wildlife habitat which will, to some degree, improve recreational values. Generally, fish eradication projects are not eligible for funding under the watershed program.

Based on water quality data and measurements of nutrient enrichment of the lake, nonpoint sources of pollution contribute to excessive nutrient loading and, to a lesser extent, degradation of water clarity associated with turbidity. In addition, internal phosphorus loading appears to contribute to water quality problems in the lake.

Goals:

- Protect/improve swimmable water by improving water quality.
- Protect/improve recreational and aesthetic value by reducing excessive nutrients and turbidity.
- Improve fish and wildlife habitat.

Objectives:

- Reduce sediment load by 50 percent or greater.
- Reduce phosphorus load 68 percent.
- Reduce internal phosphorus cycling.
- Reduce populations of carp and bullhead.
- Preserve undeveloped shorelines as water quality buffers and wildlife refuges.
- Achieve water quality goals:
    - 0.02 mg/l spring phosphorus concentration.
    - 5.6 μg/l summer average chlorophyll concentration.
    - 7.5 feet water clarity measurement.

Big Muskego Lake

Shallow lakes with nutrient rich bottom sediments generally have poor water quality. Other factors that affect the water quality of Big Muskego Lake include excessive carp and bullhead populations, residual contaminants from former waste water treatment plant discharges, and nonpoint source loadings associated with land uses in the watershed.

The principal goal for Big Muskego Lake is improved wildlife and fish habitat. Other goals include improved recreational activities (hunting, fishing, wildlife viewing) that rely on abundant bird life, healthy fisheries and other aquatic life. With an average depth of 2.5 feet, Big Muskego Lake is not suitable for high-speed boating where bottom sediments are

easily stirred up and shallow water fish habitat is heavily impaired. Instead, the use of low-draft, no-wake watercraft may be more appropriate.

Goals:

- Improve water clarity.
- Re-establish aquatic plant growth.
- Enhance habitat for endangered species (Forster's terns and Blanding's turtles) and waterfowl.
- Maximize fisheries potential.
- Improve wildlife and fisheries dependent activities.

Objectives:

- Reduce sediment load by 20 percent or greater.
- Reduce external phosphorus load 42 percent.
- Reduce internal phosphorus cycling by reducing carp and bullhead populations.
- Increase aquatic plant distribution and density.
- Increase community awareness of Big Muskego Lake's wildlife value.
- Achieve water quality goals:
    - 0.05 mg/l spring phosphorus concentration.
    - 21.1 μg/l summer average chlorophyll concentration.
    - 4.1 feet water clarity measurement.

Wind Lake

The water resource goals and objectives for Wind Lake call for improving recreational and aesthetic values and enhancing fish and wildlife habitat. To achieve these goals, nonpoint source pollution control must be supplemented by efforts to reduce phosphorus inputs from Big Muskego Lake and internal cycling within Wind Lake. These sources of pollution are addressed by the Wind Lake Management Plan.

Goals:

- Improve swimmable water by increasing water clarity.
- Improve recreational and aesthetic value by decreasing the growth of nuisance algae and nuisance aquatic plants.
- Enhance fish and wildlife habitat.

Objectives:

- Reduce sediment load by 50 percent or greater.
- Reduce total phosphorus load 70 percent:
    - 10 percent from nonpoint source pollution.
    - 20 percent from Big Muskego imports.
    - 40 percent from internal cycling.
- Maintain/enhance existing functions of shoreland wetlands.
- Preserve undeveloped shoreline and sensitive areas as water quality buffers and wildlife refuges.
- Achieve water quality goals:
    - 0.02 mg/l spring phosphorus concentration.
    - 5.6 μg/l summer average chlorophyll concentration.
    - 7.5 feet summer average water clarity measurement.

Subwatershed Descriptions and Water Resources Objectives

Linnie Lac North Subwatershed (LN)

Description

The Linnie Lac North Subwatershed drains an area of about 3,190 acres and is located in the northernmost portion of the watershed. Four small intermittent streams flow into the principal tributary stream, Calhoun Creek (stream segments 1 through 6). Approximately two miles of Calhoun Creek drain southwest into Linnie Lac, a small, shallow water impoundment.

Water Quality Conditions

Currently, approximately 50 percent or 0.79 miles of the perennial Calhoun Creek fails to support the potential use classification of warm water forage fish (WWFF) communities. The remaining 50 percent or 0.75 miles only partially supports its potential use classification of warm water sport fish (WWSF) communities. All of the 7.5 miles of intermittent streams are not supporting the potential use classification of warm water forage fish or limited forage fish (LFF) communities.

In September 1992, ten species of fish were collected by backpack shocking along a 175 foot section of Calhoun Creek at Beliot Road and further downstream at the confluence of Calhoun Creek and Summit tributary along a 150 foot stream segment. (Refer to table 3-15).

Macroinvertebrate sampling was conducted in October 1992 in Calhoun Creek at Beres Road and used to calculate a biotic index. The biotic index of 5.09 classified the water quality as "fair" indicating the presence of organic pollution.

With the exception of emergent cattails found in Calhoun Creek in the lower reaches near Linnie Lac, there were few aquatic plants found in perennial streams of the Linnie Lac North subwatershed. In addition, no evidence of severe algae blooms was found in the perennial streams. Based upon the lack of algae, phosphorus enrichment of the streams is not a primary concern, although phosphorus input to downstream Linnie Lac is a major concern.

Site inspections and habitat evaluations were conducted at numerous sites within the subwatershed. Pollutants or limiting factors causing water quality problems and threatening fish and wildlife habitat include sediment and nutrient runoff from both urban and agricultural sources, channelization, in-place sedimentation, streambank debrushing and erosion.

Potential water resource problems include pollutants in urban runoff such as pesticides and metals from subdivisions draining to intermittent tributary streams in the upper portions of the subwatershed.

Water Resource Objectives

The primary pollutant in the Linnie Lac North subwatershed is sediment and, to a lesser extent, phosphorus and urban toxic constituents. Currently, the primary sources of sediment appear to be associated with agricultural and commercial nursery operations. Runoff from subdivisions located near stream segments 2, 5, and 6 are likely to be the primary sources of urban pollutants.

Accordingly, the water resources objectives target a substantial reduction in sediment loading and corresponding reduction in phosphorus and other pollutants.

Objectives:

- Reduce sediment loading in the subwatershed by 75 percent.
- Reduce the phosphorus loading to the streams by a total of 30 percent, including urban and rural sources.
- Implement improved construction site erosion controls.
- Reduce the use of urban pesticides/fertilizers and treat urban storm water.

Table 3-15. Fish Sampling of Linnie Lac North Subwatershed: September 1992

Common Name	Sampling Location	
	Calhoun Creek at Beloit Road	Confluence of Calhoun Creek and Summit Tributary
Northern Pike	0	4
Yellow Bullhead	0	5
Bluegill	0	6
Orange Sunfish	0	1
Carp	0	2
Creek Chub	48	2
Common Shiner	25	0
Mud Minnows	7	1
White Suckers	3	21
Green Sunfish	1	0
TOTAL	84	42

Source: DNR

Linnie Lac West Subwatershed (LW)

Description

The Linnie Lac West Subwatershed drains an area of about 2,060 acres. The two-mile long Linnie Lac West tributary is the only perennial stream in the subwatershed and drains into the northwest corner of Linnie Lac. The Linnie Lac Northwest tributary (segment 7) drains the northern third of the subwatershed, joining the Linnie Lac West tributary before flowing into Linnie Lac. The upper reaches of the Linnie Lac West tributary has remained relatively undeveloped. Strips of natural vegetation occurs along most of the stream. Much of the subwatershed is undeveloped and consists largely of agricultural lands and country homes. Within one half mile of Linnie Lac, the Linnie Lac West tributary bypasses a large gravel mining operation.

Water Quality Conditions

All of the Linnie Lac Northwest tributary (1.6 miles) and 50 percent of the Linnie Lac West tributary (1.3 miles) fails to support the potential use classification of LFF. Approximately 50 percent of Linnie Lac West is only partially supporting the potential use classification of WWSF. Although only five species of fish were collected from Linnie Lac West Subwatershed, two of the species are considered game fish: green sunfish and largemouth bass. Instream deposition of pollutants is common in Linnie Lac West tributary due to low flows, lack of riffles and abundant canopy formation.

Macroinvertebrate samples were collect about 1,000 feet upstream from Teres Road and 2,000 feet downstream of the mining operation. Biotic index analysis of the upstream site indicated slightly better water quality (5.2) compared with the downstream site (5.6). Both indicate the presence of organic pollution.

Additional concern has been raised about the impacts from the nearby gravel mining operation. There is some evidence that during heavy rain events, settling ponds overflow and could potentially discharge sediment into Linnie Lac West. The gravel mining operation is currently regulated by a DNR wastewater permit.

Water Resources Objectives

The primary pollutant in the Linnie Lac West subwatershed is sediment. Secondary concerns include the degradation of riparian vegetation and isolated developed areas. Likewise, runoff from urban areas north of Interstate 43, roadside runoff from I-43, and runoff from the gravel mining operation need to be addressed.

Objectives:

- Reduce urban and agricultural sediment loading by 50 percent.
- Reduce phosphorus loading from urban and agricultural sources by a total of 50 percent.
- Implement improved construction site erosion controls.
- Ensure wastewater discharge permit compliance for point sources.
- Reduce amount of in-place sedimentation.
- Reduce the use of urban pesticides/fertilizers and treat urban storm water.

Little Muskego Lake Direct Subwatershed (LD)

Description

The Little Muskego Lake Direct Subwatershed drains an area of about 1,630 acres, consisting primarily of the city of Muskego's urban center and residential communities. Jewel Creek is a half-mile long, second order stream flowing between Linnie Lac and Little Muskego lake.

Water Quality Conditions

In recent years, the Little Muskego Lake Association undertook a stream restoration of the northern half of Jewel Creek, including bank stabilization and creation of in-stream habitat. Partly due to the restoration work, Jewel Creek is partially supporting its potential use classification of WWSF.

Fish sampling in September 1992, documented the presence of 11 fish species (6 game fish species) including walleyes and largemouth bass. Based upon the macroinvertebrates sampled in Jewel Creek, the biotic index (6.02) indicates the presence of organic pollutants.

Water Resource Objectives

The primary pollutants in the Little Muskego Lake Direct Subwatershed are associated with urban runoff, including construction site erosion, pesticides/fertilizers, metals, oil and grease. Sediment inputs to Little Muskego Lake from construction site erosion is also a major concern.

Objectives:

- Reduce sediment loading from urban runoff and storm water discharges by 30 percent or greater.
- Maintain and reduce when possible phosphorus loading.
- Implement improved construction site erosion controls.
- Protect and enhance shoreland wetland areas from storm water discharges.
- Reduce the use of urban pesticides and fertilizers especially by shoreline property owners.

Bass Bay Subwatershed (BB)

Description

The Bass Bay Subwatershed drains an area of approximately 1510 acres. The intermittent Bass Bay tributary is the principal stream flowing into Bass Bay. In addition, a smaller, intermittent stream enters the northeast corner of Bass Bay. At present, the subwatershed is experiencing increased development pressure.

Water Quality Conditions

The existing use classification of the Bass Bay tributary is limited aquatic life (LAL) and fails to support the potential use classification of LFF. Due to a lack of flow and insufficient depths, the tributary does not provide adequate habitat for a warm water forage fish or a more diverse fishery. The northeast tributary to Bass Bay has severe problems with agricultural runoff originating from fields and barnyards at the headwaters of the stream.

Water Resource Objectives

All of the runoff entering Bass Bay originates in the Bass Bay Subwatershed. With a moderate watershed to waterbody area ratio (14:1) reductions in nonpoint source pollution should result in significant improvements in water quality within Bass Bay, assuming internal cycling of phosphorus is also managed.

Therefore, a high priority in the Bass Bay Subwatershed is to implement rigid controls of both phosphorus and sediment to prevent further water quality degradation in Bass Bay.

Objectives:

- Reduce sediment loading from agricultural and urban land by 40 percent.
- Reduce the phosphorus load from existing agricultural and urban sources by 42 percent.
- Implement improved construction site erosion controls.
- Reduce urban and riparian use of pesticides and fertilizers.

Big Muskego Lake North Subwatershed (MN)

Description

The Big Muskego Lake North Subwatershed drains an area of approximately 1,440 acres. It includes residential, commercial, industrial, county park land and agricultural areas. A 2.37 miles segment of the perennial Muskego Creek flows between Little Muskego and Big Muskego Lakes. An intermittent stream (stream segments 13 and 14) drains the western portion of the subwatershed.

Water Quality Conditions

Currently, Muskego Creek fully supports the potential use classification of Warm Water Sport Fisheries Community (WWSF). Seven fish species were found during fish sampling near the intersection of Lannon and Woods Roads including the following species: largemouth bass, bluegill, green sunfish, black crappie, mud minnow, creek chub, and warmouth.

The two intermittent tributaries located in the western portion of the subwatershed are classified as Limited Aquatic Life (LAL) and only partially meeting their potential use classification of Limited Forge Fish (LFF) communities. These tributaries are degraded by urban development, channelization, and low flows.

Objectives:

- Reduce sediment loading from the subwatershed by 25 percent or more.
- Reduce the phosphorus load from existing agricultural and urban sources by 42 percent.
- Implement improved construction site erosion controls.
- Reduce urban and riparian use of pesticides and fertilizers.

Big Muskego Lake Direct Subwatershed (MD)

Description

The Big Muskego Lake Direct Subwatershed drains an area of about 5,730 acres. The eastern and northern portions of the subwatershed support a greater diversity of land uses such as farms and country estates, but no significant urban growth has yet occurred there. Several prime agricultural areas produce cash grain crops in this part of the subwatershed.

With the exception of the channel connecting Bass Bay with Big Muskego Lake, all of the streams in the Big Muskego Lake Direct Subwatershed are small, intermittent streams. A portion of the intermittent streams have been channelized for agricultural and roadway construction purposes.

Water Quality Conditions

The existing use classification of the streams flowing into Big Muskego Lake along the southwestern shoreline (stream segments 22, 23, 25) is Limited Aquatic Life (LAL). Stream segment 25 is intermittent and appears to be internally drained and is partially supporting the potential use classification of LAL.

The lower reaches of stream segments 22 and 23 drain through large wetland areas into Big Muskego Lake and provide valuable wildlife and fish spawning habitat for species that utilize Big Muskego Lake. Based upon these uses, the potential use classification of these streams is Warm Water Sport Fish community (WWSF). Due to channelization, drainage of wetlands and agricultural runoff, the streams are not supporting the potential use classification.

Water Resource Objectives

Although a large part of the Big Muskego Lake Direct Subwatershed appears to be internally drained, the streams flowing into Big Muskego Lake provide direct routes for nonpoint pollution to enter the lake. Therefore, a high priority in the Big Muskego Lake Direct Subwatershed is to implement aggressive controls of phosphorus and moderate controls of sediment.

Objectives:

- Reduce sediment loading from urban and agricultural sources by 20 percent or more.
- Reduce phosphorus loading from existing agricultural and urban sources by 30 percent.
- Reduce future discharges of untreated (both quantity and quality) storm water to surface waters.
- Implement improved construction site erosion controls.

Big Muskego Lake East Subwatershed (ME)

Description

The Big Muskego Lake East Subwatershed drains an area of approximately 2,050 acres and is located in the extreme southeast corner of the Muskego-Wind Lakes Priority Watershed Project. Five tributary stream segments were identified (segments 23, 24, 26, 27 and 28) within the subwatershed. The longest intermittent stream segments are approximately 3 miles in length. The segments of the tributary stream flowing into Big Muskego (sections 23 and 26) are classified as perennial streams with continuous flow present at the downstream reaches near Big Muskego Lake.

Water Quality Conditions

Currently, the upstream reaches south of Hwy 36 are only partially supporting the potential use classification of Warm Water Sport Fisheries (WWSF). The far upstream reaches of the tributaries (stream segments 27 and 28) are meeting the use classification of limited aquatic life (LAL). The small stream segment 24 appears to be internally drained and is also classified as LAL.

Water Resource Objectives

The primary pollutant threatening water quality in Big Muskego Lake East Subwatershed are associated with agricultural practices and new construction. This includes high nutrient and sediment runoff from agricultural lands, construction site erosion and chemical uses from commercial and residential lands.

Objectives:

- Reduce sediment loading to the subwatershed by 25 percent.
- Reduce phosphorus loading by 25 percent.
- Implement improved construction site erosion and sediment controls.
- Reduce the use of pesticides and runoff of urban toxics.

Muskego Canal West Subwatershed (CW)

Description

The Muskego Canal West Subwatershed drains an area of approximately 3,440 acres. The subwatershed discharges into the Muskego Canal below Big Muskego Lake and upstream from Wind Lake. There are a number of intermittent streams located in the subwatershed ranging in length from over 2 miles to less than a half a mile. Over 75 percent of the tributary streams are highly degraded as a result of channelization.

Water Quality Conditions

The existing use classification for many of the tributaries with marginal aquatic habitat is limited aquatic life (LAL) or limited forage fish (LFF) communities. Low water levels and excessive canopy formation degrade the intermittent streams in the upper reaches of the subwatershed. Channelization and agricultural runoff degrade the lower reaches of the perennial streams in the lower segments of the subwatershed.

Water Resources Objectives

This subwatershed drains directly into the Muskego Canal, the primary tributary to Wind Lake. Although the canal is already severely impacted by sedimentation, carp populations and channelization, nonpoint source controls should be implemented to reduce degradation of the Muskego Canal and, subsequently, Wind Lake. In addition, since the Wind Lake Management District may be dredging portions of the canal, actions to control upstream sediment transport should be implemented to protect the effectiveness of the dredging activities downstream.

Objectives:

- Reduce sediment loading in the subwatershed by 50 percent.
- Reduce phosphorus loading by 30 percent to 50 percent.
- Implement improved construction site erosion control.

Muskego Canal Direct Drainage Subwatershed (CD)

Description

The Muskego Canal Direct Subwatershed drains an area of approximately 2,800 acres and flows into Wind Lake. This subwatershed receives inflows from Big Muskego Lake and from the Muskego Canal West (CW) subwatershed. There are five tributary streams (a total of approximately 8.38 miles) and the Muskego Canal itself (1.18 miles), located in the subwatershed.

Water Quality Conditions

The Muskego Canal's potential use classification is warm water sport fisheries community (WWSF). The other perennial tributaries, stream segments 29, 31 and 34, are classified as potential warm water forage fish communities (WWFF). The Muskego Canal is only partially meeting its potential use classification due to channelization, in-stream deposition and high sediment and nutrient loading from Big Muskego Lake. Extremely large carp populations have been observed in the canal and contribute to the poor water quality of the canal. The other perennial streams are not meeting their potential uses due to channelization, in-stream deposition and agriculture runoff.

Water Resource Objectives

In general, this portion of the Muskego-Wind Lake Priority Lakes Watershed is comprised of the greatest percentage of rural and agricultural lands. However, this portion of the subwatershed also has the lowest gradients which reduce impacts from runoff and provide for more areas that are internally drained. Nonetheless, the primary pollutant sources in the Muskego Canal Direct Subwatershed are agricultural runoff and in-place pollutants.

Objectives:

- Reduce urban and agricultural sediment loading by 30 percent to 50 percent.
- Reduce phosphorus loading by 30 percent to 50 percent.
- Implement improved construction site erosion and sediment control.
- Reduce impacts from in-place pollutants and channelization.
- Reduce the use of agricultural and shoreline pesticides/fertilizers.

Wind Lake Direct Drainage Subwatershed (WL)

Description

The Wind Lake Direct Drainage Subwatershed drains a land area of approximately 800 acres. The area consists of a band of residential and small commercial properties surrounding the lake. There is one minor intermittent stream entering Wind Lake on its eastern shore. Its aquatic habitat and potential uses are largely insignificant.

Water Resource Objectives

Runoff from urban sources and construction sites in the subwatershed potentially degrade water quality in Wind Lake. Although the direct drainage area contributes a relatively small percentage of the phosphorus and sediment load to Wind Lake, nonpoint source controls should be implemented to reduce pollutant input from such highly visible sources.

Objectives:

- Reduce sediment loading from the subwatershed by 25 percent.
- Reduce existing phosphorus loading by 25 percent.
- Implement improvements in construction site erosion/sediment control.

Pollution Reduction Goals

The following discussion establishes pollution reduction goals which target the control of sediment and phosphorus in rural areas and control of sediment, phosphorus, toxic materials, and stream flow changes in urban areas.

Sediment and Phosphorus Reduction Goals

As previously discussed, extensive water quality and aquatic habitat investigations were conducted as part of the planning effort for the Muskego-Wind Lakes Watershed Project. The results indicated that significant reductions were needed in the amount of sediment and nutrient (phosphorus) loadings to achieve the watershed's water quality objectives. A determination of the needed reductions was made by comparing the findings of these field investigations with the results of the urban and rural nonpoint pollution sources inventories and analyses.

Overall, a 55 percent reduction in sediment loading is needed to improve the aquatic habitat in nearly all the lakes and streams in the watershed. This level will eventually reduce the amount of sediment embedded in the streams and lake bottoms and enhance their ability to support healthier and more diverse aquatic communities.

In addition, a 67 percent reduction in phosphorus loading is needed to reduce excessive aquatic algae growth and provide adequate water clarity in the lakes.

Specific goals are not established for stream flow. However, maintenance of base flow conditions is an important element of improving aquatic habitat in most of the smaller streams in the rural portions of the watershed. Wetland drainage and channelization has contributed to erratic stream flow and reduced capacities to support healthy aquatic communities. In urbanizing areas, increased urban land use results in greater amounts of runoff reaching streams. The "flashy" conditions often result in accelerated streambanks erosion, bottom scour, and in some cases flooding. Implementation of structural and non-structural best management practices for controlling rural and urban nonpoint sources will seek to reduce the fluctuating nature of stream flow in many of the watershed's streams.

The pollutant reduction goals in tables 3-16, 3-17, and 3-18 were selected by weighing the desire to achieve water resources objectives against the feasibility of implementing aggressive and expensive management actions in the watershed. In some instances, the level of

Table 3-16. Lake Sediment Reduction Goals - Muskego-Wind Lakes Watershed

Lake	Sources	Tons 1992	Tons Reduced	Tons 2002	% of Total	% Reduction	% Objective[4]
Linnie Lac	Cropland[1]	1,070	681	389	54	64	
	Existing Urban[2]	71	35	36	5	49	
	Planned Urban[3]	27	24	3	0	89	
	Construction Sites	520	260	260	36	50	
	Streambanks	127	91	36	5	72	
	TOTAL	1,815	1,091	724	100	60	75
Little Muskego	Cropland	1,149	737	412	57	64	
	Existing Urban	108	54	54	7	50	
	Planned Urban	44	40	4	1	91	
	Construction Sites	880	660	220	30	75	
	Streambanks	133	97	36	5	73	
	TOTAL	2,314	1,588	726	100	69	75
Bass Bay	Cropland	111	44	67	28	40	
	Existing Urban	11	5	6	2	45	
	Planned Urban	16	14	2	1	88	
	Construction Sites	390	234	156	64	60	
	Streambanks	20	8	12	5	40	
	TOTAL	548	305	243	100	56	50
Big Muskego	Cropland	645	317	328	28	49	
	Existing Urban	68	0	68	6	0	
	Planned Urban	47	42	5	0	89	
	Construction Sites	1030	309	721	62	30	
	Streambanks	117	72	45	4	62	
	TOTAL	1,907	740	1,167	100	39	25
Wind Lake	Cropland	165	87	78	36	53	
	Existing Urban	40	20	20	9	50	
	Planned Urban	6	5	1	1	83	
	Construction Sites	140	70	70	32	50	
	Streambanks	64	21	43	20	33	
	Muskego Canal[5]	82	78	4	2	95	
	TOTAL	497	281	216	100	57	40

[1] Cropland sediment delivery includes calculations for field deposition.
[2] All non-cropland sources assume 100% sediment delivery to lakes.
[3] Planned urban sediment delivery does not account for cropland taken out of production during development.
[4] Water Resources Objectives.
[5] Assumes 13% of non-cropland sediment export from Big Muskego Lake.

Table 3-17. Lake Phosphorus Reduction Goals - Muskego-Wind Lakes Watershed.

Lake	Sources	Lbs 1992	Lbs Reduced	Lbs 2002	% of Total	% Reduction	% Objective[1]
Linnie Lac	Cropland and Animal Lots	4,533	2,754	1,779	89	61	
	Existing Urban	309	93	216	11	30	
	Planned Urban	21	13	8	0	62	
	TOTAL	4,863	2,860	2,003	100	59	60
Little Muskego	Cropland and Animal Lots	4,937	3,035	1,902	81	61	
	Existing Urban[2]	459	138	321	14	30	
	Planned Urban[2]	107	64	43	2	60	
	Atmospheric Deposition	76	0	76	3	0	
	TOTAL	5,579	3,237	2,342	100	58	60
Bass Bay	Cropland and Animal Lots	842	379	463	77	45	
	Existing Urban	52	16	36	6	31	
	Planned Urban	80	48	32	5	60	
	Internal Cycling[3]	114	91	23	4	80	
	Atmospheric Deposition	51	0	51	8	0	
	TOTAL	1,139	534	605	100	47	68
Big Muskego	Cropland and Animal Lots	1,701	767	934	19	45	
	Existing Urban	215	0	215	4	0	
	Planned Urban	131	79	52	1	60	
	Atmospheric Deposition	1,051	0	1,051	21	0	
	Bass Bay[4]	297	127	170	3	43	
	Little Muskego Lake[5]	1,467	1,177	290	6	80	
	Internal Cycling[6]	10,975	8,780	2,195	46	80	
	TOTAL	15,837	10,930	4,907	100	69	42

Table 3-17. Continued

Lake	Sources	Lbs 1992	Lbs Reduced	Lbs 2002	% of Total	% Reduction	% Objective[1]
Wind Lake	Cropland and Animal Lots	1,059	552	507	28	52	
	Existing Urban	162	49	113	6	30	
	Planned Urban	27	16	11	0	59	
	Atmospheric Deposition	140	0	140	8	0	
	Big Muskego Lake[7]	2,140	1,712	428	23	80	
	Internal Cycling[3]	3,170	2,536	634	35	80	
	TOTAL	6,698	4,865	1,833	100	73	70

[1] Water Resources Objectives
[2] Assumes 100% P discharge from Linnie Lac
[3] Assumes planned alum treatment is implemented
[4] Assumes 26% P discharge from Bass Bay
[5] Assumes 26% P discharge from Little Muskego Lake
[6] Assumes planned carp eradication is implemented
[7] P load measured for Wind Lake Management Plan

Table 3-18. Stream Sediment Reduction Goals of the Muskego-Wind Lakes Watershed by Subwatershed

Subwatershed	Sources	Tons 1992	Tons Reduced	Tons 2002	% of Total	% Reduction	% Objective[2]
LW	Cropland[1]	132	61	71	79	46	
	Existing Urban	5	1	4	4	20	
	Construction Sites	10	5	5	6	50	
	Streambanks	39	29	10	11	74	
	TOTAL	186	96	90	100	52	50
LN	Cropland	1,070	681	389	55	64	
	Existing Urban	66	33	33	5	50	
	Planned Urban[3]	27	24	3	0	89	
	Construction Sites	510	255	255	36	50	
	Streambanks	88	62	26	4	70	
	TOTAL	1,761	1,055	706	100	60	75
LD	Cropland	1,149	737	412	67	64	
	Existing Urban	37	19	18	3	51	
	Planned Urban	17	15	2	1	88	
	Construction Sites	360	180	180	29	50	
	Streambanks	6	6	0	0	100	
	TOTAL	1,569	957	612	100	61	30
BB	Cropland	111	44	67	24	40	
	Existing Urban	11	5	6	2	45	
	Planned Urban	16	14	2	1	88	
	Construction Sites	390	195	195	69	50	
	Streambanks	20	8	12	4	40	
	TOTAL	548	266	282	100	49	40
MN	Cropland	28	19	9	3	68	
	Existing Urban	52	26	26	10	50	
	Planned Urban	19	17	2	1	89	
	Construction Sites	420	210	210	81	50	
	Streambanks	78	64	14	5	82	
	TOTAL	597	336	261	100	56	25

Table 3-18. Continued

Subwatershed	Sources	Tons 1992	Tons Reduced	Tons 2002	% of Total	% Reduction	% Objective
CW	Cropland	289	156	133	81	54	
	Existing Urban	2	0	2	1	0	
	Construction Sites	10	5	5	3	50	
	Streambanks	46	21	25	15	46	
	TOTAL	347	182	165	100	52	50
MD	Cropland	645	317	328	74	49	
	Existing Urban	1	0	1	0	0	
	Planned Urban	12	11	1	0	92	
	Construction Sites	210	105	105	24	50	
	Streambanks	8	0	8	2	0	
	TOTAL	876	433	443	100	49	20
ME	Cropland	237	98	139	87	41	
	Existing Urban	4	0	4	3	0	
	Construction Sites	10	5	5	3	50	
	Streambanks	11	0	11	7	0	
	TOTAL	262	103	159	100	39	25
CD	Cropland	1,248	658	590	96	53	
	Construction Sites	10	5	5	1	50	
	Streambanks	18	0	18	3	0	
	TOTAL	1,276	663	613	100	52	50

Table 3-18. Continued

Subwatershed	Sources	Tons 1992	Tons Reduced	Tons 2002	% of Total	% Reduction	% Objective
WL	Cropland	3	1	2	4	33	
	Existing Urban	38	19	19	37	50	
	Planned Urban	6	5	1	1	83	
	Construction Sites	120	90	30	58	75	
	TOTAL	167	115	52	100	69	25

[1] Cropland sediment delivery includes calculations for field deposition.
[2] Water Resources Objectives.
[3] Planned urban sediment delivery does not account for cropland taken out of production during development.

Source: DNR

nonpoint source pollution reduction in the planned scenario exceeds the objective for that water resource. In other cases it falls short of reaching the objective (example: Little Muskego Lake sediment reduction goal of 59 percent compared to 75 percent water resource objective), indicating that nonpoint source control measures alone may not be enough to restore the lake to its desired condition.

Urban Toxics Reduction Goals

Another important water quality consideration in the Muskego-Wind Lakes and their tributaries is to reduce the concentrations of toxic materials in urban runoff. Zinc and lead are often used as indicator pollutants for evaluating the impact of urban runoff on water quality. In general, the lake water quality appraisals did not find evidence of heavy metals toxicity associated with urban runoff. However, urban runoff in the Milwaukee area has been shown to contain concentrations of heavy metals that often exceed surface water quality standards for acute toxicity (Bannerman et al, 1983).

Table 3-19 shows the extent of toxicity of urban runoff monitored from different land uses in the Milwaukee area during 1980-1982, using a storm water hardness of 100 mg/l (milligrams per liter) and LC-1 toxicity standards of 170 μg/l (micrograms per liter) for lead, 17 μg/l for copper, and 103 μg/l for zinc. The LC-1 is the concentration that results in one percent mortality of the test animal populations exposed to the contaminant. The exposure period is 96 hours for fish and 48 hours for invertebrates. Table 3-19 shows the percent of monitored storm events for which the event mean concentration of the runoff exceeded the LC-1. Lead and zinc concentrations of runoff collected from commercial areas, parking lots, and high density residential areas, exceeded the toxicity standards most often. Copper concentrations of runoff from commercial areas also frequently exceeded the toxicity standards set forth in Chapter NR 105 of the Wisconsin Administrative Code. These surface water standards are set so as not to exceed the LC-1.

Table 3-19. Percent of Urban Storm Water Samples Exceeding Acute Toxicity Standards (LC-1) for Fish and Aquatic Life in Milwaukee.

Land Use	Lead	Zinc	Copper	Cadmium
Commercial	90	90	>50	0
Parking Lots	45	55	>10	0
High Density Residential	70	75	>10	0
Medium Density Residential	20	30	>10	0

Source: DNR

Although the state of Wisconsin does not currently regulate storm water discharges using numeric effluent limitations, it does use effluent limitations to regulate point source discharges from industries and municipalities. Effluent limitations are developed to assure that the LC-1 acute toxicity standards are met in the receiving waters. Where base flows in receiving waters are sufficient to dilute the effluent, the effluent discharge limits are set based on the LC-50, the lethal concentration for 50 percent of the test population.

Table 3-20 shows the percent reduction needed in urban pollutant concentrations from several different land uses in order to meet an LC-50 target. This table was developed from data collected during 1990 primarily from commercial and medium density residential areas in the cities of Milwaukee and Madison. This data was extrapolated to make estimates for the other listed land uses. It should be noted that the hardness of the storm water was measured at 25 mg/l. This low level of water hardness greatly increases toxicity above that which would occur at a hardness of 100 mg/l. At this lower hardness level, the LC-50 acute toxicity concentrations are 61 μg/l for lead, 66 μg/l for zinc, 9 μg/l for copper, and 12 μg/l for cadmium.

Table 3-20 shows that the event mean concentrations in storm water runoff from several land uses are significantly greater than the LC-50 concentrations for acute toxicity for lead, zinc, and copper. Concentrations of these three metals in runoff from commercial, industrial, and freeway land uses significantly exceed the LC-50. Concentrations of zinc and copper are also significantly higher than the LC-50 for institutional and high density land uses.

The data presented in tables 3-19 and 3-20 suggest that significant reductions will be needed to reduce the concentrations of metals in urban runoff to levels that will allow attainment of acute toxicity standards. The final identification of the reductions needed for individual storm sewer pipes and surface drainage outfalls will have to be evaluated on a case-by-case basis during project implementation.

Table 3-20. Percent of Urban Storm Water Samples Exceeding LC-50 Concentrations for Fish and Aquatic Life.

Land Use	Lead	Zinc	Copper	Cadmium
Freeways	95	86	81	0
Industrial	51	81	81	0
Commercial[1]	50	80	80	0
High Density Residential	18	70	69	0
Institutional	0	68	50	0
Other Urban Land Uses	0	0	0	0

[1] Based on extrapolation of monitored data. Other percents are based on measured data.

Source: DNR

CHAPTER FOUR
Nonpoint Source Control Needs

Introduction

This chapter identifies the nonpoint source controls to be implemented under the Muskego-Wind Lakes Priority Watershed Project. These controls are based on water quality data, results of the nonpoint source inventories, and the levels of reduction for sediment and phosphorus needed to achieve water quality goals of the plan as described in the previous chapter.

The first portion of this chapter addresses rural nonpoint source control needs. It defines management categories corresponding to the severity, need, and feasibility of controlling each nonpoint source. The management categories are used to define which sources are eligible for financial and technical assistance under the priority watershed project.

The second section addresses urban nonpoint source control needs. It prescribes best management practices (BMPs) for established and developing urban areas based on water quality goals identified in Chapter Three. Proposed management actions for each local unit of government in the watershed are presented. Finally, this section sets forth a conceptual framework for implementing urban best management practices.

Some sources of pollution derived from conditions outside the scope of the priority watershed project may affect water resources in the watershed. Therefore, management actions related to point source pollution control, fisheries, wildlife, and recreation are discussed in the previously referenced Wind Lake Management Plan (SEWRPC, 1991) and the integrated resources management sections of this plan.

Rural Nonpoint Source Control Needs

Nonpoint Source Management Categories

Management categories determine the eligibility of specific landowners and units of government for financial and technical assistance under the priority watershed project. Management categories help define the need to control specific pollution sources to meet water quality goals. Management categories are based on:

- Biological and recreational potential of lakes and streams.

- Current or expected future impacts of nonpoint sources on those biological and recreational uses.

- Pollutant load reductions needed to achieve water quality goals set for each of the lakes in the Muskego-Wind Lakes chain.

- Pollutant load reductions needed to achieve desired water quality conditions in perennial streams and intermittent tributary streams.

Management categories are established for each major nonpoint source. These include: eroding croplands, streambank erosion, barnyard runoff, and other sources of water resource degradation. Each pollution source, such as an individual barnyard or a specific cropped field, is assigned a management category depending on eligibility criteria.

The basic management categories used in this project and their implications for funding are described below.

- Management Category I: Sources in this category together contribute a large portion of the total pollutants affecting surface waters in the watershed. A reduction in their pollutant load is critical for achieving the priority watershed project's water quality goals and objectives.

  Nonpoint sources in this category are eligible for funding and technical assistance under the priority watershed project. As a condition of funding, control of all Management Category I pollution sources is normally required as part of any cost-share agreement. For example, if a landowner has several Category I pollution sources on his/her property, whether they be barnyard runoff, streambank erosion, cropland erosion, etc., all of these sources should be controlled to meet the conditions of the agreement.

  If one or more Category I field(s) on the farm cannot be managed to meet the condition of funding described above, then a "whole farm approach" can be used to meet the pollutant reduction goal established for Category I fields. To accomplish this, the total reduction in sediment delivery (tons/year) for Category I fields on the farm will be calculated. This is the "farm target number." This number can be met by achieving sediment reduction from any lands on the farm, including Category I, II and III fields. Note that it is acceptable to fall short of meeting the target criteria for individual Category I fields as long as the shortfall can be made up by working on other fields on the farm. Although sediment delivery reduction can be credited for Category I-III fields, cost sharing would only be available for practices put on Category I and II fields. Likewise, any field that is cost shared must have soil loss controlled at least to "T."

If the "whole farm approach" still does not achieve the sediment reduction target criteria, the LCDs may exercise an option to meet with the DNR Coordinator to further discuss landowner eligibility on a case-by-case basis.

- Management Category II: Sources in this category together contribute less of the pollutant load than those in Management Category I. However, their control may be important in achieving water quality goals and objectives.

  Nonpoint sources in this category are also eligible for funding and technical assistance under the priority watershed project. Inclusion of sources in this category on cost-share agreements is optional. An example is a landowner whose barnyard is considered Management Category I but who also has areas of cropland erosion in Management Category II. The cost-share agreement for control of the barnyard runoff need not stipulate control of the cropland erosion, however, county project staff implementing the project will encourage control of all Management Category II sources.

- Management Category III: Sources in this category do not contribute a significant amount of the pollutants affecting surface waters and are not eligible for funding and/or technical assistance under the priority watershed project.

Other DNR programs (wildlife and fisheries management) can, if warranted, assist county project staff to control nonpoint sources in rural areas. This may be accomplished through technical assistance, assistance with applications for funds to create wildlife habitat, or assistance with local conservation groups providing shared funds or labor.

Additionally, coordinating nonpoint source control efforts with other programs such as the federal Food, Agriculture, Conservation and Trade Act and the state Farmland Preservation Program may also assist conservation efforts.

Change in Management Category

The priority watershed project offers flexibility during implementation for reassigning pollution sources to a different management category. For example, this may be necessary as a result of a change in farm operation, or other circumstances having occurred since completion of the inventories. Changes must be consistent with the management category criteria for each nonpoint pollution source listed below.

Management Category Criteria for Eroding Croplands

Management category criteria were established for eroding croplands (including pastures, tree nurseries and commercial horticulture operations) contributing sediment and phosphorus to lakes and streams. The criteria are expressed as tons of sediment and pounds of phosphorus

delivered annually to lakes and streams. Specific criteria were not developed for eroding croplands affecting wetlands. The means for addressing these areas are discussed below.

Croplands Delivering Sediment and Phosphorus to Lakes and Streams

Eroding croplands contribute about 40 percent of the sediment load and about 30 percent of the phosphorus load to surface waters in the watershed. They will continue to be an important source of sediment and phosphorus pollution affecting lakes and streams despite anticipated urban land use conversions in the future.

Sediment and phosphorus delivery from eroding croplands can be controlled by reducing soil loss. Generally, the tolerable soil loss rate ("T") for most agricultural land in the watershed is three to five tons per acre per year (T/A/Y). The "T" value represents the amount of soil erosion which can occur without reducing long-range soil productivity. Historically, soil erosion control programs have been successful in using a combination of best management practices to achieve rates approaching "T".

An inventory and evaluation of soil erosion rates and the associated amount of sediment and phosphorus delivered to surface waters was conducted. The results of this analysis along with water quality information and aquatic habitat investigations were used to establish goals for reducing the amounts of sediment and phosphorus delivered to lakes and streams.

Sediment Reduction Eligibility Criteria

The cropland sediment reduction goals for the lakes and streams vary by subwatershed, ranging from 33 percent to 87 percent. Sediment management criteria include two factors: the estimated amount of sediment delivered to lakes and streams and estimated erosion rates. Assuming a 75 percent landowner participation in the watershed program, sediment reduction goals can be achieved if:

- erosion rates do not exceed the "T" value, and
- sediment delivery to waterbodies does not exceed 0.3 tons per acre per year.

Table 4-1 shows the management categories and eligibility criteria used to target eroding croplands for management. Lands not meeting the above criteria are designated as Management Category I. Areas where sediment delivery is above the 0.3 T/A/Y cut-off but the soil loss rate is less than or equal to "T" are designated Management Category II. Other lands with erosion rates above "T" but below or equal to the sediment delivery cut-off rate are also designated Management Category II. Lands with erosion rates below "T" and sediment delivery rates below 0.3 T/A/Y are placed in Management Category III.

As shown in table 3-18, control of sediment originating from eroding agricultural lands is needed in each of the subwatersheds. Two of the ten subwatersheds, the Linnie Lac North (LN) and Muskego Canal West (CW) subwatersheds, together account for about 50 percent of the land needing improved management to reduce erosion and sediment delivery.

Phosphorus Reduction Eligibility Criteria

The cropland phosphorus reduction goals for the lakes in the watershed range from 45 percent to 61 percent. Similar to the process used to establish sediment control management criteria, phosphorus control management criteria were selected by combining the estimated amount of phosphorus delivered to lakes with calculated erosion rates.

Since the sediment reduction goals generally require a higher level of erosion control than that required for phosphorus reduction, the phosphorus reduction goals can be achieved by applying sediment reduction criteria. Table 4-1 shows the management categories and eligibility criteria used to target eroding croplands for management.

Table 4-1. Management Categories and Criteria for Eroding Croplands in the Muskego-Wind Lakes Watershed

Management Category	Criteria		Acres	Tons Delivered	% of Total
	Sediment Delivery (tons/acre/year)	Soil Loss[1]			
I	> 0.3	> T	2,005	2077	67
II	> 0.3	≤ T	1,753	403	13
	≤ 0.3	>T			
III	< 0.3	< T	4,620	620	20

[1] "T" represents the tolerable soil loss rate, usually 3-5 tons/acre/year depending on soil characteristics.

Source: DNR and DATCP

Table 3-17 shows the amount of phosphorus control that will be achieved by implementing this strategy for croplands. On a watershed basis, sediment and phosphorus delivered to lakes and streams will be reduced 59 percent and 53 percent respectively. This will require changes in land management on 1,934 acres of the cropped fields in the watershed.

Croplands Eligible for Assistance to Protect Wetlands

The management category criteria in table 4-1 are based on sediment and phosphorus delivery to lakes and streams. These criteria do not address eroding croplands draining to either wetlands adjacent to lakes or isolated wetlands. Wetlands serve to trap most of the sediment and phosphorus contained in runoff during certain periods of the year and in the process provide a valuable water quality function. It is recognized, however, that in the process the wetland may itself suffer environmental damage. If it is severe enough, the wetland may lose its ability to continue to trap eroding sediment or suffer degraded ecological diversity and wildlife habitat.

If wetland degradation associated with sediment deposited from eroding croplands is suspected, site specific evaluations will be conducted during project implementation by the DNR Southeast District water resources management personnel and the county land conservation office staff. The DNR determines the eligibility for cost-sharing or technical assistance.

Management Category Criteria for Barnyard Runoff and Manure Storage

Management category criteria were established for barnyards draining to lakes, streams and wetlands based on their average annual loading of phosphorus. As discussed below, barnyards draining to closed depressions or with roof-covered, confined animals were not assigned specific management category criteria.

Barnyards Draining to Surface Water or Wetlands

To achieve the pollution reduction goals identified in Chapter Three, phosphorus and other pollutants contained in animal lot runoff should be controlled at a high level. Eligibility criteria for animal lot runoff are described in table 4-2.

Table 4-2. Criteria and Management Categories for Barnyards Draining to Surface Waters in the Muskego-Wind Lakes Watershed

Management Category	Barnyard Phosphorus Load per Barnyard	Number of Barnyards	Pounds Reduced	Percent Reduction
I	greater than 40 lbs.	2	423	87
II	12 to 40 lbs.	3	43	9
III	less than 12 lbs.	12	-	-

Source: DNR and DATCP

The result of applying these criteria to the 11 barnyards draining to surface waters and wetlands is shown in table 4-3. Five barnyards, are eligible for funding under the priority watershed project. Two barnyards constituting 87 percent of the phosphorus load from these sources, are classified as Management Category I. Three additional barnyards are classified as Management Category II. The five eligible sites are located in the Linnie Lac West (LW), Bass Bay (BB), Muskego Canal West (CW), and Muskego Canal Direct (CD) Subwatersheds. Residual pollutant loads following practice installation should not exceed five pounds of phosphorus annually.

Table 4-3. Barnyards Draining to Surface Waters Targeted for Control in the Muskego-Wind Lakes Watershed

Subwatershed	Category I			Category II		
	No.	lbs P	% Control	No.	lbs P	% Control
Linnie Lac West (LW)	1	380	99	0	0	0
Bass Bay (BB)	1	45	76	1	13	17
Muskego Canal West (CW)	0	0	0	1	25	88
Muskego Canal Direct (CD)	0	0	0	1	13	79
TOTAL	2	425	87	3	51	10

Note: Total phosphorus delivered to surface waters from barnyards annually = 486 pounds

Source: DNR

Landowners receiving cost sharing for animal lot runoff are required to do a nutrient management plan (SCS standard 590). For these landowners, cost sharing is also available for nutrient and pest management practices, (including SCS standards 590 and 595), soil testing and crop scouting. If the waste management system does not include waste collection, handling or storage, it may be exempt from the nutrient management plan requirement. Such systems could consist of roof runoff management (588), livestock exclusion (472), or a clean water diversion (362).

Barnyards Draining to Internally Drained Areas Overlain with Deep Soils

Six barnyards with a combined phosphorus load of 103 pounds drain to closed depressions with deep (more than 60 inches) soils. Generally, these sites have limited potential for surface or groundwater contamination. The need for BMPs will be determined jointly by the county watershed staffs, the DATCP and the DNR. These determinations will be based on groundwater pollution potential and other site specific conditions.

Confined Animal Operations

Livestock operations which have animals confined most of the time are not a significant source of pollution. They are assigned to Management Category III and are not eligible for cost-sharing nor technical assistance.

Manure Storage

Eligibility for grants for manure storage practices will be based on the nutrient management plan developed by SCS standard 590. A farm operation is eligible for a grant if the nutrient

management plan indicates that manure cannot be adequately managed during periods of snow covered, frozen or saturated conditions without the installation of storage practices. The nutrient management plan must also show that proper utilization of the manure can be achieved following installation of the storage practice.

Eligible costs for storage facilities will be based on a least cost system that will satisfy the standard 590 specifications. These options may include manure stacks, short term storage (capacity for 30 to 100 days production) and long term storage (up to 210 days production).

Landowners receiving cost share funds for storage practices or nutrient management are required to adopt the standard 590 nutrient management plan. Additionally, manure removed from cost shared storage facilities designed to hold greater than six months shall not be spread on frozen, snow covered or saturated ground.

Nutrient and Pest Management

Owners of livestock operations with winterspread manure will be encouraged to participate in an on-farm nutrient and pest management educational program to reduce overapplication of nutrients and pesticides. The first stage of this program will be developing a manure spreading plan based on SCS Nutrient Management Standard 590, without soil tests. The second stage will be developing a nutrient, and possibly pest management plan. This plan will include soil tests, farm visits and possible crop scouting.

First stage plans may be done by county Land Conservation staff or contracted to consultants. Landowners will not be charged for these basic 590 plans. Second stage plans will be developed by consultants under professional services contracts with county Land Conservation offices. Landowners will be eligible to participate in the second stage for two years and will be responsible for paying 50 percent of the consulting fees. Land Conservation staff will review first and second stage plans, keep records showing progress towards reducing fertilizer and pesticide use, and provide evaluation reports to DNR and DATCP.

All livestock operations with a winterspread manure runoff problem identified in the 590 plan will be considered eligible for this educational program, but cost sharing may be limited to 2,000 acres and no more than three years.

It is estimated that 1,000 acres (half of the total), will be evaluated for nutrient management only, and 1,000 acres will be evaluated for nutrient *and* pest management. The planning of these practices is closely tied together with their implementation, and it is cost effective to develop these plans simultaneously. It is also more cost effective to prevent further ground and surface water degradation now than to try and treat it after damage has occurred.

A landowner receiving assistance from the Nutrient and Pest Management Education Program is not obligated to correct Category I problems identified for his/her farm unless they sign a cost-share agreement.

Management Category Criteria for Streambank Degradation

Management category criteria developed for eroding streambanks are based primarily on the rate at which sediment is being released into streams by the cutting action of dynamic stream flows. Secondary considerations include stream channel obstructions and riparian habitat degradation.

Table 4-4 presents management category criteria for eroding streambanks in both the rural and urban portions of the watershed. Eleven sites containing 5,620 feet of eroding streambanks were identified as Category I. Three sites containing 1,250 feet were designated Category II. No sites were found to have severely trampled or eroded streambanks associated with cattle access.

Table 4-4. Criteria and Management Categories for Eroding Streambanks in the Muskego-Wind Lakes Watershed

Subwatershed	Management Category I	Management Category II	Tons Sediment Controlled
Linnie Lac West (LW)	sites ≥ 5 tons	none	29
Linnie Lac North (LN)	sites ≥ 10 tons	sites ≥ 5 and <10 tons	62
Linnie Lac Direct (LD)	sites ≥ 5 tons	sites ≥ 3 and <5 tons	6
Bass Bay (BB)	sites ≥ 7 tons	none	8
Big Muskego Lake North (MN)	sites ≥ 15 tons	none	64
Muskego Canal West (CW)	sites ≥ 5 tons	none	33

Source: DNR

If removal of dams and other in-stream structures occurs, it can be anticipated that newly exposed streambanks and lakeshore areas will become significant sediment sources unless adequately managed. Before these removals occur, the DNR and the appropriate unit of government will jointly evaluate the potential severity of the anticipated source and will assign it a management category. Eligibility of these sources for technical and financial assistance will be in accordance with the assigned management category.

Rural Pollution Control Practices Needed

This section describes the general types of nonpoint source control practices needed to achieve the desired level of rural nonpoint source pollution control. It also contains guidance on the use of terraces, shoreline buffers, agriculture sediment basins, and easements. A full list of best management practices available for use in the watershed project, along with estimates of the numbers of practices needed, is presented in Chapter Five, "Nonpoint Source Project Implementation."

Erosion Control Practices on Croplands

Target sediment and phosphorus delivery rates on both rotated and continuous cropland can generally be achieved using a combination of rotation changes, reduced tillage, contour plowing, and contour strip cropping. Some eroding croplands will require additional or alternative protection measures, such as critical area seeding or vegetative buffers, to achieve sediment reduction targets. To control existing gullies and prevent new ones from developing, grassed waterways, field diversions, and grade stabilization structures will be needed.

Cropland terracing is expensive to construct and usually not needed to meet sediment reduction goals when other best management practices are employed. Therefore, terraces are eligible for cost-sharing only on a case-by-case basis, provided that the eroding field is in Management Category I and that achieving the sediment delivery target is not feasible using other practices. The county land conservation departments and the DATCP should jointly determine the need for terraces.

Shoreline buffers are vegetated filter areas adjacent to waterways. They should be used wherever possible to reduce sediment delivery from lands adjacent to lakes and streams. In addition, they should be used along intermittent channels where stream flows overtop channel banks and scour adjacent fields.

In-field buffers and agriculture sediment basins may be needed to supplement other best management practices where sediment and phosphorus reduction goals cannot be achieved. However, these practices may only be used provided that companion soil erosion control practices are in place on fields draining to the buffer or sediment basin.

Wetland Restoration

Wetland restoration is an eligible best management practice for the purpose of controlling nonpoint sources of pollution. Secondary benefits of wetland restoration include the enhancement of recreation, wildlife, and fish habitat. However, the primary justification for restoration under this nonpoint source pollution control project must be water quality improvement.

Wetland restoration includes the design of wetland basins, the plugging or breaking up of existing tile drainage systems, the plugging of open channel drainage systems, other methods

of restoring the predevelopment water levels of an altered wetland, or fencing livestock out of wetlands. Wetland restoration is an eligible practice when applied to any of the following:

1. Cultivated organic soils with tile or open channel drainage systems discharging to a lake, stream, or tributary. Wetland restoration will reduce the amount of nutrients and pesticides draining from the altered wetland to lakes or streams. Establishing permanent vegetation, and disabling the drainage system will control this pollutant source.

2. Pastured wetlands adjacent to lakes, perennial streams, or intermittent streams. Eliminating livestock grazing within wetlands will reduce the organic and sediment loading to the wetland and adjacent water resource, and reduce the direct damage to the wetland from livestock. Streambank and wetland protection by fencing will control the pollutants and help restore the wetland.

3. Prior converted (PC) and farmed wetlands (FW) downslope or upslope from fields identified as Management Category I for cropland sediment sources. Restoration of wetlands in these situations will do one of two things: create a wetland filter which reduces the pollutants from an upslope field(s) to a lake or stream, or reduce the volume and/or velocity of water flowing from an upslope wetland to a downslope field. Two eligibility conditions must be met to use wetland restoration in this situation:

    - All cropland fields draining to the wetland must be controlled to a soil loss rate that is less than or equal to "T" (usually 3-5 tons per acre per year).

    - One or more of these same fields must still have a sediment delivery rate (after the application any erosion control measures) greater than 0.3 tons per acre per year.

Using Easements to Support Rural Pollution Control Practices

Nonpoint source program funds may be used to purchase land easements in order to support specified best management practices. These practices, all of which involve the establishment of permanent vegetative cover, include:

- Shoreline buffers.

- Critical area stabilization.

- Wetland restoration.

Easements shall be for a period of no less than 20 years, although perpetual easements are preferred. An easement will be developed as an agreement separate from the cost-share agreement for best management practices.

Easements may be contracts between a landowner and the DNR, or between a landowner and a local unit of government. The local unit of government will be responsible for identifying how the easement will be used in controlling targeted pollution sources. Final approval of the easement rests with the DNR's Bureau of Water Resources Management.

To initiate the process, the local unit of government shall forward the easement proposal to the DNR District nonpoint source coordinator. The nonpoint source coordinator will be responsible for obtaining review comments from the local DNR staff including those from Wildlife Management, Fish Management, and Water Regulation and Zoning. The nonpoint source coordinator will then forward the proposal to the DNR Bureau of Water Resources Management and the Bureau of Property Management for final approval.

Easements to Support Critical Area Stabilization and Shoreline Buffers

The following guidelines and criteria are for the purchase of easements used to support critical area stabilization and shoreline buffers (excluding wetland restoration which is discussed in the next section).

Riparian Lands Along "High Priority" Water Resources

These are the highest priority areas for obtaining easements to support critical area stabilization and shoreline buffer practices. These practices give added protection to lakes and streams that are most sensitive to nonpoint source pollution and may require control measures above and beyond pollutant reduction levels identified in Chapter Three to meet water resource goals. Also, these lakes and streams will experience supplemental benefits from permanent vegetative cover, including enhancements to aquatic habitat and, if agreed to by the landowner, improved public access to surface waters.

In this watershed "high priority" waters include those lakes and streams in the following subwatersheds:

- Linnie Lac West (LW)
- Linnie Lac North (LN)
- Little Muskego Lake Direct (LD)
- Bass Bay (BB)

Easements to allow the establishment of permanent vegetative cover in these areas will be considered even though other lower-cost practices, such as changes in crop rotation, reduced

tillage, contour plowing, or contour strips may provide enough control to meet pollutant reduction goals. Easements in these areas will also be considered as a cost-effective alternative to more expensive practices such as cropland terraces or agricultural sedimentation basins.

Riparian Lands Along Non- "High Priority" Water Resources

Easements may also be used to support critical area stabilization and shoreline buffers in other riparian areas of the watershed, although additional restrictions apply.

In these areas, the easement must offer pollution control at a cost that is competitive with that of other controls, as required by NR 120. Easements may not be purchased with program funds to establish shoreline protection or critical area stabilization practices outside high priority areas if significantly lower-cost practices, such as changes in crop rotation, reduced tillage, contour plowing, or contour strips provide an adequate level of control.

Easements to Support Critical Area Stabilization on Non-Riparian Lands

Easements may also be made available to support critical area stabilization in non-riparian areas if applied to reduce the delivery of sediment to surface waters. This application is limited by the following conditions:

- The land must be in cropland Management Category I.
- Other feasible alternatives must provide significantly less sediment control.

Easements to Support Shoreline Buffers

Easements may be used to support shoreline buffers designed to control the delivery of sediment to streams. The estimated feet of shoreline and acres of easements that are needed to support shoreline buffers are shown in table 4-5. The following conditions must be met to use easements for this purpose:

- The shoreline buffer must be located immediately adjacent to a perennial or intermittent stream, lake or wetland.
- If the purpose of the shoreline buffer is to reduce the delivery of sediment and nutrients from a field targeted for control, the buffer must be located directly on the targeted field. Targeted fields are those identified using the management category criteria in table 4-1. Easements may not be used to support shoreline buffers created principally as off-field filtering devices for upstream fields.

Only that portion of the targeted field that is converted into the vegetated buffer strip is eligible for the easement. Guidelines on the required widths of shoreline buffers used to control sediment delivery are shown in Appendix B.

- Shoreline buffers designed to control targeted areas of streambank degradation may also be supported by easements. Targeted areas are those that meet the criteria in table 4-5.

Table 4-5. Estimated Acres Eligible for Easements in the Muskego-Wind Lakes Watershed

Subwatershed	Shorelines		Wetland Acres	Acres of Easements
	Feet	Acres[1]		
Linnie Lac West	78,500	63	78	141
Linnie Lac North	30,700	25	239	264
L. Muskego Direct	4,600	4	0	4
Bass Bay	23,300	19	126	145
B. Muskego North	56,200	45	136	181
B. Muskego Direct	12,100	10	115	125
B. Muskego East	80,800	65	117	182
Muskego Canal West	96,200	77	337	414
Muskego Canal Direct	50,200	40	159	199
TOTAL	432,600	348	1,307	1,655

[1] Shoreline buffer acres calculated based on an average 35 foot buffer width.

Easements to Support Wetland Restoration

Easements may be used to support eligible wetland restoration projects. The eligibility criteria for wetland restoration easements are similar to the criteria for easements for shoreline buffers and critical area stabilization in areas adjacent to "high priority" water resources.

If wetland restoration does not involve the purchase of an easement, then the LCD may sign a cost-share agreement for the required costs and proceed to implement the practice.

Integrating Fish and Wildlife Management

Fish and wildlife concerns will be identified and addressed during project implementation. The county land conservation department staff will contact the DNR District wildlife management and fish management staffs for the Fox River Basin as conservation plans and cost-share agreements are developed.

The purpose of this coordination is to maximize the fish and wildlife benefits of nonpoint source control practices, to identify mitigation measures needed to offset habitat loss occurring from installation of best management practices, and to prevent the use of practices that may have an adverse impact on fish and wildlife resources.

The conditions under which land conservation department staff are to contact DNR staff for consultation and assistance, and the role of the DNR are discussed in Chapter Five.

Urban Nonpoint Source Control Needs

Urban Nonpoint Sources

As discussed in Chapter Three, the principal water quality problems derived from urban land uses result from many factors including:

- High loadings of sediment, nutrients, bacteria, heavy metals and other toxic materials.
- Stream channel modifications, including straightening and lining with concrete.
- Hydrologic disturbances, including flashy high flows and loss of base flow.
- Streambank erosion.

Three principal types of urban pollution sources must be addressed to meet pollutant reduction goals for the Muskego-Wind Lakes Priority Watershed project. These sources are eroding streambanks, established urban areas (including existing urban areas and planned urban areas), and construction sites.

Eroding Streambanks in Urban Areas

Eroding streambanks in urban areas of the watershed occur almost entirely in residential areas with single-family homes and large country estates. Of the total 314 tons of sediment per year released to streams by eroding streambanks (see table 3-6), 119 tons come from urban areas. Management of eroding streambanks is addressed in earlier sections of this chapter.

Established Urban Areas

That portion of the urban area established as of 1990 is called the "existing urban area." That portion that will be added through the year 2010 is called the "planned urban area." The urbanized area in the year 2010 is the sum of the existing and planned areas, and is called the "future urban area."

Runoff from established urban lands is an important cause of irregular and "flashy" stream flows. In turn, these flows cause streambank erosion and flooding problems. Such problems have been traditionally dealt with through extensive modifications to stream channels. The modifications often destroy fish habitat, increase hydraulic scour and cause safety problems, especially for children.

Runoff from established urban lands is also a source of pollutants, particularly organic and inorganic toxic materials and sediment. Existing urban lands must be retrofitted with storm water control practices to reduce the delivery of these pollutants to streams. This requires purchasing land, modifying in-place storm sewers and utilities, and construction of best management practices, for example, detention ponds. Existing urban pollutant loadings are a relatively small portion of the total in the Muskego-Wind Lakes watershed (see tables 3-16, 3-17 and 3-18). Therefore, expensive measures to control them may not be justified in all situations.

In contrast, planned urban areas should have storm water quality and flow control practices included as an integral part of the development. Practices installed as part of a new development are much less expensive than those retrofitted to existing urban areas.

Construction Sites

Construction sites are those areas in any phase of construction that involves disturbing the soil through grading or excavation. Included are areas where land use is being converted for the first time, as occurs during creation of a new residential subdivision or an industrial park in an area previously used for farming.

Construction sites may also include renovation or redevelopment within an established urban environment. These activities include utility replacement, street replacement, bridge reconstruction, or rehabilitation of commercial, industrial, or residential areas. Construction sites are important sources of sediment and other sediment borne pollutants.

Management Alternatives for Established Urban Areas

Alternative Actions for Existing Urban Lands

Existing urban land uses produce differing amounts of storm water pollutants and flow. Those urban land uses considered "critical" to control nonpoint source pollution were identified for each subwatershed. Two factors were used to identify critical urban land uses:

the unit per area rate (pounds/acre/year) that each land use produces pollutants and the portion of the total urban pollutant load (pounds/year) produced by each land use.

Four management alternatives were considered for each urban sub-basin. These management alternatives present a range of practices and control effectiveness which include:

1. Do nothing.

2. Increase street sweeping to once per week for critical land use areas.

3. Detain runoff from 50 percent of the critical land uses using wet detention ponds and increase street sweeping on the other 50 percent of the critical land uses to once per week.

4. Detain runoff from 100 percent of the critical land uses using wet detention ponds.

The analysis of management alternatives assumes that wet ponds will trap all sediment particles of 20 microns or larger. This will result in about a 50 percent control of suspended sediment and about 30 percent control of phosphorus and heavy metals in urban runoff. The analysis assumes an infiltration rate of 0.5 inches per hour for infiltration basins and grassed swales. This is a moderate rate of infiltration that will provide less control of pollutants than wet detention ponds. Higher infiltration rates of about 2.5 inches per hour would provide excellent control of pollutants. Existing levels of street sweeping and grassed swale drainage are accounted for in evaluating these alternatives. The alternatives analysis determines the management program for reducing the mass loading of sediment and phosphorus to achieve water quality goals for the Muskego-Wind Lakes chain and its tributaries (see Appendix C).

Alternatives for Planned Urban Lands

Alternatives for planned urban areas identify changes in pollutant loading anticipated to occur under different control strategies. These pollutant loads will ultimately affect lake water quality and can compromise gains made through controls on existing urban lands.

Two management alternatives were applied to planned urban areas. These include:

1. Redirect roof downspouts on all lands to grassed areas.

2. Detain runoff from 100 percent of all lands with wet ponds.

Alternatives for Future Urban Areas

The impacts of alternative management programs for existing urban areas were combined with those for planned urban areas to determine the net impacts on water quality under future conditions. The four management alternatives for existing areas were combined with each of the two management alternatives for planned urban areas. The result provides a comparison of pollutant loading under future conditions for eight alternative urban management options.

The plan recommendations were based on the alternative that provides for the reduction in pollutant loading which is needed to achieve the previously described water resource objectives.

Management Alternatives for Construction Sites

Two levels of management were identified for construction sites:

1. Manage construction sites, assuming control practices which are 75 percent effective in controlling off-site sedimentation.

2. Manage construction sites, assuming control practices which are 50 percent effective in controlling off-site sedimentation.

Identification of Urban Streambank Erosion Control Alternatives

Urban streambank erosion will be controlled using the same criteria specified for rural areas. Alternatives for achieving this level of control have not been evaluated but will be required as part of any feasibility study for streambank erosion control prepared prior to installing practices. Peak flow reduction through application of upstream detention or other BMPs may need to be investigated.

Urban Management Alternatives

Management alternatives for established and developing urban areas were evaluated based on their capabilities to meet pollution reduction goals. Three reduction goals identified in Chapter Three, were used as the principal criteria for evaluating the effectiveness of urban nonpoint source control alternatives. These reduction goals are:

- Decrease the existing urban suspended sediment loading to selected areas of the principal tributary streams and the Muskego-Wind Lakes chain by 50 percent.

- Reduce the phosphorus loading from existing urban areas by 30 percent in selected sub-basins.

- Reduce the heavy metals loading from existing and future urban areas to reduce the chronic toxicity of storm water draining to the Muskego-Wind Lakes chain.

Management needs for construction site and streambank erosion controls are presented below. The recommended levels of control, in comparison with those called for in rural areas of the watershed, form the basis for evaluating alternatives for established (existing and planned) urban area runoff.

Sediment Control for Construction Sites

Construction site erosion control throughout most of the watershed is critical to achieving sediment reduction goals. It is expected that the rate of construction activity will increase over past rates. Without adequate control, construction site erosion will remain as the most significant source of sediment in the watershed.

Sediment Control For Eroding Streambanks

Urban streambank erosion occurs along a significant portion of Bass Bay Tributary, Muskego Creek, and O'Leary Tributary. This erosion is caused primarily by the changing stream hydrology, which is characterized as "flashy" and having increasing volumes and peak flows. This acts to widen the stream channel, destroying the natural conditions needed for healthy communities of fish and other aquatic life. Also, the channel is scoured during heavy rainfall events, displacing in-stream cover such as rocks and logs and flushing away aquatic life as well.

Streambank erosion in urban areas will be targeted for control using the same criteria developed for other portions of the watershed. These criteria were shown in table 4-4 under the rural nonpoint source control strategy. Management category criteria were applied to 51 sites encompassing approximately 32,000 feet of streambank erosion along the Muskego-Wind Lakes chain and its principal tributaries. Approximately 9,000 feet of streambank erosion at 14 sites in urban areas were identified. These sites comprise 27 percent of the length and 38 percent of the mass load coming from all streambank sources.

Sites located in residential areas, wetlands, and woodlands may be impractical to control for several reasons. Access may be a limiting factor in any of these areas. Structural controls may not be suited to wetland areas because of unstable substrate material. In woodland areas, site preparation for structural controls may require disturbing extensive areas. As a result, sites located in these areas may need further evaluation. Options include structural controls such as riprap, shaping and seeding, fiber rolls and other bioengineering techniques. Less intrusive measures such as brush cutting to increase light penetration and vegetation establishment may also be effective. Foregoing control all together may be necessary if the degree of site disturbance needed to install practices offsets the benefits to the stream.

Sediment Controls For Established Urban Areas

The effectiveness of using nonpoint source controls in established urban areas was evaluated to determine if this additional step in managing sediment loading is cost-effective. Tables 3-16, 3-17 and 3-18 show how nonpoint source control in established urban areas can be expected to affect total sediment loads to lakes and streams in the watershed.

This analysis assumes that the recommendations presented in this plan for the control of eroding croplands, rural and urban streambanks, and construction sites will be implemented. As noted above, the analysis assumes that future construction erosion control efforts reduce sediment loading from this source by at least 50 percent in most areas and 75 percent in some areas.

The alternatives comparison revealed that management of existing and planned urban areas for purposes of reducing sediment loading to streams is needed in selected areas of the watershed. Controlling streambank erosion, construction erosion, and sediment originating from rural areas is not sufficient to meet the sediment reduction goals for the lakes and subwatersheds of the Muskego-Wind Lakes Watershed.

Each of the alternative sediment control programs is very sensitive to the effectiveness of construction site erosion controls. Improving effectiveness of construction erosion control programs from 50 percent to 75 percent would dramatically improve the total sediment control throughout most of the watershed. This supports the conclusion that it is most cost-effective to optimize construction erosion controls instead of retrofitting existing urban areas with detention basins.

Achieving greater than a 75 percent effectiveness in controlling construction erosion control practices is probably unrealistic. However, failure to attain at least a 50 percent effectiveness in these control programs will result in failure to meet sediment reduction goals in most surface waters. This shortfall in the sediment reduction goal would compromise gains made from controlling other sediment sources including upland erosion, streambank erosion, and sediment originating from future urban development.

The analysis indicates that nonpoint source controls on existing and planned areas (excluding streambank and construction site controls) are not needed in some areas of the watershed to achieve the previously described sediment reduction goals. Four subwatersheds— Big Muskego Lake Direct (MD), Big Muskego Lake East (ME), Muskego Canal West (CW), and Muskego Canal Direct (CD) fall into this category.

Reducing the Acute Toxicity of Storm Water Discharged to Lakes and Streams

The approach used to identify management actions that reduce the toxicity of storm water runoff was based on evaluating individual subwatersheds. This is necessary because individual storm water pipes and surface water discharges are a concern and existing and planned urban area runoff should be looked at separately in evaluating how best to reduce toxicity.

The need for reducing the potential for acute toxicity problems was presented in Chapter Three, where it was shown that heavy metal concentrations in urban stormwater are a concern. One way of achieving this is to reduce the mass load of pollutants entering the storm sewer system. If it is assumed that the volume of storm water remains the same, the concentrations will be reduced in direct proportion to reductions in the load of pollutants entering the storm sewer system. The Little Muskego Lake Direct (LD) subwatershed will require BMPs to achieve this goal.

Reducing Excessive Stream Flows and Maintaining Base Flows

Hydrologic analyses have not been conducted to investigate the effect of management alternatives on reducing and preventing streambank erosion and bed scour, or on maintaining

stream base flows. These studies will need to be conducted as part of future feasibility studies for the existing and planned urban areas (see Chapter Five for cost share eligibility).

Recommended Urban Nonpoint Source Control Program

The recommended urban nonpoint source control program for this watershed consists of four elements as discussed below. Each element contains general recommendations and specifies the local units of government to which they apply. Where necessary, additional recommendations follow for specific units of government.

This plan acknowledges that although county and city park land represents a reserve of open space upon which urban BMPs could potentially be located, county and municipal parks departments manage these lands for many other purposes, including recreation. The parks departments will review each nonpoint source control proposal that involves park land on a case-by-case basis to determine whether they support use of the land for such a purpose, but parks departments will not be expected to bear capital costs.

In addition, the parks departments will not assume long-term maintenance liability for practices placed on its property when those practices are installed to control pollutants and stormwater flows that are generated from urban lands located in other governmental jurisdictions. This is anticipated to be the case in all or nearly all situations. Therefore, financing of storm water improvements is expected to be provided by other units of government.

Construction Site Erosion Control

This part of the plan identifies the need for effective construction erosion control programs throughout the watershed. It is needed to control erosion from newly developing areas, urban redevelopment projects in established urban areas, and from installation and/or maintenance of roadways, bridges and buried utilities.

State and Federal Requirements

Wisconsin State Statutes 101.65, 101.651, and 101.653 deal with a statewide construction site erosion control ordinance. Currently, inspection and enforcement measures for erosion control on construction sites for 1 and 2 family dwellings will be administered by the Wisconsin Department of Industry, Labor, and Human Relations (DILHR). Other provisions to be included on a statewide erosion control ordinance are being developed in a DNR - DILHR Memorandum of Understanding (MOU). One of the major provisions that is being discussed in the MOU is agency responsibility for residential, commercial, and industrial developments with ground disturbances of 5 acres or greater as required by U.S. Environmental Protection Agency (EPA) storm water regulations.

Currently, DILHR has been authorized to enforce erosion control measures on 1 and 2 family dwellings in areas that have adopted the Uniform Dwelling Code. At this time, areas

with populations less than 2,500 are not mandated to regulate construction site erosion for 1 and 2 family dwellings.

Construction erosion control is accomplished most effectively through a local erosion control ordinance, locally administered building codes, practice standards and application guidelines, an effective administrative program and effective enforcement. Training programs are needed for staff administering ordinances and developers who are responsible for installing and maintaining the erosion control practices.

General Requirements

Ordinances must meet the applicability and content requirements of NR 120.16 dealing with erosion control. The "Model Construction Site Erosion Control Ordinance," developed cooperatively by the DNR and the League of Wisconsin Municipalities (DNR, 1987), and suggested changes to the model ordinance (set forth by Mr. James H. Schneider, League Legal Counsel, in the March 1989 issue of "The Municipality") will be used as guides to determine adequacy of ordinances. Erosion control practice standards and applicability criteria should be consistent with those set forth in the Wisconsin Construction Site Best Management Practice Handbook (DNR, 1989).

Education and training activities needed to control construction site erosion are described in Chapter Six. The nonpoint source program will provide assistance to support ordinance development, ordinance modification, and ordinance administration and enforcement. This is also discussed in Chapter Five.

Specific Needs of Local Governments and Developers

The following is a list of specific needs that the cities of New Berlin, Muskego, the town of Norway and developers should address in developing an effective construction site erosion control program.

- Municipalities and counties need to review and modify their existing ordinances to create more effective penalties for non-compliance and be more responsive to the concerns of citizens, inspection staff and developers.

- Municipalities and counties need to identify and fill staffing and training needs for effective ordinance administration and enforcement.

- Municipalities and counties need to evaluate their permit fee schedule to investigate ways to raise revenue to support effective enforcement activities.

- Developers and contractors need better access to technical information through seminars and other educational activities and materials.

- Erosion control inspectors need specific guidelines for documenting ordinance violations in order to provide for more consistent and effective legal action.

A more detailed construction site erosion control implementation program is described in Chapter Five under the Core Program Roles and Responsibilities section. An erosion control information and education strategy is described in Chapter Six.

Nonpoint Source Control in Established Urban Areas

The control program for existing urban areas is based on the pollution reduction goals for sediment and phosphorus. The following is the rationale and description of the activities needed to meet those goals.

General Requirements

The long-term management goal for all subwatersheds is to achieve a high level of control for existing critical land uses. This requires the equivalent of providing wet detention for 100 percent of the existing critical land uses for established urban areas.

Infiltration should be considered as an alternative to wet detention where soil conditions are suitable for providing an equivalent level of control and where groundwater quality would not be threatened. Infiltration basins or trenches may be used in combination with wet detention ponds to provide groundwater recharge and base flow enhancement.

A combination of increased street sweeping and detention may be used as a beginning approach toward achieving a significant level of nonpoint source control. Feasibility studies will be needed to select the site specific practices consistent with this watershed plan. The cost and complexity of studies will vary, depending on the availability of land for locating practices and the compatibility of the existing storm sewer networks with locating structures. Assistance available to communities under the priority watershed project to develop nonpoint source controls in existing urban areas is presented in Chapter Five.

Community Specific Requirements

Table 4-6 shows the level of management required for each community in its existing urban area to meet pollutant reduction goals. The total land requirements include the area for ponds and additional buffer areas approximately equal in size to the ponds. The curb-miles for street sweeping represent the maximum increase that would occur as part of a stepped approach to providing the full amount of wet detention.

Table 4-6 lists the critical acres, by subwatershed, that should be addressed through more site specific feasibility studies. The acres that need to be addressed in feasibility studies will vary depending upon land use configuration and the locations of suitable sites to install practices.

Table 4-6. Recommended Urban Best Management Practices for Existing Urban Areas in the Muskego-Wind Lakes Watershed

Community	Subwatershed	Critical Land Uses	Critical Land Use Acres	Wet Detention Acres[1]	Total Land Acres Required	Street Sweeping (curb mi/yr)
New Berlin	LW	Industrial Residential[2]	230	0.7	1.4	8
	LN	Freeway Commercial Residential	738	2.6	5.2	25
Muskego	LD	Commercial Industrial Residential	1,015	3.4	6.8	34
	BB	Commercial Residential	246	0.8	1.6	8
	MN	Commercial Industrial	310	2.1	4.2	10
Norway	WL	Residential	327	1.2	2.4	11
TOTAL	-	-	2,866	10.8	21.6	96

[1] Wet ponds or equivalent infiltration practices to control 50% (20 micron control) of suspended solids from critical land uses.
[2] Residential land uses with densities of two units per acre or greater are considered critical.

Source: DNR

Nonpoint Source Controls in Planned Areas

The pollution reduction goals for sediment and phosphorus also drives the control program for planned urban areas.

General Requirements

The long-term management goal for all subwatersheds is to achieve a high level of pollution control for planned urban development. These controls are necessary to reduce nonpoint sources in future established urban areas. A level of control equivalent to providing wet detention for 100 percent of the planned urban growth is prescribed.

Infiltration should be considered as an alternative to wet detention where conditions are suitable for providing an equivalent level of control. In particular, grassed swale drainage systems in planned residential areas should be investigated to both control pollutants and decrease the size of wet detention facilities needed for additional pollution control. Infiltration basins or trenches may be used in conjunction with wet detention to provide groundwater recharge and base flow enhancement.

Urban Best Management Practices

Four general classes of management practices are used to reduce the adverse impacts of runoff from urban areas. These classes include: source reduction practices, infiltration practices, wet detention practices, and streambank erosion control practices.

Source Reduction Practices

These practices are meant to reduce the generation of urban pollutants as close to the source as possible. At a minimum, pollutants are controlled prior to being washed from urban surfaces by rainfall and snowmelt.

Source controls are generally non-structural, relying instead on changes in lifestyle by urban residents. Reducing the amount of automobile traffic is an example of a source control, as automobiles are the source of many urban pollutants. Current policies requiring removal of lead from gasoline and asbestos from automobile brake linings are also examples of source controls. Other source controls that should be used as part of the Muskego-Wind Lakes Priority Watershed Project include, but are not limited to:

- Reduce the use of galvanized roof materials and gutters, a primary source of zinc in urban runoff.
- Remove pet wastes immediately from lawns, sidewalks, and streets to reduce bacterial contamination of urban runoff.
- Control the timing and reduce the amount and type of fertilizer and pesticide applications in urban areas.
- Dispose of automobile waste fluids such as radiator water and engine oil appropriately, keeping them out of the storm sewer system.
- Remove leaves and street dirt from street and parking lot surfaces through municipal sweeping and leaf collection.
- Control land use through zoning, which, in part, considers on-site suitability for storm water management practices to meet water quality, habitat, and flood prevention objectives.
- Control construction site erosion.
- Minimize use of street de-icing compounds.
- Reduce the amount of motorized traffic.
- Reduce the areal extent of parking lots.

- Encourage urban developments to take place on lands within urban service area boundaries.

Source controls that prevent the discharge of pollutants, such as the removal of lead from gasoline are the most effective. However, these controls often cannot be initiated at the local level but rather are regional or national initiatives. Citizen action that leads to this type of control is an important component of any long-range urban strategy to reduce nonpoint pollution.

Source controls that rely on better housekeeping practices, such as pet waste control programs, oil recycling, and responsible use of lawn and garden products can be initiated locally. These types of controls are inexpensive and important for any program to reduce urban nonpoint pollution. Information and education efforts presented in Chapter Six are critical in supporting these "grass roots" approaches to solving urban water quality problems.

Infiltration Practices

Reducing pollutant transport to surface waters involves reducing the amount of urban storm water reaching streams, primarily from impervious surfaces. This is accomplished by increasing the infiltration of storm water into the soil and ground layers. Storm water infiltration on a suitable site can effectively reduce nonpoint pollution. In addition, infiltration can help stabilize the hydrology of small urban streams by replenishing groundwater, much of which is ultimately discharged to surface water. Infiltration practices can be used with wet detention facilities to augment pollutant removal effectiveness or reduce pond size.

Practices that promote on-site infiltration include porous pavements, redirecting roof downspouts to grassy areas, and directing runoff waters to infiltration trenches. These practices are generally most applicable to small source areas such as rooftops and parking lots. Grassed swale drainage systems can also be used to reduce infiltrate runoff. Finally, infiltration basins can be located at the end of drainage outlets serving larger drainage areas.

Not all sites are appropriate for the use of infiltration practices. A minimum separation distance of three feet between the bottom of the infiltration device and the groundwater or bedrock is generally required. Heavy or poorly drained soils limit the effectiveness or practical use of infiltration devices. Slopes may limit the use of grassed swales in residential areas. Most importantly, precautions must be taken when infiltrating urban storm water to prevent groundwater contamination. Runoff from residential rooftops and driveways, rooftops in institutional, commercial, and non-manufacturing industrial areas can generally be infiltrated with little risk of groundwater contamination.

Runoff from parking lots in institutional areas, commercial areas and separate employee or visitor parking lots in non-manufacturing industrial areas can be routed through infiltration devices but require some type of pretreatment. Infiltration devices in these areas should be monitored to assure that groundwater contamination is not occurring. Highly contaminated runoff, such as that from commercial and industrial storage and loading areas should not be routed through infiltration practices.

Wet Detention Practices

Wet detention ponds effectively control particulate pollutants and can be designed to control peak flow discharges. Consequently, the wet ponds can be employed to serve many needs, including removal of pollutants, control of peak flooding and/or storm water flows that may be causing streambank erosion and streambed scour. These ponds have limited effectiveness in controlling pollutants dissolved in storm water, and cannot effectively reduce the total storm water volume or enhance stream base flows. Wet ponds can be situated near a small source area such as a parking lot, but they are more commonly used to control runoff from larger areas with a combination of uses.

Streambank Erosion Control Practices

Streambank erosion control practices used along urban streams are similar to those used to control unstable banks in rural areas. Generally, these practices include seeding and shaping for areas with minor erosion problems. Rapidly eroding sites, extensive areas of erosion, or areas with steep or high streambanks may require more stable materials. These include bioengineering (carefully engineered use of vegetation), rock riprap, gabions, or other structural practices with the ability to withstand higher stream flows.

Easements for Wetland Restoration, Critical Area Stabilization, and Shoreline Buffers

Easements may be used to support wetland restoration, critical area stabilization, and shoreline buffers in urban areas in order to reduce the water quality impacts of storm water runoff. Use of these practices as stormwater runoff control measures, and the use of easements to support these practices, must be reviewed on a case-by-case basis by the DNR. The same general rules governing the use of easements in rural areas also apply to urban areas.

Performance Standards and Design Criteria for Urban Structural Practices in Established Urban Areas

The guidelines in this section are presented to facilitate the design, review, and approval phases required before controls can be installed and cost-shared through the nonpoint source program. The design standards contained in this section are preliminary, and may need to be supplemented by engineering references and design manuals. Also, the DNR Nonpoint Source and Land Management staff should be contacted prior to the start of practice design activities, in accordance with NR 120.

To meet water resources objectives for the Muskego-Wind Lakes chain and its principal tributary streams, the combined effect of all practices must achieve at least a 50 percent reduction of sediment loads from existing areas and reduce to the maximum extent possible pollutant loads from new development. In addition, existing urban storm water flows must be reduced sufficiently in urban portions of the Muskego-Wind Lakes chain to help

rehabilitate Shubring Bay, Moonlight Bay, and Pigs Bay of Little Muskego Lake; Bass Bay; and northern portions of Wind Lake.

In planned urban areas throughout the watershed, impacts on stream hydrology must be minimized. Conformance of individual practices to the following guidelines will assure that the total level of control is adequate, provided the recommended plan is fully implemented.

Standards

The following preliminary standards should be used to guide the design of individual practices. They will be superseded by standards developed as part of the model ordinance for storm water management, which is being prepared by the DNR.

1. Wet detention ponds in existing and planned urban areas should be designed to control at least 50 and 90 percent, respectively, of the incoming suspended sediment load. This will be achieved by trapping the 20 and 5 micron or larger particle sizes. This will provide a high degree of control of heavy metal loads from lands tributary to the pond. Where retrofitted, ponds should be located to control runoff coming primarily from the critical land uses. Where planned as part of new development, ponds should be located to control runoff from all land uses.

2. Wet detention ponds in existing urban areas should contribute to reducing stream velocities and minimize erosion and streambed scour.

3. Wet detention ponds in planned urban areas should prevent increases in peak flows and duration of peak flows for the 2-year, 24-hour storm.

4. Infiltration devices in existing and planned urban areas should infiltrate all runoff from the one-inch storm. Infiltration basins and grassed swales are most effective, since they control runoff from all impervious surfaces (roofs, streets, parking lots) in the contributing area. Where retrofitted, these devices should be located to control runoff coming primarily from the critical land uses. Where planned as part of new development, ponds should be located to control runoff from all land uses. In locating practices, infiltration rates should be carefully considered as they are a prime determinant of the pollution control effectiveness.

5. Infiltration devices in existing urban areas should contribute to reducing stream velocities to speeds that do not erode banks or scour habitat.

6. Infiltration devices in planned urban areas should prevent increases in peak flows and durations of peak flows for the 2-year, 24-hour storm at pre-development levels.

Design Criteria

NR 120.14(22) requires that the DNR participates in the practice design process, and approve detailed practice designs. Selected preliminary design criteria for wet detention ponds and infiltration devices are presented in table 4-8.

Pretreatment and groundwater monitoring in the practice design for infiltration devices is generally required. Providing pretreatment for these devices will greatly reduce required maintenance to reduce clogging and restore infiltration. Pretreatment could be a sediment trap, a wet detention pond, a grass filter strip, or street sweeping. Practices should be equipped with groundwater monitoring wells to assure that groundwater contamination remains within acceptable bounds.

Finally, all detention and infiltration practices should be equipped with signs that clearly identify that the site contains urban storm water pollutants. Such signs should also carry warnings, where appropriate, against using storm water treatment facilities for swimming, consumptive fishing, wading, dumping of wastes, or any other activity that could endanger public health.

Environmental and Public Health Concerns

Public concern has been expressed about the potential economic, environmental and public health impacts of storm water detention ponds. Concern has been expressed about the toxicity of sediments and water in wet detention ponds and the danger posed to humans and wildlife. Concern was also expressed about the disposal of contaminated sediments and the costs which may be incurred in finding and utilizing suitable disposal technology.

Information was collected in 1990 about the water and sediment quality in a wet detention pond serving a mixed residential and commercial area in Madison, Wisconsin. This information is discussed below as it relates to these public concerns. It is important to recognize that sediment and water quality may vary between detention ponds serving the same general land uses, due to differences in the specific mix of tributary land uses and spills or illegal connections to the storm sewer system. Caution should also be used in applying these data to ponds serving more intensive land uses, such as industrial areas.

Detention Pond Water Quality

Samples were collected on each of nine different days between early May and late June. The study evaluated three heavy metals (lead, zinc, copper), bacteria, polyaromatic hydrocarbons, pesticides, and phthalate esters. Metals concentrations measured in the pond were compared to the chronic toxicity standards for warm water fish and aquatic life; bacteria concentrations

Table 4-8. Selected Preliminary Design Criteria for Wet Detention Basins and Infiltration Devices

Practice	Design Criteria			
Wet Detention Basins	Size: (% of total drainage area)	Land Use	90% control of suspended solids (% of total drainage area)	50% control of suspended solids (% of total drainage area)
		Freeways	2.8	1.0
		Industrial	2.0	0.8
		Commercial	1.7	0.6
		Institutional	1.7	0.6
		Residential	0.8	0.3
	Pond Depth: ≥ 5 feet of permanent pond			
	Safety Shelf: ≥ 10 feet around pond perimeter			
	Sideslope: ≥ 5:1			
	Shape: ≥ 3:1 length to width ratio			
	Vegetated buffer width: ≥ 25 feet			
	Depth to groundwater: ≥ 3 feet (all soil types)			
Grass Swales	Gradient: ≥ 0.5% and ≤ 5%			
	Sideslopes: ≥ 3:1			
	Depth to groundwater: ≥ 3 feet (all soil types)			
	Velocity: ≤ 6 feet per second			
	Infiltration rates: ≥ 0.5 inch per hour			
	Vegetative cover: dense, water-tolerant, erosion-resistant grasses			
	Other: prevent compaction and clogging before and after construction			
Infiltration Devices	Depth to groundwater: ≥ 3 feet (all soil types)			
	Width: wider than deep			
	Distance to water supply wells: ≥ 100 feet or as needed			
	Infiltration rates: ≥ 0.5 inches per hour			
	Pretreatment: grass filter strip, detention basin, sediment trap, etc.			
	Other: prevent compaction and clogging before and after construction			

Source: DNR

were compared to the standard for full body contact recreation; insecticide concentrations were compared to acute toxicity criteria for water fleas; polyaromatic hydrocarbon concentrations were compared to the human cancer criterion, and phthalate ester concentrations were compared to the human threshold criterion.

The study concluded that polycyclic aromatic hydrocarbons (PAHs), pesticides, and phthalate ester concentrations in the pond water did not exceed the applicable criteria on any of the dates sampled. Bacteria concentrations were found to significantly exceed the recreational standard on several sampling dates, with the greatest concentrations soon after rainfall events. All heavy metals, however, were found to occasionally exceed the applicable standard. Lead concentrations exceeded the chronic toxicity standard for all samples. Copper and zinc concentrations exceeded the chronic toxicity standard about 25 percent of the time. All metals concentrations were between one and 1.5 times the chronic toxicity standard, but well below the acute toxicity standards.

In addition to these tests, acute toxicity was evaluated through a 24-hour exposure bioassay test using water fleas as the test organisms. All samples tested completely negative, showing 0 percent mortality.

In summary, the water in ponds receiving runoff from commercial and residential areas should not be a concern except for the human health hazard associated with bacterial contamination. Ponds should not be used for any type of contact recreation. Although aquatic life will develop in these ponds, consumptive fishing should be discouraged as an added precaution.

Detention Pond Sediment Quality

Assuming a sediment accumulation rate of one to two inches per year and a pond storage depth of two feet, most wet detention ponds will require periodic dredging about once every 15-20 years. The quality of pond sediments is a concern in part because it will determine available options for disposing of contaminated sediments.

The concentrations of eight heavy metals (lead, cadmium, zinc, copper, nickel, arsenic, chromium, and cyanide) were measured in sediment taken from a detention pond serving a mixed residential and commercial area in Madison, Wisconsin. The concentrations were evaluated to determine whether the sediments could be landspread or placed in a conventional land fill, as opposed to requiring disposal in a special hazardous waste landfill at a significantly greater cost.

None of the eight metals tested from the commercial/residential area would require disposal at a hazardous waste landfill under Wisconsin state law. Only one metal, lead, showed any potential of posing a hazardous waste problem. Upon further testing, using the EP Toxicity Test and the TCLP Test, concentrations of this metal were found to pose no hazard.

The options for disposal would appear to be either landspreading or burying in a conventional landfill. In order to evaluate the suitability of sediments for landspreading,

metals criteria set forth in NR 204 Wis. Adm. Code (Municipal Sludge Management) were used. Concentrations of lead in detention pond sediments are well below the limit of 250 mg/kg (milligrams per kilogram) specified in NR 204. Concentrations of cadmium throughout the pond are also well below the 10 mg/kg threshold specified in NR 204.

Landspreading may be a disposal option, but several cautions are needed. First, variability in cadmium and zinc concentrations, even within ponds draining residential and commercial land uses, may make some sediments marginally acceptable or unacceptable for landspreading. Secondly, some organic contaminants in sediments may restrict landspreading. Placement of dredge spoils in a land fill or adjacent to the wet detention pond in areas not used for the growing of food crops may be the best options.

In addition to heavy metals, organic pollutants were also measured in detention pond sediments. These included: the pesticides diazinon, chlordane and DDT; PCBs; PAHs; and phthalate esters.

Pollutant Bioaccumulation

There is also public concern over the potential for bioaccumulation of toxicants in wet detention ponds and their subsequent export back into the surrounding ecosystem. This is an area needing further investigation.

In-Lake Nonpoint Source Control Needs

Nutrient inactivation is recommended to reduce internal cycling of phosphorus from bottom sediments, thereby improving water quality conditions in the lakes. Alum treatments are needed to achieve the pollutant reduction goals of this plan for Bass Bay and Wind Lake. These treatments are eligible for cost-sharing under NR 120. However, nutrient inactivation practices should be conducted only after significant reductions in rural and urban nonpoint sources are achieved, as determined by the DNR Southeast District Nonpoint Source Coordinator.

Nutrient inactivation may be expected to reduce phosphorus loading from internal cycling by 80 percent. The relative contribution of phosphorus loading from internal cycling is estimated to be 10 percent and 47 percent of the total annual loading to Bass Bay and Wind Lake respectively. Therefore, the net reduction to the total phosphorus load attributable to alum treatments is expected to be about 8 percent and 38 percent respectively. A water quality sampling program to assess the effects of in-lake management measures is described in Chapter Eight.

CHAPTER FIVE
Implementation Program

Introduction

This chapter identifies the means for implementing the rural and urban management actions for nonpoint source pollution control described in the previous chapter. It is divided into two major sections. The first section describes the counties' nonpoint source implementation strategy for rural areas. The second section contains the elements of the nonpoint source pollution control implementation strategy for the urban and developing areas of the watershed, including the roles and responsibilities of the cities of Muskego and New Berlin, the town of Norway, and the lake management districts in the watershed. The success of this priority watershed project depends on the aggressive implementation of these nonpoint source pollution control strategies.

More specifically this chapter identifies:

- agencies and units of government responsible for carrying out the identified tasks;
- best management practices (BMPs) necessary to control pollutants on the critical sites identified in Chapter Four;
- cost-share budgets;
- cost containment policies;
- cost-share agreement reimbursement procedures including administrative procedures for carrying out the project;
- staffing needs including total hours per year and number of staff to be hired;
- schedules for implementing the project;
- involvement of other programs;
- project budgets including the expenses for cost-sharing, staffing for technical assistance, administration, and the information and education program.

Rural Implementation Program

Project Participants, Roles and Responsibilities

Landowners and Land Operators

Owners and operators of public and private lands are important participants in the priority watershed program. They will adopt BMPs which reduce nonpoint sources of water pollution and protect and enhance fish, wildlife and other resources. Land owners and land operators in the Muskego-Wind Lakes Watershed eligible for cost-share assistance through the priority watershed program include individuals, counties, lake management districts, other governmental units described in NR 120.02(19), corporations, and the State of Wisconsin.

Waukesha County and Racine County

The counties are the primary units of government responsible for implementing this plan in rural areas. Other units of government such as authorized lake management organizations may continue to assume a key role in areas such as shoreline and streambank stabilization, wetland restoration and shoreline buffers.

The Waukesha County and Racine County Land Conservation Committees (LCCs) will act for the County Boards and will be responsible contractually and financially to the State of Wisconsin for management of the project in areas with rural land uses. The County LCCs will coordinate the activities of all other agencies involved with the rural portion of the project.

The specific responsibilities for the counties are defined in the Wisconsin Administrative Rules, s. NR 120.04, and are summarized below:

1. Identify in writing a person to represent the county during implementation of the project.

2. Contact all owners or operators of lands identified as significant nonpoint sources (Category I) within one year of signing the nonpoint source grant agreement. The county's strategy for contacting landowners is included in this chapter.

3. Develop farm conservation plans consistent with the needs of the project.

4. Enter into nonpoint source cost-share agreements with eligible landowners and enforce the terms and conditions of cost-share agreements as defined in s. NR 120.13, Wisconsin Administrative Code.

5. For lands the county owns or operates, enter into cost-share agreements with DNR to correct identified nonpoint sources and fulfill their obligations as a cost-share recipient.

6. Design best management practices and verify proper practice installation.

7. Reimburse cost share recipients for the eligible costs of installing BMPs at the rates consistent with administrative rules established in this plan.

8. Prepare and submit annual work plans for activities necessary to implement the project. The Waukesha and Racine County LCDs shall submit a workload analysis and grant application to the DATCP (DATCP) as required in s. Ag. 166.50.

9. Prepare and submit to the DNR (DNR) and the DATCP (DATCP) the annual resource management report required under s. NR 120.21(7) to monitor project implementation by tracking changes in the nonpoint source inventory, and quantifying pollutant load reductions which result from installing BMPs.

10. Participate in the annual watershed project review meeting.

11. Conduct the information and education activities identified in this plan for which they are responsible.

DNR

The role of the DNR (DNR) is identified in s. 144.24, Stats. and s. NR 120, Wis. Adm. Code. (NR 120) The Department has been statutorily assigned the overall administrative responsibility for the Wisconsin Nonpoint Source Pollution Abatement Program. The Department's role is summarized below.

Project Administration

Project administration includes working with the counties to ensure that work commitments required during the 8-year project implementation phase can be met. The DNR will participate in the annual work planning process with the county.

The Department reviews cost-share agreements signed by the county and the participating landowners for installing BMPs. The DNR provides guidance when questions arise concerning the conformance of proposed activities with the statutes, administrative rules, and the watershed plan.

Financial Support

Financial support for implementation of the priority watershed project is provided to each county in two ways: a local assistance grant agreement, and a nonpoint source grant agreement. These agreements are described later in this chapter. The DNR may also enter

into cost-share agreements directly with local or state units of government for the control of pollution sources on land the governments own or operate.

Project Evaluation

The DNR has responsibility for priority watershed project monitoring and evaluation activities. These efforts determine if changes in water quality occur as best management practices and other pollution controls are installed or implemented. The water quality evaluation and monitoring strategy for the Muskego-Wind Lakes Watershed is included in Chapter Eight. The DNR documents the results of monitoring and evaluation activities in interim and final priority watershed project reports.

Technical Assistance

The DNR provides technical assistance to the county on the design and application of best management practices. This assistance is primarily for urban areas.

Other Responsibilities

These include:

1. The Southeast District Nonpoint Source Coordinator to arrange for DNR staff to assist county staff with site reviews to determine the impacts of nonpoint sources on lakes, streams, wetlands and/or groundwater quality.

2. Assisting county staff to integrate wildlife and fish management concerns into selection and design of BMPs.

DATCP

The role of the DATCP (DATCP) is identified in s. 144.25, stats., ch. 92 stats., and NR 120. In summary, the DATCP will:

1. Manage a training program for the staff involved with project implementation.

2. Cooperate with the University of Wisconsin - Extension to act as a clearinghouse for information related to agricultural best management practices, sustainable agriculture, and nutrient and pest management.

3. Assist the counties to carry out the information and education activities or tasks described in this plan.

4. Assist county staff to identify watershed participants subject to federal or state conservation compliance programs.

5. Assist counties, if requested, to develop a manure storage ordinance.

6. Assist county staff to complete annual workload analyses and grant applications for work conducted under the priority watershed project.

7. Participate in the annual project review meetings.

8. If the need arises, assist in developing technical standards for agricultural BMPs, and provide technical assistance to county staff concerning application of these practices.

9. Assist county staff to evaluate the site specific practicality of implementing rural best management practices.

10. Provide technical and engineering assistance to counties for agricultural BMPs.

Other Agencies

The Muskego-Wind Lakes Watershed Project will receive assistance from the agencies listed below.

Soil Conservation Service (SCS)

This agency works through the local LCC to provide technical assistance for planning and installing conservation practices. The local SCS personnel will work with the county staff to provide assistance with technical work when requested by the Land Conservation Committee and if SCS staff time is available. Personnel from the Area SCS office will provide staff training and engineering assistance for best management practices. Efforts will be made by DATCP to assist SCS to coordinate the Muskego-Wind Lakes Priority Watershed Project with the conservation compliance and other conservation provisions of the 1985 and subsequent Federal Farm Bills.

University of Wisconsin Extension (UWEX)

County and Area Extension agents will provide support in developing and conducting a public information and education program aimed at increasing voluntary participation in the project. This will include assistance to carry out the information and education activities identified in this plan.

Agricultural Stabilization and Conservation Service (ASCS)

ASCS administers most of the federal programs aimed at the stabilization of the prices paid producers for agricultural products and administers federal funds for rural soil and water and other resource conservation activities. The Agricultural Conservation Program (ACP) which is administered by ASCS will, to the extent possible, be coordinated with the Muskego-Wind Lakes Priority Watershed Project. In addition other conservation incentives such as the Conservation Reserve Program (CRP) will be used whenever possible to control critical nonpoint sources of pollution.

Agricultural Best Management Practices (BMPs)

BMPs Eligible For Cost-Sharing And Their Rates

Best management practices are those practices identified in NR 120 which are determined in this watershed plan to be the most effective controls of the nonpoint sources of pollution. The practices eligible for cost-sharing and the cost share rates for each BMP are listed in the tables below.

Design and installation of all BMPs must meet the conditions listed in NR 120. Generally these practices use specific standard specifications included in the SCS Field Office Technical Guide. In some cases additional specifications may apply. The applicable specifications for each BMP can be found in NR 120.14. The Department may approve alternative best management practices and design criteria based on the provisions of NR 120.15 where necessary to meet the water resource objectives. Regarding alternative agricultural BMPs, this approval is developed in consultation with DATCP.

If the installation of BMPs destroys significant wildlife habitat, NR 120 requires that habitat will be recreated to replace the habitat lost. The DNR District Private Lands Wildlife Specialist or a designee will assist the LCD in determining the significance of wildlife habitat and the methods used to recreate the habitat. Every effort shall be made during the planning, design, and installation of BMPs to prevent or minimize the loss of existing wildlife habitat.

Following is a brief description of some of the most commonly used BMPs included in table 5-1 and 5-2. A more detailed description of these practices can be found in NR 120.14.

- **Contour Farming** - The farming of sloped land so that all operations from seed bed preparation to harvest are done across the slope, not up and down the slope.

- **Contour Strip Cropping** - Growing crops in a systematic arrangement of strips or bands, across the slope, in alternating strips of crops, such as grasses or legumes and row crops. All operations from seed bed preparation to harvest are done across the slope, not up and down the slope.

- **Reduced Tillage** - A tillage system which leaves substantial amounts of crop residue on the soil surface after crops are planted. The minimum amount of ground cover after planting shall be at least 30 percent. It is utilized in two situations: one for continuous (at least 3 consecutive years) row crops, the other for short crop rotations (no more than 2 years corn and small grains and hay) or for the establishment of forages and small grains.

Table 5-1. State Cost-Share Rates for Best Management Practices[1]

Best Management Practice	State Cost Share Rate
Field Diversions and Terraces	70%
Grassed Waterways	70%
Critical Area Stabilization	70%[2]
Shoreline Buffers	70%[2]
Wetland Restoration	70%[2]
Shoreline and Streambank Stabilization	70%[2]
Grade Stabilization Structures	70%
Agricultural Sediment Basins	70%
Barnyard Runoff Management	70%
Animal Lot Relocation	70%
Manure Storage Facilities	70%[3]
Livestock Exclusion from Woodlots	50%
Nutrient and Pesticide Management	50%[4]

[1] Table 5-2 shows BMPs cost shared at a flat rate.
[2] Easements may be entered into with landowners identified in the watershed plan in conjunction with these BMPs. See Chapter Four for an explanation of where easements may apply.
[3] Maximum cost share amount is $20,000 for manure storage.
[4] Spill control basins have a state cost share rate of 70%.

Source: DNR

Table 5-2. Practices Using a Flat Rate for State Cost-Share Funding

Best Management Practice	Flat Rate
Contour Farming	$ 6.00/ac[1]
Contour Strip Cropping	$ 12.00/ac[1]
Reduced Tillage	$ 45.00/ac[2]
Reduced Tillage	$ 15.00/ac[3]

[1] Wildlife habitat restoration components of this practice are cost-shared at 70%.
[2] $45 per acre over 3 years for reduced tillage on continuous row croplands.
[3] $15 per acre for one year only for reduced tillage on crop rotations involving hay.

Source: DNR

- **Critical Area Stabilization** - The planting of suitable vegetation on critically eroding sites or other treatments necessary to stabilize a specific eroding condition.

- **Grassed Waterways** - A natural or constructed channel shaped, graded and established with suitable cover as needed to prevent erosion by runoff.

- **Grade Stabilization Structure** - A structure used to reduce the grade in a channel to protect the channel from erosion or to prevent the formation or advance of gullies.

- **Livestock Exclusion** - The confinement of livestock away from woodlots, streambanks, lake shorelines, and wetlands by fencing or other means.

- **Shoreline and Streambank Stabilization** - The stabilization and protection of stream and lake banks against erosion and the protection of fish habitat and water quality from livestock access. This practice includes streambank riprap, streambank shaping and seeding, stream crossings, livestock watering, fencing and fish habitat structures. This practice may also include plans and practices to manage or exclude livestock.

- **Terraces** - A system of ridges and channels with suitable spacing and constructed on the contour with a suitable grade to prevent erosion in the channel.

- **Field Diversions** - The purpose of this practice is primarily to divert water from areas it is in excess or is doing damage to where it can be transported safely.

- **Barnyard Runoff Management** - Structural measures such as filter systems and/or diversions and rain gutters to redirect surface runoff around the barnyard, and collect, convey or temporarily store runoff from the barnyard.

- **Manure Storage Facility** - A structure for the storage of manure for a period of time that is needed to reduce the impact of manure as a nonpoint source of pollution. Livestock operations where this practice applies are those where manure is winter spread on fields that have a high potential for runoff to lakes, streams and groundwater. The facility is needed to store and properly spread manure according to a management plan.

- **Agricultural Sediment Basins** - A structure designed to reduce the transport of sediment eroded from critical agricultural fields and other pollutants to surface waters and wetlands.

- **Shoreline Buffers** - A permanently vegetated area immediately adjacent to lakes, streams, channels and wetlands designed and constructed to manage critical nonpoint sources or to filter pollutants from nonpoint sources.

- **Animal Lot Relocation** - Relocation of an animal lot from a critical site such as a floodway to a suitable site to minimize the amount of pollutants from the lot to surface or groundwater.

- **Wetland Restoration** - The construction of berms or destruction of the function of tile lines or drainage ditches to create conditions suitable for wetland vegetation.

- **Nutrient Management** - The management and crediting of nutrients for the application of manure and commercial fertilizers, and crediting for nutrients from legumes. Management includes the rate, method and timing of the application of all sources of nutrients to minimize the amount of nutrients entering surface or groundwater. This practice includes manure nutrient testing, routine soil testing, and residual nitrogen soil testing.

- **Pesticide Management and Spill Control Basin** - The management of the handling, disposal and application of pesticides including the rate, method and timing of application to minimize the amount of pesticides entering surface and groundwater. This practice includes integrated pest management scouting and planning and spill control basins with liquid-tight floors for pesticide handling areas.

- **Easements** - Although not considered to be Best Management Practices, easements are useful legal tools and their applicability is defined in Chapter Four, Management Actions. Details for such arrangements will be worked out between DNR and the counties during implementation phase.

Alternative BMPs

Under some circumstances, practices may be recommended that are not included in the list above. Administrative Rule NR 120.15 provides for alternative practices where necessary to meet water resources objectives identified in the watershed plan. The DNR shall identify in the nonpoint source grant agreement the design criteria and standards and specifications where appropriate, cost share conditions, and cost share rates for each alternative best management practice.

BMPs Not Cost-Shared

BMPs not cost-shared, but which shall be included on the cost share agreement if necessary to control the nonpoint sources, are listed in NR 120.17. Several examples are included below.

- That portion of a practice to be funded through other programs.

- Practices previously installed and necessary to support cost-shared practices.

- Changes in crop rotations and other activities normally and routinely used in growing crops or which have installation costs that can be passed on to potential consumers.

- Changes in location of unconfined manure stacks involving no capital cost.

- Manure spreading management.

- Other activities the DNR and the Counties determine are necessary to achieve the objectives of the watershed project.

Activities and Sources of Pollution Not Eligible for Cost Share Assistance

Priority watershed cost-share funds cannot be used to control sources of pollution and land management activities specifically listed in NR 120.10(2). The following is a partial list of ineligible activities most often inquired about for cost-sharing in rural areas.

- Operation and maintenance of cost-shared BMPs,

- Actions which have drainage of land or clearing of land as the primary objective,

- Practices already installed,with the exception of repairs to the practices which were rendered ineffective due to circumstances beyond the control of the landowner,

- Activities covered under the Wisconsin Pollution Discharge Elimination System (WPDES) Program or covered in other ways by Chapter 147 of Wis. Stats. (including livestock operations with more than 1,000 animal units, or livestock operations issued a notice of discharge under ch. NR 243),

- Septic system controls or maintenance,

- Dredging activities,

- Silvicultural activities,

- Bulk storage of fertilizers and pesticides,

- Activities and structures intended primarily for flood control,

- Practices required to control sources which were adequately controlled at the time the cost-share agreement was signed, with the exception of those that occur beyond the control of the landowner,

- Other practices or activities determined by DNR not to meet the objectives of the program.

Cost-Share Budget

Costs of Installing BMPs in Rural Areas

The quantity and type of management practices that are required to meet the water quality objectives for rural elements of this project are listed in tables 5-3 through 5-5. The capital cost of installing the BMPs are listed in this table assuming landowner participation rates of 100 percent and 75 percent. Also included are the units of measurement and cost per unit for the various BMPs.

The capital cost of installing the Best Management Practices is approximately $618,444 assuming 100 percent participation.

State funds necessary to cost-share this level of control would be about $503,531.

The local share provided by landowners and other cost-share recipients would be about $114,913.

At a 75 percent level of participation, the state funds needed to cover capital installation would be about $377,648.

Easement Costs

Chapter Four identifies where nonpoint source program funds can be used to purchase easements. The estimated cost of purchasing easements on eligible lands in both Waukesha and Racine County portions of the watershed is shown in table 5-5. At 100 percent participation, the estimated purchase price of easements on eligible lands would be $30,000. At 75 percent participation, the cost would be $22,500. The easement costs would be paid for entirely by the state. However, it is very difficult to determine landowner response to easements as a management tool. Easements are a relatively new tool in the Nonpoint Source Pollution Abatement Program. Therefore, it is very difficult to estimate costs.

Cost Containment

Cost Containment Procedures

Chapter NR 120 requires that cost containment procedures be identified in this plan. Cost-share payments will be based on actual installation costs. If actual installation costs exceed the amount of cost-sharing determined by the bidding, range of costs, and average cost methods the amount paid the grantee may be increased with the approval of the county land conservation committee. Appropriate documentation regarding the need for changes will be submitted to DNR.

Table 5-3. Cost-Share Budget Needs for Rural Management Practices in Waukesha County

Best Management Practices	Number	Cost/Unit	Total Cost (1)	100% Participation		75% Participation	
				State Share	Local Share	State Share	Local Share
Cropland NPS Control							
Change in Crop Rotation	133 ac	NA(2)	0	0	0	0	0
Contour Cropping	300 ac	$6.00	1,800	1,800	(3)	1,350	(3)
Reduced Tillage (4)	4,700 ac	$45.00	211,500	211,500	0	158,625	0
Reduced Tillage (5)	500 ac	$15.00	7,500	7,500	0	5,625	0
Critical Area Stabilization	15 ac	$100.00	1,500	1,050	450	788	338
In-Field Buffers	15 ac	$200.00	3,000	2,100	900	1,575	675
Grass Waterways	12 ac	$2,800.00	33,600	23,520	10,080	17,640	7,560
Field Diversions & Terraces	0 ft	$3.00	0	0	0	0	0
Grade Stabilization	0 ea	$5,000.00	0	0	0	0	0
Agricultural Sediment Basin	0 ea	$11,800.00	0	0	0	0	0
Nutrient Mgmt only (8)	800 ac	$12.00	9,600	4,800	4,800	3,600	3,600
Nutrient and Pest Mgmt. (8)	800 ac	$20.00	16,000	8,000	8,000	6,000	6,000
Spill Control Basin	0 ea	$15,000.00	0	0	0	0	0
Shoreline Buffers (6)	100 ac	$150.00	15,000	10,500	4,500	7,875	3,375
Wetland Restoration	1 ea	$3,000.00	3,000	2,100	900	1,575	675
Livestock Exclusion from Woodlots	0 rods	$14.00	0	0	(3)	0	(3)
Animal Waste Management							
Barnyard Runoff Control							
Complete System	4 ea	$25,000.00	100,000	70,000	30,000	52,500	22,500
Clean Water Diversion	2 ea	$8,000.00	16,000	11,200	4,800	8,400	3,600
Manure Storage Facility (7)	3 ea	$30,000.00	90,000	63,000	27,000	47,250	20,250
Streambank Erosion Control							
Shape and Seeding	5,870 ft	$3.00	17,610	12,327	5,283	9,245	3,962
Streambank Fencing	0 rods	$10.00	0	0	(3)	0	(3)
Rural Rip-Rap	1,000 ft	$12.00	12,000	8,400	3,600	6,300	2,700
Livestock/Machinery							
Crossing/Watering Ramp	0 ea	$1,150.00	0	0	0	0	0
Remote Watering Systems	0 ea	$500.00	0	0	0	0	0
Subtotals:			$538,110	$437,797	$100,313	$328,348	$75,235
Easements	20 ac	$1,000.00	20,000	20,000	0	15,000	0
TOTALS			$558,110	$457,797	$100,313	$343,348	$75,235

(1) Total cost to control identified critical pollution sources
(2) NA means that cost share funds are not available for this practice
(3) Local share consists of labor and any additional equipment costs, also see flat rates
(4) Reduced tillage on continuous row crops, greater than 3 years
(5) Reduced tillage, including no-till, on rotations including hay
(6) Shoreline Buffer practice needs will be determined during implementation
(7) Maximum cost-share is $20,000 of which a maximum of $5000 can be for waste transfer
(8) Calculated on 2 yr of cost share from BMPs listed in NR 120 (stage 2)

Sources: DNR, DATCP and the Waukesha County LCD

Table 5-4. Cost Share Budget Needs for Rural Management Practices in Racine County

Best Management Practices	Number	Cost/Unit	Total Cost (1)	100% Participation		75% Participation	
				State Share	Local Share	State Share	Local Share
Cropland NPS Control							
Change in Crop Rotation	22 ac	NA(2)	0	0	0	0	0
Contour Cropping	49 ac	$6.00	294	294	(3)	221	(3)
Reduced Tillage (4)	765 ac	$45.00	34,425	34,425	0	25,819	0
Reduced Tillage (5)	81 ac	$15.00	1,215	1,215	0	911	0
Critical Area Stabilization	4 ac	$100.00	400	280	120	210	90
In-Field Buffers	5 ac	$200.00	1,000	700	300	525	225
Grass Waterways	8 ac	$2,800.00	22,400	15,680	6,720	11,760	5,040
Field Diversions & Terraces	0 ft	$3.00	0	0	0	0	0
Grade Stabilization	2 ea	$5,000.00	10,000	7,000	3,000	5,250	2,250
Agricultural Sediment Basin	0 ea	$11,800.00	0	0	0	0	0
Nutrient Mgmt only (8)	200 ac	$12.00	2,400	1,200	1,200	900	900
Nutrient and Pest Mgmt. (8)	200 ac	$20.00	4,000	2,000	2,000	1,500	1,500
Spill Control Basin	0 ea	$15,000.00	0	0	0	0	0
Shoreline Buffers (6)	0 ac	$150.00	0	0	0	0	0
Wetland Restoration	1 ea	$3,000.00	3,000	2,100	900	1,575	675
Livestock Exclusion from Woodlots	0 rods	$14.00	0	0	(3)	0	(3)
Animal Waste Management							
Barnyard Runoff Control							
Complete System	0 ea	$25,000.00	0	0	0	0	0
Clean Water Diversion	0 ea	$8,000.00	0	0	0	0	0
Manure Storage Facility (7)	0 ea	$30,000.00	0	0	0	0	0
Streambank Erosion Control							
Shape and Seeding	200 ft	$3.00	600	420	180	315	135
Streambank Fencing	0 rods	$10.00	0	0	(3)	0	(3)
Rural Rip-Rap	50 ft	$12.00	600	420	180	315	135
Livestock/Machinery							
Crossing/Watering Ramp	0 ea	$1,150.00	0	0	0	0	0
Remote Watering Systems	0 ea	$500.00	0	0	0	0	0
Subtotals:			$80,334	$65,734	$14,600	$49,301	$10,950
Easements	10 ac	$1,000.00	10,000	10,000	0	7,500	0
TOTALS			$90,334	$75,734	$14,600	$56,801	$10,950

(1) Total cost to control identified critical pollution sources
(2) NA means that cost share funds are not available for this practice
(3) Local share consists of labor and any additional equipment costs, also see flat rates
(4) Reduced tillage on continuous row crops, greater than 3 years
(5) Reduced tillage, including no-till, on rotations including hay
(6) Shoreline Buffer practice needs will be determined during implementation
(7) Maximum cost-share is $20,000 of which a maximum of $5000 can be for waste transfer
(8) Calculated on 2 yr of cost share from BMPs listed in NR 120 (stage 2)

Source: DNR, DATCP and the Racine County LCD

Table 5-5. Cost Share Budget Needs for Rural Management Practices in the Total Muskego Wind Lake Watershed

Best Management Practices	Number	Cost/Unit	Total Cost (1)	100% Participation		75% Participation	
				State Share	Local Share	State Share	Local Share
Upland NPS Control							
Change in Crop Rotation	155 ac	NA(2)	0	0	0	0	0
Contour Cropping	349 ac	$6.00	2,094	2,094	(3)	1,571	(3)
Reduced Tillage (4)	5465 ac	$45.00	245,925	245,925	0	184,444	0
Reduced Tillage (5)	581 ac	$15.00	8,715	8,715	0	6,536	0
Critical Area Stabilization	19 ac	$100.00	1,900	1,330	570	998	428
In-Field Buffers	20 ac	$200.00	4,000	2,800	1,200	2,100	900
Grass Waterways	20 ac	$2,800.00	56,000	39,200	16,800	29,400	12,600
Grade Stabilization	2 ea	$5,000.00	10,000	7,000	3,000	5,250	2,250
Nutrient Mgmt only (8)	1000 ac	$12.00	12,000	6,000	6,000	4,500	4,500
Nutrient and Pest Mgmt. (8)	1000 ac	$20.00	20,000	10,000	10,000	7,500	7,500
Shoreline Buffers (6)	100 ac	$150.00	15,000	10,500	4,500	7,875	3,375
Wetland Restoration	2 ea	$3,000.00	6,000	4,200	1,800	3,150	1,350
Animal Waste Management							
Barnyard Runoff Control							
Complete System	4 ea	$25,000.00	100,000	70,000	30,000	52,500	22,500
Clean Water Diversion	2 ea	$8,000.00	16,000	11,200	4,800	8,400	3,600
Manure Storage Facility (7)	3 ea	$30,000.00	90,000	63,000	27,000	47,250	20,250
Streambank Erosion Control							
Shape and Seeding	6070 ft	$3.00	18,210	12,747	5,463	9,560	4,097
Rip-Rap	1050 ft	$12.00	12,600	8,820	3,780	6,615	2,835
Subtotals:			$618,444	$503,531	$114,913	$377,648	$86,185
Easements	30 ac	$1,000.00	30,000	30,000	0	22,500	0
TOTALS			$648,444	$533,531	$114,913	$400,148	$86,185

(1) Total cost to control identified critical pollution sources
(2) NA means that cost share funds are not available for this practice
(3) Local share consists of labor and any additional equipment costs, also see flat rates
(4) Reduced tillage on continuous row crops, greater than 3 years
(5) Reduced tillage, including no-till, on rotations including hay
(6) Shoreline Buffer practice needs will be determined during implementation
(7) Maximum cost-share is $20,000 of which a maximum of $5000 can be for waste transfer
(8) Calculated on 2 yr of cost share from BMPs listed in NR 120 (stage 2)

Source: DNR, DATCP and the Waukesha and Racine County LCDs

Bids, Average Costs, and Flat Rates

The cost containment procedures to be used by the counties are described in their bidding procedure, average cost list, and flat rate list. These have been approved by the DATCP and DNR. Copies of the bidding procedure and the lists can be obtained from the county LCDs. If these procedures or lists change, they are subject to approval by DATCP and DNR.

Competitive bids will be required for all structural BMPs with estimated total costs exceeding $5,000, as determined by the project technician. The bidding process requires the cost share recipient to receive a minimum of two bids from qualified contractors in lump sum bid. The cost share recipient must provide copies of the bids to the county prior to initiating construction. In cases where the cost share recipient provides proof that bids were requested from a minimum of three qualified contractors, but only one bid was received, the county will determine if the bid constitutes an appropriate cost for the project. If no bids are received or if the lone bid is not deemed appropriate, the county will limit cost sharing based on average costs.

Average costs will be used for all structural BMPs with an estimated cost equal to or less than $5,000, unless the cost share recipient decides to bid the installation of the BMP. The average cost list will be reviewed periodically and appropriate changes made. If changes are made, the list will be forwarded to the DNR and the DATCP for final approval before the changes are used for calculating cost share agreements and payments.

BMPs using flat rates are shown in table 5-2. The rates shown are the state's share of the practice installation costs. Nonstructural BMPs are subject to average costs to verify cost containment.

Cost-Share Agreement Reimbursement Procedures

Nonpoint Source Grant Agreement and Administration

General Information

The Nonpoint Source Grant Agreement is the means for transmitting funds from the DNR (through the Nonpoint Source Program) to Waukesha and Racine Counties for use in funding the state's share of cost share agreements. Cost share agreements are the means to transmit funds from the county to the landowners.

A portion of the Nonpoint Source Grant is forwarded to the counties to enable them to set up a project account. Funds from this account are used by the counties to pay landowners after practices are installed through the project. As this account is drawn down, the county will request reimbursements from DNR to replenish the account. The counties will submit reimbursement requests on a quarterly basis or sooner if needed. This reimbursement schedule will insure that the account balance is maintained at an adequate level. The

Nonpoint Source (NPS) Grant Agreement will be amended annually to provide funding needed for cost sharing for the year. The funds obligated under cost share agreements must never exceed the total funds in the NPS Grant Agreement.

Fiscal Management Procedures, Reporting Requirements

Counties are required by NR 120 to maintain a financial management system that accurately tracks the disbursement of all funds used for the Muskego-Wind Lakes Watershed Project. The records of all watershed transactions must be retained for 3 years after the date of final project settlement. A more detailed description of the fiscal management procedures can be found in NR 120.25 and NR 120.26.

Cost Share Agreement and Administration

Purpose and Responsibilities

Consistent with s. 144.25, Stats. and NR 120, Wis. Adm. Code, cost-share funding is available to landowners for a percent of the costs of installing BMPs to meet the project objectives. Landowners have three years after formal approval of the watershed plan to enter into cost-share agreements (CSA). Practices included on cost-share agreements must be installed within the schedule agreed to on the cost-share agreement. Unless otherwise approved, the schedule of installing BMPs will be within 5 years of signing of the cost-share agreement. Practices must be maintained for a minimum of ten years from the date of installing the final practice included in the cost-share agreement.

The cost-share agreement is a legal contract between the landowner and the county. The agreement includes the name and other information about the landowner and grant recipient, conditions of the agreement, the practices involved and their location, the quantities and units of measurement involved, the estimated total cost, the cost share rate and amount, the timetable for installation, and number of years the practice must be maintained. The agreements also identify and provide information on practices not cost-shared through the nonpoint program but that are essential to controlling pollution sources (such as crop rotations). These items will be completely listed in the conservation plan and the conservation plan is tied to the CSA via addendum 2 of the CSA. Once it is signed by both parties, they are legally bound to carry out the provisions in it.

If land ownership changes, the cost-share agreement remains with the property and the new owner is legally bound to carry out the provisions. NR 120.13(9) and (10) has more information on changes of land ownership and the recording of cost-share agreements.

Local, state, or federal permits may be needed prior to installation of some BMPs. The areas most likely to need permits are zoned wetlands and the shoreline areas of lakes and streams. These permits are needed whether the activity is a part of the watershed project or not. Landowners should consult with the County Planning and Zoning Department or the

Land Conservation Department offices to determine if any permits are required. The landowner is responsible for acquiring the needed permits prior to installation of practices.

The cost-share agreement binds the county to provide the technical assistance needed for the planning, design, and verification of the practices on the agreement, and to provide the cost-share portion of the practice costs.

Counties are responsible for enforcing compliance of cost-share agreements to which they are a party. Where DNR serves as a party to an agreement with a unit of government, the DNR will take responsibility for monitoring compliance. The responsible party will insure that BMPs installed through the program are maintained in accordance with the operation and maintenance plan for the practice for the appropriate length of time. The counties will check for compliance with practice maintenance provisions once every three years after the last practice has been installed. The county LCDs must check maintenance after the Nonpoint Source Agreement has lapsed. State funding for this activity may become available during the implementation or monitoring phase of this project.

Landowner Contact Strategy

The following procedure will be used to make landowner contacts.

- During the first three months of the implementation period, all landowners or operators with eligible nonpoint sources will receive from the county a mailing explaining the project and how they can become involved.

- After the initial landowner mailings, county staff will make personal contacts with all landowners that have been identified as having critical nonpoint sources of pollution (Management Category I). These contacts will occur within the cost-share sign-up period.

- The county will continue to make contacts with eligible (Management Category I and II) landowners and operators until desired participation levels have been reached.

- The county will contact all eligible landowners (as explained above) not signing cost-share agreements by personal letter six months prior to the end of the cost-share sign-up period.

Procedure for Developing a Cost Share Agreement

Eligibility for cost-sharing is verified following a site visit, using the criteria described in Chapter Four. The development of farm conservation plans will be the primary method used to develop cost-share agreements. These plans are specific to a particular landowner and address all needs for conservation of soil and other resources on the farm. The farm plan takes into consideration the sustainability of the agricultural resources and the management decisions of the owner or operator.

The cost share agreement specifies the items listed in the farm conservation plan that are necessary to reduce the nonpoint sources of pollution. The conservation plan and cost share agreement will document existing management which must be maintained to protect water quality.

The following procedure will be used by the county for developing and administering agreements. Below are the steps from the initial landowner contact through the completion of BMP maintenance.

- Landowner and county staff meet to discus the watershed project, NPS control practice needs, and coordination with conservation compliance provisions if applicable.
- Landowner agrees to participate with the watershed project.
- A farm conservation plan is prepared by the county.
- The landowner agrees with the plan, a Cost Share Agreement is prepared and both documents are signed by the landowner and the county. A copy of the Cost Share Agreement (CSA) is sent to the DNR Southeast District Nonpoint Source Coordinator and a copy given to the landowner. The CSA will be recorded by the county with the County Register of Deeds.
- Practices are designed by the county, or their designee, and a copy of the design is provided to the landowner.
- Landowner obtains the necessary bids or other information required in the cost containment policy.
- Amendments to the CSA are made if necessary.
- The county staff oversee practice installation.
- The county verifies the installation.
- The landowner submits paid bills and proof of payment (canceled checks or receipts marked paid) to the county.
- Land Conservation Committees or their designated representative and if required, county boards, approve cost-share payments to landowners.
- Checks are issued by the county to the respective landowners and project ledgers are updated.
- The county records the check amount, number, and date.
- DNR reimburses the county for expended cost-share funds.

Identifying Wildlife and Fishery Needs

The county staffs will consult with DNR's Southeast District wildlife management and fisheries management staff to optimize the wildlife and fish management benefits of nonpoint source control BMPs. Specifically, the county staff will contact DNR staff if, in the county's opinion, fence rows, rock piles, wetlands, or other wildlife habitat components will be adversely affected by installation of agricultural BMPs.

The DNR staff will assist county staff (at their request) by:

- Identifying streambank protection practices that benefit fish and wildlife.
- Identifying wildlife habitat components that could be incorporated into vegetative filter strips along streams or in upland areas.
- Reviewing placement of agricultural sediment basins to assure that negative impacts on stream fish and aquatic life do not occur and recommending wildlife habitat components.
- Providing technical assistance when the installation of BMPs will require the removal of obstructions or other wildlife habitat by proposing measures to minimize impact on wildlife habitat.
- Assisting to resolve questions concerning effects of agricultural nonpoint source BMPs on wetlands.

Submittal to the DNR

Cost-share agreements do not need prior approval from DNR, except in the following instances:

- where cost-share funds are to be used for practices on land owned or controlled by the county.
- for agreements or amendments where the cost-share amount for all practices for a landowner exceeds $50,000 in state funds.
- for grade stabilization structures and agricultural sediment basins with embankment heights between 15 and 25 feet and impoundment capacities of 15 to 50 acre feet.
- for streambanks to be controlled using riprap or other materials with banks over 6 feet high, according to NR 120.14. If applications are similar to each other in content, they will be reviewed to determine if future applications need be subject to this approval procedure.

- for animal lot relocation.
- for roofs over barnyards or manure storage facilities.

Local Assistance Grant Agreement Administration

General Information

The Local Assistance Grant Agreement (LAGA) is a grant from the DNR to the counties for staff and support costs. Consistent with NR 120, the counties will use funds from the LAGA for staff to implement the project and conduct information and education activities. Other items such as travel, training, and certain office supplies are also supported by the LAGA. Further clarification of eligible costs supported by this grant is given in NR 120.14(4) and (6).

Grant Agreement Application Procedures

An annual review of the Local Assistance Grant Agreement is conducted through the development of an annual workload analysis by the county. This workload analysis estimates the work needed to be accomplished each year. The workload analysis is provided to DATCP and DNR for review and clarification. Along with the workload analysis, a grant application form is sent. Funds needed to complete the agreed upon annual workload are amended to the local assistance grant agreement.

Fiscal Management Procedures, Reporting Requirements

Counties are required by NR 120 to maintain a financial management system that accurately tracks the disbursement of all funds used for the Muskego-Wind Lakes Watershed Project. The records of all watershed transactions must be retained for 3 years after the date of final project settlement. A more detailed description of the fiscal management procedures can be found in NR 120.25 and NR 120.26. NR 120 requires quarterly reports to DATCP from the county in accordance with s. Ag. 166.40(4) accounting for staff time, expenditures, and accomplishments regarding activities funded through the watershed project. Reimbursement requests may be included with the submittal of the quarterly project reports.

Budget and Staffing Needs

This section estimates the funding and staffing required to provide technical assistance for the rural portion of this project.

Staff Needs

Table 5-6 lists the total estimated staff needed to implement the project. Figures are provided for both the 50 percent and 75 percent levels of participation. A total of about 24,800 staff hours are required to implement this plan at a 75 percent landowner participation rate. This includes an estimated 3,280 staff hours to carry out the information and education program.

Currently, 2.4 staff positions are being funded on the Muskego-Wind Lakes watershed project. The counties and state agencies will determine the need for additional staff based on the annual workload analysis. The counties will assess the number and type of staff required for the final five years of the project based on the actual landowner participation following the three year cost-share sign-up period.

Staffing Costs

The estimated cost for staff at the 75 percent participation rate (see table 5-11) is approximately $671,370. These costs will be paid by the state through Local Assistance Grant Agreements.

Schedules

Grant Disbursement and Project Management Schedule

Implementation may begin upon approval of this watershed plan by the Waukesha and Racine County Boards, DATCP, and the DNR. The priority watershed project implementation period lasts eight years. It includes an initial three year period for contacting eligible landowners and signing cost-share agreements. Practices on any cost-share agreement must be installed within a five years of signing the CSA.

Under extenuating circumstances, the initial period for entering into cost-share agreements can be extended by DNR for a limited period of time if it will result in a significant increase in nonpoint source control. Limited extensions for the installation period for practices on individual cost-share agreements must also be approved by DNR and DATCP.

The disbursement of grants (Local Assistance and Nonpoint Source) to Waukesha and Racine Counties will be based on an annual workload analysis and grant application process. The estimated grant disbursement schedule based on 75 percent participation by eligible landowners can be found in table 5-7.

Table 5-6. Estimated County LCD Staff Needs for Project Implementation

Activity	Project Years	Waukesha County		Racine County	
		75% Participation (staff hours)	50% Participation (staff hours)	75% Participation (staff hours)	50% Participation (staff hours)
Project and Financial Management	1-8	5,000	5,000	700	700
Information and Education	1-8	3,100	3,100	180	180
Pre-Contact Office Inventory; Landowner Contracts and Progress Tracking	1-3	3,750	2,500	700	467
Conservation Planning and Cost-Share Agreement Development	1-3	4,050	2,700	650	433
Plan Revisions and Monitoring	1-8	435	240	100	67
Practice Design and Installation	1-8	2,380	1,587	407	270
Easements	1-8	100	100	50	50
Training	1-8	2,400	2,400	800	800
Total LCD Workload:		21,215	17,627	3,587	2,967
Estimated Staff Required for Years 1-3:		2.1 per year (4,283 hours per year)	1.7 per year (3,391 hours per year)	0.3 per year (705 hours per year)	0.3 per year (554 hours per year)
Estimated Staff Required for Years 4-8:		1.1 per year (2,227 hours per year)	1.0 per year (1,950 hours per year)	0.2 per year (388 hours per year)	0.2 per year (338 hours per year)

Source: DNR, DATCP and the Waukesha and Racine County LCDs

Table 5-7. Grant Disbursement Schedule at 75 percent Landowner Participation

Item	County	Project Year (Dollars)			
		1	2	3	4 – 8
Cost-Share Funds: Practices	Waukesha Racine	98,504 14,790	98,504 14,790	131,339 19,720	0 0
Cost-Share Funds: Easements	Waukesha Racine	4,500 2,250	4,500 2,250	6,000 3,000	0 0
Local Assistance Staff Support	Waukesha Racine	102,396 16,744	102,396 16,744	102,396 16,744	267,835 46,115
Information/Education: Direct Costs	Waukesha Racine	1,500 500	1,500 500	1,500 500	7,500 2,500
Stage I Nutrient Management	Waukesha Racine	800 200	800 200	0 0	0 0
Direct: (travel, supplies, etc.)	Waukesha Racine	16,000 5,328	16,000 5,328	16,000 5,328	52,000 17,316
TOTALS		263,512	263,512	302,527	393,266

Salary + Indirect = $47,840/yr $23.00/hr

Source: DNR, DATCP and the Waukesha and Racine County LCDs

Total Project Cost

The total state funding required to meet the rural nonpoint source pollution control needs at a 75 percent level of landowner participation is presented tables 5-11 and 5-12. These figures includes the capital cost of practices, staff support, and easement costs presented above. The estimated cost to the state would be $1.2 million.

This cost estimate is based on projections developed by the agency planners and Land Conservation staff. Historically, the actual expenditures for projects are less than the estimated costs. The factors affecting expenditures for this watershed project include: the time it takes to plan the project; the length of time the project is under implementation; the amount of cost sharing that is actually expended; the number of staff working on the project; the amount of support costs; and the time local assistance is necessary.

Involvement of Other Programs

Coordination With State and Federal Conservation Compliance Programs

The Muskego-Wind Lakes Watershed Project will be coordinated with the conservation compliance features of the Wisconsin Farmland Preservation Program (FPP) administered by DATCP, and the Federal Food Security Act (FSA) administered by the Soil Conservation Service. DATCP will assist the LCD and the SCS offices to identify landowners within the watershed that are subject to the compliance provisions of FPP and FSA. Conservation Farm Plans were to be completed for all landowners in FSA programs by December 31, 1989.

Implementation and amendment of these conservation plans will be necessary during the implementation phase of the watershed project. Watershed project staff will inform FPP and SCS staff of changes in plans resulting from management decisions and the installation of needed BMPs for nonpoint source pollution abatement. This approach to farm planning will help meet the various goals and objectives for all the programs in which the landowner participates.

Some eroding croplands in Management Categories I and II may need greater controls those required by state or federal soil erosion control programs. Where this occurs, technical and financial assistance from the Nonpoint Source Program can be used to support practice design and installation on these critical lands. This assistance applies only where the additional control needed to meet soil erosion goals can be achieved using low cost practices.

Urban Program for Implementation

Sequence of Urban Management Program Activities

The following discussion provides guidance on how the urban nonpoint source control program will be implemented. It considers first, the elements of a "core" program for controlling urban nonpoint sources. Second, the implementation of more complex "segmented" elements of the urban management program--detention, infiltration, street sweeping--are presented.

Core Elements of the Urban Management Program

The core elements of the urban nonpoint source control program applicable to local units of government include basic measures that can be implemented without further study. Adopting a community specific core program is the first step in the implementation process. Communities will need to commit to implementing the core program within the first three

years of the project. This is a requirement to receive technical and financial assistance through the priority watershed project. This requirement applies only to the receipt of funds used directly by the municipality as a grantee, such as where the municipality installs, owns, and operates a BMP. It does not apply to those instances where the municipality acts as a grantor, passing cost share funds through to private landowners. This means that individual landowners could receive cost-share funds from the DNR for the installation of BMPs prior to a municipality's agreement to conduct core elements of the urban program.

The basic elements of the core program are:

- Effectively enforce the construction erosion control provisions in local ordinances based on the state model ordinance and state building codes.

- Develop and implement a community specific program of urban "housekeeping" practices which reduce urban nonpoint source pollution. This may include a combination of efforts such as an information and education program, adoption of ordinances regulating pet wastes or changes in the timing and scheduling of leaf collection.

- Implement an information and education program containing the elements and achieving the goals of the strategy presented in Chapter Six.

- Following the completion and adoption of the DNR Storm Water Management Guidebook (in preparation), *it is recommended* that a storm water management ordinance be incorporated into the core program.

Segmented Elements of the Urban Management Program

The segmented elements of the urban nonpoint source program include those requiring site specific investigations prior to installation (example: detention ponds needing an engineering feasibility study).

Importantly, the higher costs of implementing this portion of the urban management program will require communities to budget expenditures over the course of several years. Best management practices implemented under this portion of the program likely will include detention ponds, infiltration devices, stream bank erosion controls and other structural means for reducing urban nonpoint source pollution. These elements also include changes in schedules and equipment used for street sweeping.

The detailed studies will include engineering feasibility and other site specific investigations for existing and new development. The results will determine the best means for reducing urban nonpoint sources in a specific community by more site specific application of the plan's recommendations.

Communities can implement the segmented elements of the urban management strategy any time following development and initial implementation of the core program. However, cost

sharing will be limited to segmented program activities completed within the eight year implementation period.

The basic elements of the segmented program are:

- Conduct detailed engineering studies to determine the best means to implement nonpoint source control measures for existing urban areas. These studies should set forth the allocation of local costs between municipalities where more than one municipality contributes runoff to a BMP. The allocation should result in an equitable distribution of costs based on the contribution of each municipality to the total pollutant loading or storm water runoff volume being controlled. This element will also consider accelerated street sweeping as a component of the control strategy for existing urban areas.

- Design and install BMPs for existing urban areas, including detailed engineering studies.

- Develop, as needed, storm water management plans for existing and planned urban development. These plans will identify the type and locations of BMPs.

- Adopt and enforce a storm water management ordinance consistent with the State's model storm water ordinance (in preparation).

Program Participants--Roles and Responsibilities

The specific roles and responsibilities for program participants are summarized below. The primary participants include local units of government (cities, towns, counties, lake management districts), the DNR, other state agencies, lake associations, landowners and land operators. Where applicable, the roles and responsibilities are discussed according to the previously described core and segmented approaches to project implementation. As noted in Chapter One, "Plan Purpose and Legal Status," implementation begins following approval of this priority watershed plan by Waukesha County, Racine County and DNR.

Local Units of Government Core Program Roles and Responsibilities

The following is a schedule for implementing the core elements of the urban nonpoint source control strategy for this priority watershed project. Each participating unit of government should:

1. Identify in writing an authorized representative for the local unit of government within 30 days of the start of implementation.

2. Identify the roles and responsibilities of the cities, towns, counties, lake management districts, developers, contractors, and landowners for controlling construction erosion in all areas of the watershed within 6 months of the start of

implementation. Develop administrative procedures, and determine staff needs to enforce construction erosion control ordinances and building codes in all communities within 12 months of the start of implementation. Amend, as needed, current construction erosion control ordinances to address problems listed in Chapter Three within 12 months of the start of implementation.

3. Develop and implement a community specific program of urban "housekeeping" practices which reduce urban nonpoint source pollution. This may include but is not limited to a combination of information and education efforts, adoption of ordinances regulating pet wastes, and changes to the timing and scheduling of leaf and yard waste collection. The activities of the community specific program and a schedule for implementation will be negotiated by the local unit of government and the DNR within 12 months of the start of implementation.

4. Implement the information and education strategy as described in the Chapter Six.

5. Prepare and submit annual work plans for staff and activities necessary to implement the project.

6. Prepare and submit to the DNR an annual report for the purpose of monitoring project implementation.

7. Participate in the annual watershed project review meeting.

Local Units of Government Segmented Program Roles and Responsibilities

The following is a schedule for the segmented elements of the urban nonpoint source control strategy for this priority watershed project. Each community wishing to participate should:

1. Identify within 12 months of the start of implementation, the high priority sub-basins the community wishes to address in existing and planned urban areas through the priority watershed project. This list can be amended throughout the 8 year project period.

2. Conduct engineering feasibility and site location studies for urban nonpoint source control practices in high priority areas for existing urban development. A commitment to implementing the recommendations will be required as a condition for financial assistance for these studies.

3. Adopt, administer, and enforce a comprehensive storm water management ordinance for planned urban development within 12 months of the approval date of the state's model storm water management ordinance (in preparation).

4. Enter into cost-share agreements for eligible best management practices.

a. For practices installed and maintained by private individuals, the cost-share agreement is between the landowner and the local unit of government. The local units of government will be required to:

- Design or contract for the design of best management practices and verify proper BMP installation.
- Request reimbursement from the DNR for practices installed by private landowners. Eligible BMPs must be listed in the cost-share agreement signed prior to construction .
- Reimburse landowners for the eligible amount of cost sharing.
- Monitor landowner compliance with provisions of the cost-share agreement.

b. For practices installed and maintained by a local unit of government, the cost-share agreement is between the unit of government and the DNR. Where more than one municipality contributes runoff to a control practice, the DNR will enter into cost share agreements consistent with an equitable allocation based on municipal contributions to the pollutant loads and storm water volumes being controlled.

c. Practice maintenance is the responsibility of the grant recipient. In some cases, urban storm water pollutants are generated wholly or in part by a community different than that in which the storm water control practice is located.

In these instances, there are several alternatives to properly distribute the financial burden of practice maintenance. Two examples are presented below. In each example, the upstream community generates all or part of the urban pollutant load to the best management practice, which is located in the downstream community.

- The downstream community can act as grant recipient, which includes ultimate accountability for practice maintenance. The responsibility could then be delegated, all or in part, to the upstream community through an inter-governmental agreement.

- The upstream community can act as the grant recipient, which includes ultimate accountability for practice maintenance. The downstream community could provide, through an inter-governmental agreement, all or part of the local share of the practice installation cost.

5. Conduct detailed alternative financing/implementation studies which determine the means to pay for administering an urban nonpoint source control program in each municipality. These studies will be conducted on a parallel schedule with the other initial high priority elements undertaken under the segmented program.

6. Submit information to DNR needed for project evaluation.

DNR

The DNR has been statutorily assigned the overall administrative responsibility for the Wisconsin Nonpoint Source Water Pollution Abatement Program. This includes providing financial support for local staff and installation of management practices, assisting local units of government to integrate wildlife and fish management concerns into selection and design of BMPs, and conducting project evaluation activities. The DNR's role in assisting local units of government in carrying out the core and segmented activities are as follows:

DNR Core Program Roles and Responsibilities

1. Assist local governments to enforce construction erosion control provisions developed by the DNR - DILHR Memorandum of Understanding.

2. Review community specific programs of urban "housekeeping" practices for nonpoint source control.

3. Review and approve annual work plans for staff and activities necessary to implement the project.

4. Review and approve annual project implementation reports.

5. Participate in the annual watershed project review meeting.

6. Track changes in urban pollutant loads using information supplied by local units of government.

DNR Segmented Program Roles and Responsibilities

1. Develop a model storm water management ordinance for planned urban development. Assist communities with adoption and enforcement of storm water management ordinances.

2. Assist communities to develop priorities, schedules and requirements for segmented activities.

3. Participate in the selection of BMPs and approve practice designs. Review nonpoint source cost-share agreements signed by local units of government with eligible land owners.

4. Enter into nonpoint source cost-share agreements with the eligible lands the local unit of government owns or operates.

5. Review designs of urban nonpoint source BMPs for which cost-share agreements are signed.

6. Reimburse cost share recipients for the eligible costs of installing BMPs at the rates consistent with administrative rules and those established in this plan.

Landowners and Land Operators

In many situations, private landowners will install BMPs on their property. Landowners are important participants in the urban implementation activities. Eligible landowners will participate in the project by signing cost-share agreements with local units of government. Maintenance responsibility can be assigned using agreements similar to those discussed above.

County Land Conservation Staff (LCD)

To enhance intergovernmental coordination within the Muskego-Wind Lakes Watershed project, LCD staff will assist the DNR in implementing the core program by:

1. Designating a primary LCD staff contact to coordinate services with each municipality.

2. Assigning an LCD staff contact to assist DNR, as requested by the municipality, to review municipal capital improvement project lists for potential for nonpoint pollution control measures.

3. Providing assistance to municipalities in preparing the information and educational elements for submittal in Local Assistance Grant Agreement applications. Information and education will be consistent with the recommendations identified in the public awareness marketing strategy developed for the Waukesha County priority watersheds.

4. Reviewing draft construction erosion control ordinances for municipalities within the watershed to ensure effectiveness and consistency with other established ordinances in other municipalities.

5. Providing assistance in construction erosion control training programs for local government staff, consultants, developers, contractors and builders

USDA-Soil Conservation Service (SCS)

This agency works through the local land conservation committee to provide technical assistance for planning and installing conservation practices. The district conservationist or

other SCS personnel may work with the landowners or units of government to provide assistance with technical work.

University of Wisconsin Extension (UWEX)

Area extension agents will provide support in developing and conducting a public information and education program aimed at increasing voluntary participation in the project. These activities are described in Chapter Six in the information and education strategy.

Best Management Practices (BMPs)

BMPs Eligible For Cost-Sharing And Their Rates

Best management practices are those practices identified in NR 120 determined in this watershed plan to be the most effective in reducing nonpoint sources of pollution. Design and installation of the best management practices previously described under the rural implementation strategy must meet the conditions listed NR 120. Generally, these practices use standard specifications in the U.S. Soil Conservation Service Field Office Technical Guide.

Specifications for the structural urban practices were described in Chapter Four, "Nonpoint Source Control Needs." Application of these practices will be guided by technical assistance provided by the DNR. Eligible practices and state cost share rates are listed below and in table 5-8.

Table 5-8. State Cost Share Rates for Urban Best Management Practices

Best Management Practice	State Cost-share Rate
Critical Area Stabilization[1]	70%
Grade Stabilization Structures	70%
Streambank and Shoreline Stabilization	70%
Shoreline Buffers[1]	70%
Wetland Restoration[1]	70%
Wet Detention Ponds[2]	70%
Infiltration Trenches and Basins[2]	70%
Grass Swales and Waterways[2]	70%
Street Sweeping[3]	50%
In-lake Nutrient Stabilization[3]	50%

[1] Easements may be used in conjunction with these practices.
[2] Applies only to structures for established urban areas--those in existence prior to the date the DNR approves this watershed plan.
[3] This is an alternative best management practice not listed in NR 120 of the Wisconsin Administrative Code.

Activities and Sources of Pollution Not Eligible for Cost Share Assistance

Priority watershed cost-share funds cannot be used to control sources of pollution and land management activities specifically excluded in NR 120.10 and NR 120.17. The following is a partial list of ineligible activities for cost-sharing in urban areas:

1. Operation and maintenance of cost-shared best management practices (BMPs).

2. Construction erosion control practices.

3. Structural BMPs for new urban development--those whose construction activity commenced after DNR approval of this plan.

4. BMPs installed prior to signing cost-share agreement.

5 Activities covered under the Wisconsin Pollution Discharge Elimination System (WPDES) Program, including industrial site run-off.

6. On-site septic system controls or maintenance.

7. Dredging activities.

8. Activities and structures intended primarily for flood control.

9. Minimum levels of street sweeping and leaf collection (see Appendix C).

Nonpoint Source Grant Agreement and Administration

The Nonpoint Source Grant Agreement is the means for transmitting funds from the DNR to local units of government to provide cost sharing for installation of BMPs. In some cases the municipality will act only as a grantee. In this case, the municipality will use funds obtained under the grant agreement directly for practices it will install, own, and operate.

In other cases, the municipality will play an additional role as a grantor. In these situations, the municipality will pass the cost share funds it has received from the DNR to private landowners who have responsibility for installing, operating, and maintaining the management practices. When this occurs, the municipality will enter into a separate cost-sharing agreement with the private landowner receiving the state funds.

The procedures for administering Nonpoint Source Grant Agreements and Cost Share Agreements parallel those contained in this plan's rural implementation strategy and in NR 120, Wis. Adm. Code.

Cost Share Agreement and Administration

Purpose and Responsibilities

Consistent with s. 144.25, Stats. and NR 120, cost-share funding is available to landowners and local units of government for a percent of the costs of installing BMPs to meet the project objectives. Cost-share agreements must be initiated within three years after formal approval of the watershed plan and are filed as part of the property deed. They may be amended throughout the 8 year project period.

Practices included in cost-share agreements must be installed within the schedule agreed to in the cost-share agreement. Unless otherwise approved, the schedule of installing BMPs will be within 5 years of signing of the cost-share agreement. Practices must be maintained for a minimum of ten years from the date of installing the final practice included in the cost-share agreement.

Local, state, or federal permits may be needed prior to installation of some BMPs. The areas most likely to need permits are wetlands and shoreline areas of lakes and streams. These permits are needed whether the activity is a part of the watershed project or not. The cost share recipient is responsible for acquiring the needed permits prior to installation of practices.

Local units of government are responsible for enforcing compliance of cost-share agreements to which they are a party. Where DNR serves as a party to an agreement with a unit of government, the DNR will take responsibility for monitoring compliance. The responsible party will insure that BMPs installed through the program are maintained in accordance with the operation and maintenance plan for the practice for the appropriate length of time.

Identifying Wildlife and Fishery Needs

The local units of government will consult with DNR's Southeast District wildlife management and fisheries management staff to optimize the wildlife and fish management benefits of nonpoint source control BMPs. Specifically, the DNR will be contacted if:

- Stream bank protection practices or critical area stabilization practices are being considered.
- Wetlands or other wildlife habitat components will be adversely affected by installation of BMPs.

The DNR staff will assist by:

- Identifying stream bank protection practices that benefit fish and wildlife.
- Identifying wildlife habitat components that could be incorporated into vegetative filter strips along streams or in upland areas.

- Providing technical assistance when the installation of BMPs will require the removal of obstructions or other wildlife habitat by proposing measures to minimize impact on wildlife habitat.

- Assisting to resolve questions concerning effects of nonpoint source BMPs on wetlands.

Cost Containment Procedures

Cost containment procedures for local units of government are governed by state statute.

Local Assistance Grant Agreement Administration

General Information

The Local Assistance Grant Agreement (LAGA) is a grant from the DNR to local units of government for supporting their staffing and support costs of carrying out the urban implementation strategy. Each local unit of government will have its own agreement. Consistent with NR 120 these grant funds will be used for design, installation and inspection of best management practices on land owned by the local unit of government; additional staff to implement the project; development and enforcement of erosion control and storm water management ordinances; and information and education activities. Other items such as travel, training, and supplies are also supported by the LAGA. Further clarification of eligible costs supported by this grant is given in NR 120.14(4) and (6).

Activities described in the core and segmented elements of the urban implementation strategy are eligible for financial assistance. The type of eligible activities and the amount of state funds available are described below and in table 5-9.

Grant Agreement Application Procedures

An annual review of the Local Assistance Grant Agreement is conducted through development of an annual work plan by the local unit of government. This plan estimates the work needed to be accomplished each year. The work plan is provided to the DNR for review and clarification. Along with the work plan, a grant application form is sent. Funds needed to complete the agreed upon annual workload are amended to the local assistance grant agreement.

Table 5-9. Urban Implementation Activities Eligible for State Funding

Activity	Cost Share Rate
Construction site erosion control ordinance amendments	100%
Development of storm water management plans	100%
Engineering studies for existing urban areas and planned urban areas[1]	100%
Design and engineering for structural best management practices[1]	100%
Staff for enforcing construction site erosion control and storm water management ordinances[2]	50%
Additional staff needed for supplementary street sweeping[2]	100%
Development of alternative financing and administration strategies	100%

[1] Funding not available for components dealing exclusively with drainage and flood control.
[2] Funding is limited. Level of staffing based on a work plan submitted by local units of government and approved by the DNR.

Source: DNR

Fiscal Management Procedures, Reporting Requirements

Local units of government are required by NR 120 to maintain a financial management system that accurately tracks the disbursement of all funds used for the Muskego-Wind Lakes Watershed Project. The records of all watershed transactions must be retained for 3 years after the date of final project settlement. A more detailed description of the fiscal management procedures can be found in NR 120.25 and NR 120.26. NR 120 requires quarterly reports from each local unit of government accounting for staff time, expenditures, and accomplishments regarding activities funded through the watershed project. Reimbursement requests may be included with the submittal of the quarterly project reports.

Urban Budget and Staffing Needs

The urban program budget and staffing requirements include several key components. These are presented below, along with estimates of budget and staffing needs.

Engineering Feasibility Studies

Engineering feasibility studies will be needed for approximately 4,036 acres of existing and planned urban development in order to determine the type, size and location of BMPs. Most

of these studies will probably be carried out by the private sector, with most of the cost borne by the DNR. The estimated costs of preparing these feasibility studies for each community are presented in table 5-10. In making these estimates, a planning cost of $100/acre was estimated.

Detailed Engineering Designs

Once BMP feasibility studies are completed, detailed designs must be prepared. These designs will probably be prepared partly by the private sector and partly by staffs of local governments. The cost of site designs for structural practices located in existing and planned urban areas is included in cost estimates presented in the following sections and in table 5-10. It has been assumed that designs are prepared by the private sector and funded 100 percent by the DNR.

Alternative Funding Sources

A substantial portion of the estimated costs of implementing this plan's urban management recommendations is for the construction of storm water management practices in existing urban areas to control pollutants discharged by a wide variety of activities. Where urban structural practices are used to control storm water pollutants, state cost sharing is limited and the burden falls heavily on local funding sources.

Some municipalities have endorsed a concept of distributing the cost of pollution control by developing a mechanism to charge those responsible for discharging the pollutants. In addition, municipalities have indicated a desire to pursue additional state or federal funding sources.

One way to distribute costs is to assess the sources of each storm water pollutant. This requires the identification of sources responsible for pollutant discharges. This plan endorses investigations that identify specific sources of urban storm water pollutants. If storm water pollutant dischargers cannot take actions to reduce runoff pollutants, they can be charged a portion of the local share of the cost of the BMP that would be installed by a downstream landowner or local unit of government.

State or federal programs could be developed to help distribute the cost of pollution control. This could be done by collecting storm water pollution discharge fees and redistributing these funds to local units of government. Such fees could be associated with the production or use of polluting materials. Current examples include the state's tire tax which is collected on every tire sale to finance long-term tire disposal. Alternatively, costs could by distributed by assessing local charges within the urban area based on the amount of polluted runoff discharged. Current examples include utility districts and basin authorities being used throughout the country to finance storm water management practices.

Table 5-10. Estimated Costs of Urban Activities (8 years) of the Muskego-Wind Lakes Watershed Project

Item	Community	State Cost Share Rate	State Cost	Local Cost	Total Cost
Storm Water Planning $100/acre[1]	New Berlin	100%	130,200	0	130,200
	Muskego	100%	233,600	0	233,600
	Norway	100%	39,800	0	39,800
Construction Site Erosion Control $250/acre	New Berlin	0%	0	83,500	83,500
	Muskego	0%	0	191,250	191,250
	Norway	0%	0	14,555	14,555
Ordinance Enforcement Staff (5 staff years)[2]	New Berlin	50%	30,000	30,000	60,000
	Muskego	50%	60,000	60,000	120,000
	Norway	50%	10,000	10,000	20,000
BMPs on Existing Urban Areas[3]	New Berlin	70%	1,056,578	452,818	1,509,396
	Muskego	70%	2,016,910	864,390	2,881,300
	Norway	70%	384,193	164,653	548,846
BMPs on Newly Developing Urban Areas[4]	New Berlin	0%	0	203,000	203,000
	Muskego	0%	0	441,000	441,000
	Norway	0%	0	84,000	84,000
TOTAL		-	3,961,281	2,599,166	6,560,447

[1] Planning for existing and developing areas. Funding not available for components dealing exclusively with drainage and flood control.
[2] Funding is available to support total costs minus collected fees up to one-half the total. Within five years, it is expected that the local government will charge fees adequate to support the total cost of the enforcement program.
[3] BMPs for existing areas at $320,000 state share per acre of wet pond and $25 per curb mile for street sweeping. Pond costs include land purchases at 50% cost share rate and design work at 100% state share.
[4] BMPs for new development are $70,000 per acre of pond and do not include land purchases.

Source: DNR

This plan endorses continuing investigation into source control alternatives as well as development of alternatives for distributing local pollution control costs. Some of these alternatives, such as the collection and redistribution of fees at the state level and increased state funding for urban nonpoint source control practices should be investigated through further Legislative Council Study on Nonpoint Source Pollution Control. Other alternatives, such as the creation of local utility districts should be investigated by respective municipalities.

Cost of Installing Structural Practices in Existing Urban Areas

Factors that affect the cost of constructing BMPs to control pollutants in existing urban runoff include:

- labor rates,
- land costs,
- cost of relocating residences,
- excavation costs, and
- cost of rerouting storm sewers.

These costs vary from case to case. Land and labor costs will vary by community. In rare cases, residences and businesses in densely urbanized areas may be removed or relocated to allow space for BMPs. Excavation costs for underground structures, such as detention below parking lots or buildings, are several times greater than for surface structures. Finally, rerouting storm sewers to retrofitted BMPs can be costly.

Table 5-10 presents cost estimates for installing wet detention ponds and street sweeping in existing urban areas. It assumes detention and street sweeping will be implemented for all areas identified as critical (see Chapter Four). The total cost for installing these ponds in urbanized areas ranges from $400,000 to $800,000 per surface acre of pond, including land purchases. The lower cost assumes that open land is available for purchase, but that extensive rerouting of the storm sewer system is required. The upper end of the cost range assumes that land is completely developed and condemnation of existing businesses or homes would be required. Both figures assume that design, excavation, inlet/outlet construction, and landscaping costs about $70,000 per surface acre of pond.

In all cases, the state share is limited to 50 percent of the land purchase, 70 percent of the cost for pond construction and 100 percent of design costs. This equals an estimated average $320,000 of state assistance per surface acre of detention pond (based, in part, on true costs of similar projects in the metropolitan Milwaukee area). The remaining costs, including annual operation and maintenance are not eligible for cost sharing under the existing rules governing the state nonpoint source program.

Some local governments have indicated they are unable to fund some components of these costs. Therefore, this plan recognizes that additional funding through other initiatives must be provided to meet project goals.

Cost of Installing Structural Practices in Planned Urban Areas

Table 5-10 presents an estimate of the cost for wet detention in planned urban areas. In developing areas, storm water planning can assure that adequate land is set aside, and storm water practices are incorporated into the conveyance systems.

Table 5-10 shows that an estimated $728,000 will be required to design and install wet detention in planned urban areas. Any land costs would be additional. The entire cost would be borne locally, as Nonpoint Source Program funds are not used for practices in areas of new development.

Operation and Maintenance for Structural Practices

Operation and maintenance costs for detention are about 5 percent of the capital construction cost per year. This cost must be borne locally.

Total Costs of BMPs in Existing Urban Areas

Table 5-10 shows the estimated cost of recommended levels of wet detention, including street sweeping for 50 percent of the critical urban land uses as part of a program that phases in detention. The costs presented in the table assume a total cost of $25 per curb mile for street sweeping. The total annual cost of treating existing urban areas with BMPs recommended in this plan is about $617,000. The annual state share would be approximately $432,000 and the annual local share about $185,000.

After five years, local units of government would need to maintain the supplementary levels of street sweeping at their own expense as the Nonpoint Source Program funding is limited to a five-year period. As wet detention or other practices providing equivalent control are installed, the supplementary sweeping could be discontinued.

Cost of Preparing Construction Site Erosion Control Plans

This cost has not been estimated. It will be borne primarily by the private sector to meet requirements of local ordinances, state building codes and storm water permits.

Cost of Installing Construction Erosion Control Practices

It is assumed that construction site practices will average $250 per acre. Using this unit cost, it will require an estimated $289,000 to install construction site erosion control practices in the watershed. All of this cost will be borne locally by the private sector to meet requirements of local ordinances, state building codes, and state storm water permits.

Cost of Amending and Enforcing Construction Erosion Control Ordinances

Funding is available on a limited basis to support total costs minus collected fees up to one-half the total. Within five years, it is expected that the local government will charge fees adequate to support the total cost of the enforcement program. Five additional staff-years

(shared by Muskego, New Berlin and Norway shown in table 5-10) are needed to administer and enforce water quality related ordinances.

Cost of Enforcing Storm Water Management Ordinances

Likewise, the cost of additional staff for enforcing storm water management ordinances will be funded 50 percent by the DNR for the first five years. Permit fees should be structured so that continued funding is planned.

Cost of Alum Treatments

Planning of alum treatments must take into account both the cost of the treatment and the time and equipment needed for application. The cost for labor and supplies vary, depending mainly on alum application rates. A commonly cited figure is two worker days (one barge-day) per 2.5 acres treated at an aluminum hydroxide dosage of 10 ppm. The total costs of alum treatments prescribed by this plan and the Wind Lake Management Plan are $45,000 and $55,000 for Bass Bay and Wind Lake respectively. The state will cost share these treatments at a rate of 50 percent. Alum treatments require no additional maintenance costs.

Table 5-11. Summary of Total Estimated Project Costs (over eight years in 1993 dollars)

Item	State Share	Landowner Share	Waukesha County	Racine County	New Berlin	Muskego	Norway	TOTAL
Rural Costs								
Cost Share Funds: Practices	377,648	86,185	0	0	0	0	0	463,833
Cost Share Funds: Easements	22,500	0	0	0	0	0	0	22,500
Local Assistance Staff Support	671,370	0	0	0	0	0	0	671,370
Information and Education Direct	16,000	0	0	0	0	0	0	16,000
Stage I Nutrient Management	2,000	0	0	0	0	0	0	2,000
Other Direct (travel, supplies, etc.)	133,300	0	0	0	0	0	0	133,300
Subtotal	1,222,818	86,185	0	0	0	0	0	1,309,003
Urban Costs								
Cost Share Funds: Practices on Existing Urban Areas[1]	3,457,681	0	0	0	452,818	864,390	164,653	4,939,542
Cost Share Funds: Practices on New Development	0	728,000	0	0	0	0	0	728,000
Construction Site Erosion Control Practices	0	289,305	0	0	0	0	0	289,305
Local Assistance: Staff Support and Storm Water Planning[1]	503,600	0	0	0	30,000	60,000	10,000	603,600
Information and Education Direct	65,250	0	0	0	0	0	0	65,250
Cost Share Funds: Alum Treatments	50,000	0	0	0	0	22,500	27,500	100,000
Subtotal	4,076,531	1,017,305	0	0	482,818	946,890	202,153	6,725,697
TOTAL	5,299,349	1,103,490	0	0	482,818	946,890	202,153	8,034,700

[1] NOTE: A portion of the cost of practices on existing urban areas and storm water planning may be paid by private landowners instead of local governments.

Table 5-12. Summary of Estimated State Share Distributions (over 8 years in 1993 dollars)

Item	TOTAL	Waukesha County	Racine County	New Berlin	Muskego	Norway
Rural						
Cost Share Funds: Practices	377,648	328,348	49,300	0	0	0
Cost Share Funds: Easements	22,500	15,000	7,500	0	0	0
Local Assistance Staff Support	671,370	575,023	96,347	0	0	0
Information and Education Direct	16,000	12,000	4,000	0	0	0
Stage I Nutrient Management	2,000	1,600	400	0	0	0
Other Direct (travel, supplies, etc.)	133,300	100,000	33,300	0	0	0
Subtotal	1,222,818	1,031,971	190,847	0	0	0
Urban						
Cost Share Funds: Practices on Existing Urban Areas	3,457,681	0	0	1,056,578	2,016,910	384,193
Local Assistance: Staff Support and Storm Water Planning	503,600	0	0	160,200	293,600	49,800
Information and Education Direct	65,250	0	0	19,750	37,750	7,750
Cost Share Funds: Alum Treatments	50,000	0	0	0	22,500	27,500
Subtotal	4,076,531	0	0	1,236,528	2,370,760	469,243
TOTAL	5,299,349	1,031,971	190,847	1,236,528	2,370,760	469,243

CHAPTER SIX
Information and Education Strategy

This chapter describes an information and education strategy designed to support implementation of the water quality recommendations made in this plan. The strategy identifies goals, targets audiences, recommends activities to reach these audiences, and estimates funding needs. More specific descriptions of activities, timing and responsible parties are included in Appendix D.

Background

Each watershed has distinctive characteristics that must be considered when developing an information and education strategy. Land uses, water quality problems, and population characteristics dictate the type and content of educational programs and informational materials that are needed. The Muskego-Wind Lakes Watershed has characteristics that distinguish it from its neighbors and yet it also has similarities. Therefore, the strategy recommended for this watershed relies on some programs shared with neighboring watersheds and on some geared to this watershed's particular needs.

Watershed Characteristics

Urbanization Pressure

Today, the Muskego-Wind Lakes Watershed is mostly undeveloped with 80 percent of the land remaining in rural land uses. However, the watershed lies just south of the rapidly growing corridor from Milwaukee to Waukesha. Improvements to Interstate 43 combined with the availability of sanitary sewer service and the proximity of the large New Berlin industrial park make this watershed a prime area for development. As noted in Chapter Three, the Southeastern Wisconsin Regional Planning Commission has projected a 920 acre or 18 percent increase in urban land use from 1985 to 2010. Most of this growth will occur in the headwaters draining to Linnie Lac and Bass Bay.

Agriculture on the Urban Fringe

While cropland erosion is still the leading source of sediment in this watershed, reducing this source of pollution may be difficult due to the pressures of urbanization. Property taxes are high and much of the land is held by owners waiting for the right moment to sell to a developer. Many owners are speculators or older farmers near retirement. These owners

need high profits to pay their taxes and are usually unwilling to make long-term investments in purchasing new equipment or learning new techniques. They see only short term farming opportunities and are not motivated to protect the soil and water for future generations. They will be reluctant to sign agreements that require long-term maintenance. This scenario suggests that information materials for these owners should emphasize low-cost practices and encourage the sale of easements to protect key water resources even after development occurs.

Other rural landowners in this watershed are specialty crop farmers who need to be located near urban markets. These include tree and landscape plant nurseries in the northern part of the watershed and the sod and vegetable growers in the southeastern part of the watershed. While these owners may be more willing to invest in new practices or equipment, they too are concerned about profits and taxes. However, they have a somewhat longer time horizon and are concerned about minimizing conflicts with neighboring residential landowners. Informational materials for this group should emphasize practices such as nutrient and pesticide management that protect profits for owners and minimize impacts for neighbors.

High Value Lake Resources

Residents of the Muskego-Wind Lakes Watershed recognize the value of their lakes and are highly motivated to take action to improve and protect them. The lakes provide an aesthetic living environment with easy access to boating, fishing and wildlife habitat. Information and education materials should clearly discuss how implementing the recommendations in this plan will improve the lakes and protect residents' investment in a high quality environment.

Neighboring Watershed Projects

The Muskego-Wind Lakes Watershed adjoins two other watersheds included in the Priority Watershed Program — the Upper Fox River and Menomonee River. Because the Muskego-Wind Lakes and Upper Fox River watersheds are both part of the Fox River basin and are both located primarily in Waukesha County, opportunities for combining newsletters and other educational activities should be explored. Coordinating information and education programs with adjacent watersheds will use staff and limited funds more efficiently and avoid sending conflicting messages. Careful coordination is especially important for the public awareness and media campaigns needed to reach urban audiences.

Audience Characteristics

Key audiences have been grouped into five categories for this educational strategy. In order of priority, they reflect the needs to be addressed by watershed staff:

1. Local governments and community leaders.
2. Rural landowners and operators.
3. Business and industry.

4. Urban and lake district residents.
5. Youth.

Important characteristics of each group and information about the best ways to reach them are summarized below.

Local Governments and Community Leaders

There are 7 local governments in this watershed (town of Norway; cities of Muskego, New Berlin and Franklin; Counties of Waukesha, Racine and Milwaukee). In addition, there are 3 lake districts in this watershed (Little Muskego Lake District, Big Muskego/Bass Bay Lake District, and Wind Lake Management District). Characteristics of the local government and community leader audiences which have become apparent during the planning process include:

Reluctance to tax more than neighboring communities and resistance to raising local taxes.

Concern about economic issues such as job attraction and expanding tax base.

Concern about protecting quality of life for residents.

Ability of community groups to act independently and decisively about environmental issues which they support.

The most effective ways to reach these audiences are:

Presentations at local government and community group meetings — with high quality support materials.

Workshops for local government staff.

Direct work with local government staff reviewing capital improvement projects to identify opportunities for implementing watershed plan recommendations.

Pollution prevention audits of current public works and parks activities.

News articles in local newspapers, which also have general readership appeal.

Watershed newsletters specifically targeted to these audiences.

Tours of good practices, including demonstration projects in adjoining watersheds.

Considerable time and effort must be devoted to this audience due to the importance of their actions to control construction erosion, manage stormwater runoff, and stabilize eroding streambanks.

Rural Landowners and Operators

Rural land uses still account for 80 percent of the area in the Muskego-Wind Lakes Watershed and eroding cropland is still the leading source of sediment to the lakes. Therefore, rural landowners and operators are an important audience because their action in controlling erosion is essential to meeting water quality objectives. As discussed previously, the agricultural sector is both in a state of transition and a significant cause of water quality degradation by nonpoint source pollution. Thus, convincing this audience to take action will be a difficult but vital task.

General characteristics of rural audiences in this watershed are listed below:

Significant cash grain and specialty crop farming (landscape plants and trees, sod, vegetables)

Hobby farms and large suburban landowners pursuing some agricultural activity.

Short planning horizon for many farms due to landowner age and pressures of urbanization.

Speculator landowners and farmers near retirement age who anticipate urban development.

Economic pressure of escalating land values and taxes.

The best ways to reach this audience are methods used, to varying degrees, in other watersheds:

One-on-one contacts — with a folder of materials tailored to each.

Demonstration project and good practice mini-tours.

Fact sheets on recommended practices, with an emphasis on nutrient and pest management and profitability.

Presentations for special interest groups such as 4H groups with members who have horses.

Exhibits at county fairs.

Reaching rural audiences in this watershed and securing their participation will require flexibility in the Priority Watersheds Program. Policies and practices that work in other parts of the state will not work well here. To be successful, the content of our messages must change to reflect the pressures of urbanization. Different practices must be promoted and flexibility must be exercised in implementing program policies and rules.

Business and Industry

The primary business and industry audiences who must take action to implement the recommendations of this plan are developers, contractors, and builders. Others who will be affected include owners of property with eroding streambanks or property identified as critical areas for retrofitting stormwater devices (primarily property with large impervious areas of parking lots and roofs).

Characteristics of this audience which should be considered when selecting educational methods and developing materials include:

Concern about economic costs and benefits.

Sense of civic responsibility and pride in their work.

Value placed on quality of life (including clean water for recreation) in decisions about corporate relocation and subdivision marketing.

Seasonal variations in time availability for those in the construction industry.

Effective methods for use with this audience include:

Locally available workshops, videos, fact sheets, handbooks, and technical assistance for developers, contractors and builders.

Watershed speakers for business and industry associations, including builders associations and chambers of commerce.

Articles in trade journals.

Exhibits at appropriate industry shows and meetings (e.g. Home Show).

Recognition of good job sites, possibly using these as examples for tours.

Urban and Lake District Residents

Based on surveys of urban residents conducted in other watersheds, most urban residents (50-60%) are likely to learn about water quality issues through television or newspaper reports, community newsletters or materials received in the mail. Only a few (less than 15%) are very likely to attend meetings or workshops, check out video programs from their libraries or tour demonstration projects. However, most are supportive of water quality improvement programs and are willing to take action at home to protect their environment by recycling oil, cleaning up pet waste, separating household hazardous waste for collection, limiting use of yard chemicals, directing downspouts onto lawns, and composting leaves and grass clippings.

Characteristics of the urban audience which must be kept in mind when selecting educational techniques and developing materials include:

Value placed on quality of life and clean neighborhoods.

Perception that industry is the leading cause of water quality problems.

Preference for funding sources other than property taxes.

Reliance on television, radio and newspapers for current information.

Reluctance to attend meetings or workshops unless highly motivated by personal interests.

Commitment to water quality improvement, especially among lake district residents and lake users.

To reach the broad spectrum of urban residents, the information and education program must revolve around a high quality marketing campaign with supportive educational activities for interested citizens. Therefore, the recommended methods for this audience include:

Public awareness or marketing campaign, coordinated with the Upper Fox River Watershed and based on recommendations from professionals in public relations.

Newspaper coverage including news, feature articles, and targeted advertising.

Television and radio coverage including news, talk shows and targeted advertising.

Watershed newsletters sent to citizens and groups expressing specific interest.

Printed materials and signs distributed at key times and locations.

Articles in lake district newsletters.

Watershed speakers for local groups — with high quality audio-visual and printed materials.

Exhibits at local events, especially water-related ones.

Storm drain stenciling of sewered neighborhoods.

The educational approach for the urban public relies heavily on the mass media and mailings or handouts for targeted groups of residents such as waterfront property owners, pet owners, purchasers of vehicle oil and yard chemicals, and boat owners. Workshops, speakers, demonstrations, and leader training are reserved for interested citizens and organizations.

Youth

Youth are addressed by this plan because they are the ones who must support action to reduce nonpoint source pollution in the future. They also influence today's decision-makers and are a focus for media attention. The current statewide movement to infuse environmental education in school curricula makes the timing for water quality education initiatives especially appropriate.

Characteristics of the youth audience in this watershed include:

Interest and participation in water-based recreation.

Local access to lakes, wetlands and wildlife habitat.

Some access to water resource education and teachers having appropriate training and adequate funding for field trips.

Educational activities recommended for this audience include:

Use or adaptation of existing water resources curricula.

Speakers for schools, teacher in-services and youth leader workshops.

Expansion of the Fox River "Testing the Waters" program to high schools in this watershed.

Youth group projects, including storm drain stenciling, litter cleanups and other volunteer activities.

Major Water Quality Problems

Based on preceding chapters of this plan, the major water quality problems which must be addressed by the information and education strategy are (in order of priority):

1. Sediment and nutrients from eroding cropland and nurseries.

2. Sediment from eroding construction sites.

3. Nutrients, bacteria and decaying organic matter from a few barnyards.

4. Changes in stream flows and increases in water pollution due to runoff from new urban development.

5. Sediment from eroding stream banks.

6. Sediment, nutrients and potentially toxic pollutants in runoff from existing urban areas.

7. Recycling of nutrients from lake bottom sediments.

Information and Education Priorities

To address these water quality problems, the information and education strategy must support implementation of the solutions recommended in the plan. Specifically, the strategy must help build:

1. Public appreciation of water resources, awareness of the watershed program, and support for water quality improvement efforts.

2. Participation in the watershed cost-sharing and other agricultural programs (especially nutrient and pesticide management) for key cropland and nurseries.

3. Better compliance with construction erosion control regulations.

4. Participation in watershed cost-sharing and manure management planning for problem barnyards.

5. Development and implementation of stormwater ordinances and plans.

6. Participation in watershed cost-sharing for eroding streambanks coordinated with stormwater management to control upstream flows.

7. Participation in watershed cost-sharing for retrofitting stormwater controls for critical land uses in existing urban areas coupled with changes in pollution prevention practices such as street sweeping, leaf collection and hazardous waste disposal or recycling.

8. After nonpoint source controls have been implemented, participation in watershed cost-sharing for nutrient in-activation programs for Bass Bay and Wind Lake.

Due to limited staff and funding, information and education programs cannot address all of these needs at once. Therefore, budgets and schedules for information and education programs will be based in large part on this priority list.

Goals, Audiences and Activities

This section is the heart of the information and education strategy for the Muskego-Wind Lakes Watershed. It sets goals, identifies target audiences and recommends specific activities to reach these audiences. More detailed activity descriptions are included in Appendix D.

Public Awareness

Goal

Build a strong foundation of support for implementing the watershed plan by increasing public appreciation of water resources, awareness of watershed program and understanding of water quality improvement efforts.

Audiences and Activities

Local government officials and staff

Publish a newsletter (coordinated or combined with the Upper Fox River Watershed)

Media

Hold editorial meetings with local newspaper editors and reporters

Distribute news releases about watershed activities, especially successful water quality improvement projects and home pollution prevention practices

Youth, youth group leaders and teachers

Promote the use of appropriate water quality curricula (such as the SCS Conserving Soil, International Crane Foundation Wetland Ecology, Paddle to the Sea, Adopt-a-Lake)

Notify schools of speakers available through Waukesha County Land Conservation office

Expand participation in Fox River water quality monitoring programs to schools in this watershed (in coordination with Friends of the Fox River and schools in the Upper Fox River Watershed)

Community groups and lake districts

Publish a newsletter (coordinated or combined with the Upper Fox River Watershed)

Notify community groups of speakers available through the county Land Conservation office

General public

Conduct a marketing campaign in coordination with Upper Fox River Watershed

Prepare resource packets and exhibits for use at local libraries

Cropland Erosion

Goal

Reduce sediment and nutrient load from agricultural lands by providing rural landowners information about watershed cost-sharing and other agricultural programs, especially nutrient and pest management.

Audiences and Activities

Cropland Owners/Renters

Make one-to-one contacts
Use fact sheets on nutrient and pesticide management
Hold minimum tillage meetings co-sponsored with equipment dealers

Nursery Owners

Use the nursery demonstration projects (Trees-on-the-Move and Needles and Leaves) for tours, news articles and other activities

Develop new fact sheets for nurseries on:

Cover crops that do not inhibit tree growth

Nutrient and pesticide management

Streambank stabilization

Muck Farm Operators

Monitor to determine if tile lines are a significant source of nutrients and pesticides and, if appropriate, develop educational materials

Consider the need for a nutrient and pest management demonstration project on muck farms in Racine County

Wetland Owners

Make one-to-one contacts with owners of farmed wetlands identified as a high priority for restoration

Reprint or replace DNR Wetlands/Wonderlands publication (for use in schools)

Construction Site Erosion

Goal

Reduce sediment load from construction sites by raising public awareness and helping local governments and the construction industry develop the values, knowledge and skills needed for better compliance with construction erosion control regulations.

Audiences and Activities

Developers, Contractors, and Builders

Promote UW-Extension erosion control workshops

Distribute "Erosion Control for Home Builders" fact sheets with permits

Develop a 15 minute video on erosion control practices for home sites

Direct mailings about training opportunities, changes in regulations and handbook updates

Provide information about cases where fines/penalties were issued through newsletter articles

Publish a story on successful erosion control projects and benefits of erosion control in a trade journal

Distribute model language for deed restrictions to require erosion control

In addition to erosion control information, distribute information about waste disposal, spill prevention and spill response

Consulting and Municipal Engineers, Architects, Landscape Architects

Promote the 3 day UW-Engineering Professional Development workshop

Develop a one-day workshop for architects, engineers and contractors who will not attend the 3 day workshop

Distribute information on new silt fence specifications and other handbook updates

Local Government Officials

Make presentations at board/council meetings emphasizing "why" and using high quality materials such as the video described above (under the heading for Developers, Contractors and Builders)

Provide information on ordinance changes, procedures, and enforcement options to improve compliance

Provide information on grant fund availability for training and additional enforcement staff

In addition to erosion control information, distribute information about requiring dumpsters and spill kits at construction sites and requiring a plan of operations that covers spill response

Local Government Staff

Conduct a field workshop on installation and inspection (tied to a meeting of the Southeast Wisconsin Building Inspectors Association)

Develop a checklist for use in inspections and enforcement cases

Conduct a "customer service" survey for inspectors to get feedback from builders

Judges and Attorneys

Hold a forum on what is legal for erosion control enforcement (also invite local government staff)

Develop a short video showing the impact of erosion on waterways

New Home Owners

Mail information about erosion control directly to the owner after a building permit is issued

Provide information about lawn establishment to new home owners

Public

Play the urban nonpoint video and new erosion control video on local cable television

Develop a poster and/or refrigerator magnet on who to call about erosion control problems

Conduct "Mud Patrol" training for interested citizens such as lake district members

Once adequate local staff is available, set up an anonymous telephone complaint line in building inspection offices for erosion control (with telephone directory listings)

Make presentations at lake district/association meetings providing information about erosion control practice effectiveness (to set reasonable expectations)

Barnyard Runoff and Other Livestock Waste Sources

Goal

Reduce nutrients and bacteria from animal waste by providing livestock owners with information about watershed cost-sharing and manure management.

Audiences and Activities

Critical barnyard owners (5 eligible barnyards)

Make one-to-one contacts

Use existing fact sheets for packets tailored to each owner

Livestock operations with winterspread manure

Make one-to-one contacts to develop nutrient management plans and, where appropriate, pest management plans

Horse farm and stable owners

Give presentations about pasturing along streambanks and manure management to

4H and other groups with horses or other livestock

Runoff from New Development

Goal

Prevent an increase in polluted runoff from new development by helping local governments, consultants, and the construction industry develop the values, knowledge and skills needed to develop adopt and implement stormwater ordinances and plans.

Audiences and Activities

Consulting and municipal engineers, architects and developers

Promote training opportunities

Make presentations at their association meetings

Write articles for their trade journals

Update the Southeast Area UW-Extension urban contacts mailing list for use in distributing workshop brochures and new educational materials

Local government officials, including plan commissions

Develop a series of 15 minute videos for use at their regular meetings covering stormwater subjects:

Why — what's in runoff and its impact

Benefits — how do local governments and communities benefit

How — incorporating new stormwater controls into site plans and existing stormwater systems

Ordinances — what should be included

Maintenance — providing funds and staff for long-term maintenance of stormwater controls

Streambank and Lakeshore Erosion

Goal

Reduce sediment load from eroding streambanks, lakeshores and roadside ditches by providing waterfront property owners and their consultants information about stabilization techniques and watershed cost-sharing.

Audiences and Activities

Waterfront property owners

For owners of critical sites, make one-to-one contacts

For owners of other waterfront property, distribute materials on alternative stabilization techniques with DNR riprap permit applications and at events such as lake district meetings and lake festivals

Engineers, planners, and landscape architects

Use the demonstration of streambank protection at Trees-on-the-Move for tours, news articles and other educational activities

Conduct and promote a bioengineering workshop

Distribute information about the SCS Engineering Field Manual specifications on streambank bioengineering

Local public works staff

Educate Racine County and town of Norway public works staff on roadside ditch stabilization techniques and the importance of timely stabilization

Owners of lots with roadside ditches

Develop a fact sheet, display for use at community/lake festivals and direct mailings to provide information about the function of roadside ditches, their impact on water quality, and appropriate maintenance

Sportsmen and other community groups

Where possible, involve these groups in lakeshore and streambank stabilization projects

Promote water quality benefits of no-wake boating regulations through presentations and signs or handouts at access sites

Runoff from Existing Urban Areas

Goal

Reduce sediment, nutrient and potentially toxic pollutants in runoff from existing urban areas by providing information about stormwater management and pollution prevention to local governments, commercial property owners and urban residents.

Audiences and Activities

Owners of sites or businesses likely to produce significant amounts of polluted runoff or spills of hazardous materials (such as large parking lots, businesses with outdoor storage, gravel mining, garden centers, gas stations, car dealers, commercial painters)

For sites covered by stormwater permit program, provide information about permit program and support work of DNR Wastewater staff and UW-Extension Pollution Prevention staff

For sites not covered by permit program, make one-to-one contacts and develop or use existing pollution prevention materials

Home owners/renters

Distribute Yard Care and other fact sheets through exhibits and direct mailings

Make a presentation to the Muskego Woman's Club about environmental issues related to yard care and their beautification program

Promote recycling opportunities for leaves and aquatic weeds

Distribute DNR Recycling materials on impacts of leaf burning

Use displays and presentations to provide interested citizens with information about Stormwater ponds

Develop a more popularized fact sheet on stormwater ponds based on the one currently being developed for local government officials

Lakeshore property owners/renters

Develop an awards program sponsored by a local group such as a lake district or Woman's Club for lawn management that protects water quality ("Friend of the Lake" or "Natural Yard")

Develop fact sheets on watering with lake water

Develop promotional materials on using low or no phosphate fertilizer (including signs for garden centers and an article for lake district newsletters)

"Hands-on" lakes exhibit for State Fair and community/lake festivals

Program on lakeshore property management for lake district annual meetings

Develop fact sheet on benefits of emergent aquatic plants used as lakeshore buffers

Pet owners

Review local ordinances related to pet waste cleanup and, if appropriate, provide information on potential changes

Distribute pet waste fact sheet at veterinary clinics, dog kennels, pet supply stores and municipal counters where pet licenses are renewed

Vehicle owners, especially "do-it-yourself"

Stencil storm drains with a "Dump No Waste" message

For use at stores that sell vehicle oil, develop pads of take-home notes with information about local oil recycling centers or how to call InfoSource for a list of oil recycling centers

Work with commercial car washes to encourage advertising of their environmental benefits

Develop information on alternatives for washing vehicles at home in a less environmentally damaging way

Provide information about oil and antifreeze recycling, hazardous waste collection and vehicle washing to industrial arts teachers at high schools and technical colleges

Septic system owners

Rely on educational programs conducted by county Health Departments

Use existing fact sheets from DILHR and UW-Extension on septic system maintenance

Local government officials and staff

Develop a pollution prevention self-assessment form and provide related training and technical assistance

Assess parks and public works practices for water quality impacts and, if appropriate, provide information on potential changes

Meet with local government staff to review proposed capital projects and look for opportunities to implement stormwater controls

Use the demonstrations of stormwater management practices at Freedom Square and the Heinze commercial property for tours, news articles and other educational activities

Inlake Nutrient Recycling

Goal

After other nonpoint source controls are implemented, reduce nutrient recycling from lake bottom sediments by providing information about nutrient inactivation techniques, watershed cost-sharing, and long-term lake management to local governments, lake districts and local residents.

Audiences and Activities

Lake district residents

Develop articles for lake district newsletters

Develop or use existing fact sheets about nutrient inactivation techniques (how and when, why, environmental and other impacts, costs, benefits)

Local government and lake district officials

Make one-to-one contacts

Make presentations to local government and lake district meetings — with fact sheets and other supportive materials

Public

Provide reporters for local media with information for news stories

Develop an exhibit for use at libraries, government offices and community/lake festivals

Budget

This budget includes watershed-specific costs for the Muskego-Wind Lakes Watershed Project. It does not reflect costs of exhibits, newsletter publication and distribution, fact sheet printing, workshops and other activities covered through contracts between DNR and UW-Extension. In addition, it does not include the marketing strategy which is proposed for funding through the Upper Fox River Watershed, but will be used to benefit this watershed as well. Finally, costs listed in this budget are based on 1993 data and will require adjustment in future years to reflect available funds, inflation, and changes in activities that are needed to achieve the goals of the program.

County Land Conservation Departments/Divisions

Waukesha County

$1500/year for 8 years $12,000

Racine County

$500/year for 8 years 4,000

Local Governments

10% of urban local assistance grants 60,000

Special Projects

Marketing Strategy

Covered under a grant through the Upper Fox River Watershed ---

Testing the Waters

3 High Schools @ $1200 each for equipment, texts and other curriculum materials, teacher training 3,600

3 High Schools @ $110/year for buses for 5 years 1,650

Video Series for Local Governments

Statewide project to be funded as a separate proposal, possibly including grants from other sources

Total **$81,250**

CHAPTER SEVEN
Integrated Resource Management Program

Introduction

The purpose of this chapter is to define the principles and guidelines for assuring that the watershed project is integrated with other resource management programs, organizations, and activities. Each of these activities is described below.

Fisheries

BMPs, such as streambank protection, shoreline buffer strips, and easements, should be implemented in such a way that will enhance fishery habitat management goals. The DNR fishery manager should be consulted during the design phase of each streambank protection BMP.

Wetland Restoration

Many restorable wetland areas exist in the watershed. General guidelines for wetland restoration, easement acquisition, and shoreline buffers to protect existing wetlands should be followed (see Chapter Five). Wetlands that are important wildlife habitats will be identified by the U.S. Fish and Wildlife Service in consultation with the DNR private lands manager. Shoreline buffer easements may be acquired adjacent to these wetlands to better protect them from sedimentation and other nonpoint source pollution.

These wetlands (existing and restorable) were identified in the wetlands inventory conducted by the County LCDs and the DNR. In addition to the normal priority watershed funding, cost-sharing may be available to provide 100 percent of the restoration or acquisition costs. This additional funding may be available through the DNR district private lands manager, and/or the U.S. Fish and Wildlife Service. Eligibility for this additional funding would be determined by the DNR's private lands manager or the district nonpoint source coordinator.

Stewardship Program

Under this program, the DNR could obtain an easement on both sides of the stream (generally 66 feet wide on each side). If needed, the DNR will financially support the fencing of the stream to protect it from livestock access. Streams in the watershed should be nominated for eligibility when the DNR nomination period is opened.

Endangered and Threatened Species Sites

Endangered, threatened, and special concern species and natural areas are listed in Chapter Two of this plan. To the extent possible, every effort should be made to protect these species. If site-specific information is needed, contact the DNR Bureau of Endangered Resources.

Cultural Resources

Procedures for coordination with state and federal historic preservation laws can be obtained from the DNR Nonpoint Source Coordinator. If archaeological sites are found within the Muskego-Wind Lakes watershed, special consideration must be given to their protection when BMP installations are being considered. Detention basins, manure storage structures, and streambank or shoreline shaping and riprapping are the most common practices that may disturb archaeological sites.

Coordination with State and Federal Conservation Compliance Programs

The Muskego-Wind Lakes Watershed Project will be coordinated with the conservation compliance features of the Wisconsin Farmland Preservation Program (FPP) administered by DATCP, and the Federal Food Security Act (FSA) administered by the Soil Conservation Service.

Coordination with Lake Management Districts

Lake management districts are local units of government established for the purpose of protecting and rehabilitating lakes. Muskego-Wind Lakes Watershed Project staff members will continue to cooperate with the three lake districts on watershed projects, attending board meetings and public meetings upon request. Fact sheets and other educational materials targeting riparian landowners will be distributed to lake district representatives. An active member of each district will serve on the Citizens Advisory Committee. As local units of government, lake management districts may apply for local assistance grants (see Chapter Five). Little Muskego, Big Muskego (including Bass Bay) and Wind Lake each has an established inland lake protection and rehabilitation district under Ch. 33 Wis. Stats.

Coordination with Lake Associations

Lake associations are voluntary organizations. They raise money for special projects, cosponsor lake fairs and other events that educate and inform the public about lake issues, and they participate in local actions to protect and improve lakes. Lake associations are eligible for nonpoint source program local assistance grant funds if they meet the following criteria:

- They must be incorporated under Chapter 181 Wisconsin Statutes.
- They must specify in the articles of incorporation or by-laws that they support the protection or improvement of inland lakes for the benefit of the general public and demonstrate this by their past actions.
- They must allow membership in the association to any individual living on or within one mile of the lake for at least one month each year or individuals who own real estate on or within one mile of that lake.
- They do not limit or deny the right of any member or class of members to vote as provided under Chapter 181.16(1), Wisconsin Statutes.
- They have been in existence for at least one year, have at least 25 members, and requires annual membership fees of not less than $10 nor more than $25.

Coordination with EPA Clean Lakes Program

The Wind Lake Management District, SEWRPC and the DNR cooperated in the preparation of a diagnostic feasibility study using federal Clean Lakes Funds. As a result, a Clean Lakes Restoration Project has been launched for Wind Lake and Big Muskego Lake. The proposed goals and objectives for this project will require an integrated approach to lake management.

It is intended that this plan implement several components of the proposed lake restoration project including:

- An environmental assessment to address the concerns of endangered species, recreational impacts and other water resource issues.
- An information, awareness and consensus building campaign for local residents about the short-term impacts and long-term benefits of a drawdown on Big Muskego Lake.
- A carp eradication project in Big Muskego Lake to reduce internal loading of phosphorus within the lake and downstream phosphorus transport to Wind Lake.

State Lake Planning and Lake Protection Grant Programs

Local units of government and qualified lake associations in the watershed are eligible to receive Lake Planning Grants and/or Lake Protection Grants to do the following:

- Gather lake and watershed information and prepare lake management plans.
- Develop environmental ordinances to improve and protect lake water quality and lake ecosystems.
- Purchase property which will significantly contribute to lake water quality or lake ecosystems. (Note: dam property purchase or alteration is ineligible.)
- Restore wetlands.

Lake Planning Grant funds are available at a 75% cost share rate for up to $10,000 per two-year period and $30,000 for the life of the program. Lake Protection Grant funds are limited to $100,000 for property purchases, wetland restorations, and regulation development, and program funds must be matched with an equal share by the local government.

To date, lake districts in the watershed have received five Lake Planning Grants:

1.	Big Muskego Lake	October 15, 1991	$1,319
2.	Wind Lake	March 6, 1992	$3,305
3.	Little Muskego Lake	March 6, 1992	$4,346
4.	Linnie Lac	March 6, 1992	$3,223
5.	Little Muskego Lake	January 12, 1993	$3,648

Coordination with Muskego Area Conservancy Trust

In 1992, with seed money from the Little Muskego Lake Association, the Muskego Area Conservancy Trust was created. Its purpose is to acquire environmentally sensitive lands to be set aside for protection from development. The Trust has identified and prioritized lands within the area. Lands purchased by the Trust may be eligible for easements under the watershed, stewardship or lake protection grant program.

Coordination with Other Organizations and Activities

In addition to those activities and organizations listed above, others such as the Department of Transportation (DOT) highway expansion projects, Wind Lake Management Plan activities, and Conservation Corps activities should be integrated with the watershed project to more effectively achieve water resources objectives of this plan.

CHAPTER EIGHT
Project Evaluation

Introduction

This chapter briefly summarizes the plan for monitoring the progress and evaluating the effectiveness of the Muskego-Wind Lakes Priority Watershed Project. The evaluation strategy includes these components:

- Administrative review
- Pollution reduction evaluation

Information on these components will be collected by the Waukesha County and Racine County LCDs and reported on a regular basis to the DNR and the DATCP. Additional information on the numbers and types of practices on cost-share agreements, funds encumbered on cost-share agreements, and funds expended will be provided by the DNR's Bureau of Community Assistance.

Administrative Review

The first component, the administrative review, will focus on the progress of Waukesha County, Racine County and other units of government in implementing the project. The project will be evaluated with respect to accomplishments, financial expenditures, and staff time spent on project activities.

Accomplishment Reporting

The Computer Assisted Management and Planning System, called CAMPS, is a computer data management system that has been developed by the U.S. Soil Conservation Service (SCS). The SCS, the DNR and the DATCP use CAMPS to meet the accomplishment reporting requirements of all three agencies. The Waukesha and Racine County LCDs will use CAMPS to collect data for administrative accomplishments, and will provide the information to the DNR and the DATCP for program evaluation.

The County LCDs will provide the following data to the DNR and the DATCP on a quarterly basis:

- Number of personal contacts made with landowners
- Completed information and education activities
- Number of farm conservation plans prepared for the project
- Number of cost-share agreements signed
- Number of farm conservation plan and cost-share agreement status reviews completed
- Number of farms and acres of cropland checked for proper maintenance of BMPs

In addition to quarterly reports, county staff and supervisors will meet with the DNR and the DATCP staff annually to review progress and plan for the subsequent year.

Likewise, participating local units of government implementing the urban nonpoint source management program will meet periodically with DNR staff to review progress. The DNR and local units of government will jointly evaluate the urban implementation program. Annual reports of governmental units will include:

- Information and education activities
- Construction site erosion control ordinance amendments adopted
- Number of permits monitored for ordinance compliance
- Implementation of urban "housekeeping" program activities
- Acres of existing (1992) urban lands covered by engineering feasibility studies
- Acres of new (post-1992) urban development, by land use, covered by storm water management plans for controlling water quality
- Storm water management ordinance provisions adopted

Financial Expenditures

County LCDs and other participating units of government will provide the following financial data to the DNR and the DATCP on a quarterly basis:

- Number of landowner cost-share agreements signed
- Amount of money encumbered in cost-share agreements
- Number of landowner reimbursement payments made for the installation of best management practices (BMPs), and the amount of money paid
- Staff travel expenditures
- Information and education expenditures
- Expenditures for equipment, materials, and supplies
- Expenditures for professional services and staff support costs
- Total project expenditures for the LCD staff
- Amount of money paid for installation of BMPs, and money encumbered in cost-share agreements

The County LCDs and other participating units of government will also provide the DNR with the following financial data on an annual basis:

- Staff training expenditures
- Interest money earned and expended
- Total budget and expenditures on the project

Time Spent On Project Activities

The County LCDs and other participating governmental units with local assistance grants will provide time summaries to both departments for the following activities on a quarterly basis:

- Project and fiscal management
- Clerical assistance
- Pre-design and conservation planning activities
- Technical assistance: practice design, installation, cost-share agreement status review and monitoring
- Educational activities
- Training activities
- Leave Time

Nonpoint Source Pollutant Load Reduction

The purpose of the second evaluation component, pollutant load reduction, is to estimate reductions in nonpoint source pollutants as a result of installing BMPs. Key sources were identified for estimating changes in pollutant loads that reach surface waters in the Muskego-Wind Lakes Watershed, including cropland sediment, construction sediment erosion, barnyard phosphorus runoff, streambank erosion, and urban nonpoint source pollutants. Chapter Three of this plan describes target pollutant reductions for each of the lakes and subwatersheds.

Cropland Sediment Sources

County LCDs will use the WIN HUSLE (Wisconsin Nonpoint Source) model to estimate sediment reductions due to changes in cropping practices. The counties will use CAMPS to provide data for the WIN HUSLE model on a quarterly basis, as described above.

Streambank Sediment Sources

County LCD staff will estimate changes in streambank sediment erosion. A tally will be kept of landowners contacted, the amount of streambank sediment (in tons) being generated at the time of contact, and changes in erosion levels estimated after installing BMPs.

Animal Lot Nutrient Runoff

County LCDs will use the BARNY (Modified ARS) model to estimate phosphorus reductions due to the installation of barnyard control practices. The LCDs will report the information to the DNR through CAMPS. In the event that CAMPS is replaced, the replacement system will be used for all project tracking.

Construction Sites

Local units of government participating in the urban implementation program will report annually to the DNR on the number of construction sites served by adequate erosion control practices, number of construction sites receiving appropriate permits, and any amendments to construction site erosion control ordinances that affect sediment loads associated with these sources.

Existing and Planned Urban Areas

Local units of government will report annually to the DNR on any activities that may result in changes in urban pollutant loadings. Such activities include acres of existing (1992) and new (post-1992) urban land, by land use, served by new storm water BMPs; new urban lands, by land use, not served by storm water BMPs; and other information requested by the DNR concerning BMP characteristics.

Evaluation Monitoring

Evaluation monitoring activities in priority watersheds are planned and conducted according to monitoring program guidance in the Bureau of Water Resources, Surface Water Monitoring Strategy. However, evaluation monitoring is not conducted in every priority watershed. Currently, lake management districts share costs with the U.S. Geological Survey for lake monitoring conducted at sites in Bass Bay, Big Muskego Lake, Wind Lake, and Little Muskego Lake. Depending on the availability of state and local funding, these monitoring activities should continue throughout the project period.

Monitoring of the lakes will continue as described in the appraisal monitoring plan and report. Trophic State Index (TSI) calculations based on Secchi disk, chlorophyll and total phosphorus recordings will be used to evaluate changes in lake water quality.

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APPENDIX A
Glossary

ACUTE TOXICITY:
Any poisonous effect produced by a single short-term exposure to a chemical that results in a rapid onset of severe symptoms.

ADVANCED WASTEWATER TREATMENT:
The highest level of wastewater treatment for municipal treatment systems. It requires removal of all but 10 parts per million of suspended solids and biological oxygen and/or 50 percent of the total nitrogen. Advanced wastewater treatment is also known as "tertiary treatment."

AGRICULTURAL CONSERVATION PROGRAM (ACP):
A federal cost-sharing program to help landowners install measures to conserve soil and water resources. ACP is administered by the USDA ASCS through county ACP committees.

ALGAE:
A group of microscopic, photosynthetic water plants. Algae give off oxygen during the day as a product of photosynthesis and consume oxygen during the night as a result of respiration. Therefore, algae effect the oxygen content of water. Nutrient-enriched water increases algae growth.

AMMONIA:
A form of nitrogen (NH_3) found in human and animal wastes. Ammonia can be toxic to aquatic life.

ANAEROBIC:
Without oxygen.

AREA OF CONCERN:
Areas of the Great Lakes identified by the International Joint Commission (IJC) as having serious water pollution problems.

AREAWIDE WATER QUALITY MANAGEMENT PLANS (208 PLANS):
A plan to document water quality conditions in a drainage basin and make recommendations to protect and improve basin water quality. Each basin in Wisconsin must have a plan prepared for it, according to section 208 of the Clean Water Act.

ANTIDEGRADATION:

A policy stating that water quality will not be lowered below background levels unless justified by economic and social development considerations. Wisconsin's antidegradation policy is currently being revised to make it more specific and meet EPA guidelines.

AVAILABILITY:

The degree to which toxic substances or other pollutants are present in sediments or elsewhere in the ecosystem and are available to affect or be taken up by organisms. Some pollutants may be "bound up" or unavailable because they are attached to clay particles or are buried by sediment. Oxygen content, pH, temperature and other conditions in the water can affect availability.

BACTERIA:

Single-cell, microscopic organisms. Some can cause disease, but others are important in organic waste stabilization.

BASIN PLAN:

See "Areawide Water Quality Management Plan".

BENTHIC ORGANISMS (BENTHOS):

Organisms living in or on the bottom of a lake or stream.

BEST MANAGEMENT PRACTICE (BMP):

The most effective, practical measures to control nonpoint sources of pollutants that runoff from land surfaces.

BIOACCUMULATION:

The uptake and retention of substances by an organism from its surrounding medium and food. As chemicals move through the food chain, they tend to increase in concentration in organisms at the upper end of the food chain such as predator fish, or in people or birds that eat these fish.

BIOASSAY STUDY:

A test for pollutant toxicity. Tanks of fish or other organisms are exposed to varying doses of treatment plant effluent. Lethal doses of pollutants in the effluent are then determined.

BIOCHEMICAL OXYGEN DEMAND (BOD):

A measure of the amount of oxygen consumed in the biological processes that break down organic matter in water. BOD_5 is the biochemical oxygen demand measured in a five day test. The greater the degree of pollution, the higher the BOD_5.

BIODEGRADABLE:

Waste that can be broken down by bacteria into basic elements. Most organic wastes such as food remains and paper are biodegradable.

BIOTA:

All living organisms that exist in an area.

BUFFER STRIPS:

Strips of grass or other erosion-resisting vegetation between disturbed areas and a stream or lake.

BULKHEAD LINES:

Legally established lines that indicate how far into a stream or lake an adjacent property owner has the right to fill. Many of these lines were established many years ago and allow substantial filling of the bed of the river and bay. Other environmental laws may limit filling to some degree.

CARCINOGENIC:

A chemical capable of causing cancer.

CATEGORICAL LIMITS:

All point source discharges are required to provide a basic level of treatment. For municipal wastewater treatment plants this is secondary treatment (30 mg/1 effluent limits for SS and BOD). For industry the level depends on the type of industry and the level of production. More stringent effluent limits are required, if necessary, to meet water quality standards.

CHLORINATION:

The application of chlorine to wastewater to disinfect it and kill bacteria and other organisms.

CHLORORGANIC COMPOUNDS (CHLORORGANICS):

A class of chemicals that contain chlorine, carbon and hydrocarbon. This generally refers to pesticides and herbicides that can be toxic. Examples include PCB's and pesticides such as DDT and dieldrin.

CHRONIC TOXIcity:

The effects of long-term exposure of organisms to concentrations of a toxic chemical that are not lethal, but is injurious or debilitating in one or more ways. An example of the effect of chronic toxicity is reduced reproductive success.

CLEAN WATER ACT:

See "Public Law 92-500."

COMBINED SEWERS:

A wastewater collection system that carries both sanitary sewage and stormwater runoff. During dry weather, combined sewers carry only wastewater to the treatment plant. During heavy rainfall, the sewer becomes swollen with stormwater. Because the treatment plant cannot process the excess flow, untreated sewage is discharged to the plant's receiving waters, i.e., combined sewer outflow.

CONFINED DISPOSAL FACILITY (CDF):

A structure built to contain and dispose of dredged material.

CONGENERS:

Chemical compounds that have the same molecular composition, but have different molecular structures and formula. For example, the congeners of PCB have chlorine located at different spots on the molecule. These differences can cause differences in the properties and toxicity of the congeners.

CONSERVATION TILLAGE:

Planting row crops while only slightly disturbing the soil. In this way a protective layer of plant residue stays on the surface. Erosion rates decrease.

CONSUMPTION ADVISORY:

A health warning issued by DNR and WDHSS that recommends people limit the fish they eat from some rivers and lakes based on the levels of toxic contaminants found in the fish.

CONTAMINANT:

Some material that has been added to water that is not normally present. This is different from a pollutant, which suggests there is too much of the material present.

CONVENTIONAL POLLUTANT:

Refers to suspended solids, fecal coliforms, biochemical oxygen demand, and pH, as opposed to toxic pollutants

COST-EFFECTIVE:

A level of treatment or management with the greatest incremental benefit for the money spent.

CRITERIA:

See water quality standard criteria.

DDT:

A chlorinated hydrocarbon insecticide that was banned because of its persistence in the environment.

DIOXIN (2,3,7,8-tetrachlorodibenso-p-dioxin):

A chlorinated organic chemical which is highly toxic.

DISINFECTION:

A chemical or physical process that kills organism that cause disease. Chlorine is often used to disinfect wastewater.

DISSOLVED OXYGEN (DO):

Oxygen dissolved in water. Low levels of dissolved oxygen cause bad smelling water and threaten fish survival. Low levels of dissolved oxygen often result from inadequate wastewater treatment. The DNR considers 5 ppm DO necessary for fish and aquatic life.

DREDGING:

Removal of sediment from the bottom of water bodies.

ECOSYSTEM:

The interacting system of biological community and its nonliving surrounding.

EFFLUENT:

Solid, liquid or gas wastes (byproducts) that are disposed on land, in water or in air. As used in the RAP, effluent generally means wastewater discharges.

EFFLUENT LIMITS:

The DNR issues WPDES permits establishing the maximum amount of pollutant to be discharged to a receiving stream. Limits depend on the pollutant and the water quality standards that apply for the receiving waters.

EMISSION:

A direct (smokestack particles) or indirect (busy shopping center parking lot) release of any contaminant into the air.

ENVIRONMENTAL PROTECTION AGENCY (USEPA):

The federal agency responsible for enforcing federal environmental regulations. The Environmental Protection Agency delegates some of its responsibilities for water, air and solid waste pollution control to state agencies.

ENVIRONMENTAL REPAIR FUND:

A fund established by the Wisconsin Legislature to deal with abandoned landfills.

EPIDEMIOLOGY:

The study of diseases as they affect populations rather than individuals, including the distribution and incidence of a disease mortality and morbidity rated, and the relationship of climate, age, sex, race and other factors. EPA uses such data to establish national air quality standards.

EROSION:

The wearing away of the land surface by wind or water.

EUTROPHIC:

Refers to a nutrient-rich lake. Large amounts of algae and weeds characterize a eutrophic lake (see also "Oligotrophic" and "Mesotrophic").

EUTROPHICATION:

The process of nutrient enrichment of a lake loading to increased production of aquatic organisms. Eutrophication can be accelerated by human activity such as agriculture and improper waste disposal.

FACILITY PLAN:

A preliminary planning and engineering document that identifies alternative solutions to a community's wastewater treatment problems.

FECAL COLIFORM:

A group of bacteria used to indicate the presence of other bacteria that cause disease. The number of coliform is particularly important when water is used for drinking and swimming.

FISHABLE AND SWIMMABLE:

Refers to the water quality goal set for the nation's surface waters by Congress in the Clean Water Act. All waters were to meet this goal by 1984.

FLOURANTHENE:

A polyaromatic hydrocarbon (PHA) with toxic properties.

FLY ASH:

Particulates emitted from coal burning and other combustion, such as wood burning, and vented into the air from stacks, or more likely, collected by electrostatic precipitators.

FOOD CHAIN:

A sequence of organisms where each uses the next as a food source.

FURANS (2,3,7,8-tetra-chloro-dibenzpfurans):

A chlorinated organic compound which is highly toxic.

GREEN STRIPS:

See buffer strip.

GROUNDWATER:

Undergroundwater-bearing areas generally within the boundaries of a watershed, which fill internal passageways of porous geologic formations (aquifers) with water that flows in response to gravity and pressure. Often used as the source of water for communities and industries.

HABITAT:

The place or type of site where a plant or animal naturally lives and grows.

HEAVY METALS:

Metals present in municipal and industrial wastes that pose long-tern environmental hazards if not properly disposed. Heavy metals can contaminate ground and surface waters, fish and other food stuffs. The metals of most concern are: arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium and zinc (see also separate listings of these metals for their health effects).

HERBICIDE:

A type of pesticide that is specifically designed to kill plants and can also be toxic to other organisms.

HYDROCARBONS:

Any chemical of a large family of chemicals containing carbon and hydrogen in various combinations.

INCINERATOR:

A furnace designed to burn wastes.

INFLUENT:

Influent for an industry would be the river water that the plant intakes for use in its processing. Influent to a municipal treatment plant is untreated wastewater.

IN-PLACE POLLUTION:

As used in the RAP, refers to pollution from contaminated sediments. These sediments are polluted from post discharges from municipal and industrial sources.

INTERNATIONAL JOINT COMMISSION (IJC):

An agency formed by the United States and Canada to guide management of the Great Lakes and resolve border issues.

ISOROPYLBIPHENYL:

A chemical compound used as a substitute for PCB.

LANDFILL:

A conventional sanitary landfill is "a land disposal site employing an engineered method of disposing of solid wastes on land in a manner that minimizes environmental hazards by spreading solid wastes in thin layers, materials at the end of each operating day". Hazardous wastes frequently require various types of pretreatment before they are disposed of, i.e., neutralization chemical fixation encapsulation. Neutralizing and disposing of wastes should be considered a last resort. Repurifying and reusing waste materials or recycling them for another use may be less costly.

LC-1:

The concentration that results in 1% mortality of the test animal populations exposed to the contaminant.

LC_{50}:

Lethal concentration for 50% of the test population exposed to a toxicant substance.

LD_{50}:
Lethal dose for 50 percent of the test population exposed to a toxicant substance.

LEACHATE:
The contaminated liquid which seeps from a pile or cell of solid materials and which contains water, dissolved and decomposing solids. Leachate may enter the groundwater and contaminate drinking water supplies.

LOAD:
The total amount of materials or pollutants reaching a given local.

MACROPHYTE:
A rooted aquatic plant.

MASS:
The amount of material a substance contains causing it to have weight in a gravitational field.

MASS BALANCE:
A study that examines all parts of the ecosystem to determine the amount of toxic or other pollutant present, its sources, and the processes by which the chemical moves through the ecosystem.

MESOTROPHIC:
Refers to a moderately fertile nutrient level of a lake between the oligotrophic and eutrophic levels. (See also "Eutrophic" and "Oligotrohpic.")

MILLIGRAMS PER LITER (mg/1):
A measure of the concentration of substance in water. For most pollution measurement this is the equivalent of "parts per million".

MITIGATION:
The effort to lessen the damages caused, by modifying a project, providing alternatives, compensating for losses or replacing lost values.

MIXING ZONE:
The portion of a stream or lake where effluent is allowed to mix with the receiving water. The size of the area depends on the volume and flow of the discharge and receiving water. For streams the mixing zone it is one-third of the lowest flow that occurs once every 10 years for a seven day period.

NONPOINT SOURCE POLLUTION (NSP):
Pollution whose sources cannot be traced to a single point such as a municipal or industrial wastewater treatment plant discharge pipe. Nonpoint sources include eroding farmland and construction sites, urban streets, and barnyards. Pollutants from these sources reach water bodies in runoff, which can best be controlled by proper land management.

NPS:

See nonpoint source pollution.

OLIGOTROPHIC:

Refers to an unproductive and nutrient-poor lake. Such lakes typically have very clear water. (See also "Eutrophic" and "Mesotrophic.")

OUTFALL:

The mouth of a sewer, drain, or pipe where effluent from a wastewater treatment plant is discharged.

PATHOGEN:

Any infective agent capable of producing disease. It may be a virus, bacterium, protozoan, etc.

PELAGIC:

Referring to open water portion of a lake.

PESTICIDE:

Any chemical agent used to control specific organisms, such as insecticides, herbicides, fungicides, etc.

PH:

A measure of acidity or alkalinity, measured on a scale of 0 to 14 with 7 being neutral and 0 being most acid, and 14 being most alkaline.

PHENOLS:

Organic compounds that are byproducts of petroleum refining, textile, dye, and resin manufacture. High concentrations can cause taste and odor problems in fish. Higher concentration can be toxic to fish and aquatic life.

PHOSPHORUS:

A nutrient that, when reaching lakes in excess amounts, can lead to overfertile conditions and algae blooms.

PLANKTON:

Tiny plants and animals that live in water.

POINT SOURCES:

Sources of pollution that have discrete discharges, usually from a pipe or outfall.

POLLUTION:

The presence of materials or energy whose nature, location, or quantity produces undesired environmental effects.

POLYCHLORINATED BIPHENYLS(PCBs):

A group of 209 compounds, PCBs have been manufactured since 1929 for such common uses as electrical insulation and heating/cooling equipment, because they resist wear and chemical breakdown. Although banned in 1979 because of their toxicity, they have been detected on air, land and water. Recent surveys found PCBs in every section of the country, even those remote from PCB manufacturers.

POLYCHLORINATED ORGANIC COMPOUNDS:

A group of toxic chemicals which contain several chlorine atoms.

PRETREATMENT:

A partial wastewater treatment required from some industries. Pretreatment removes some types of industrial pollutants before the wastewater is discharged to a municipal wastewater treatment plant.

PRIORITY POLLUTANT:

A list of toxic chemicals identified by the federal government because of their potential impact in the environment and human health. Major dischargers are required to monitor all or some of these chemicals when their WPDES permits are reissued.

PRIORITY WATERSHED:

A drainage area about 100,000 acres in size selected to receive Wisconsin Fund money to help pay the cost of controlling nonpoint source pollution. Because money is limited, only watersheds where problems are critical, control is practical, and cooperation is likely are selected for funding.

PRODUCTIVITY:

A measure of the amount of living matter which is supported by an environment over a specific period of time. Often described in terms of algae production for a lake.

PUBLIC LAW 92-500 (CLEAN WATER ACT):

The federal law that sets national policy for improving and protecting the quality of the nation's waters. The law set a timetable for the cleanup of the nation's waters and stated that they are to be fishable and swimmable. This also required all dischargers of pollutants to obtain a permit and meet the conditions of the permit. To accomplish this pollution cleanup, billions of dollars have been made available to help communities pay the cost of building sewage treatment facilities. Amendments in the Clean Water Act were made in 1977 by passage of Public Law 95-217, and in 1987.

PUBLIC PARTICIPATION:

The active involvement of interested and affected citizens in governmental decision-making.

PUBLICLY OWNED TREATMENT WORKS (POTW):

A wastewater treatment plat owned by a city, village or other unit of government.

RAP:

See Remedial Action Plan.

RECYCLING:
The process that transforms waste materials into new products.

REMEDIAL ACTION PLAN:
A plan designed to restore beneficial uses to a Great Lakes Area of Concern.

REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RF/FS):
An investigation of problems and assessment of management options conducted as part of a superfund project.

RESOURCE CONSERVATION AND RECOVERY ACT OF 1976 (RCRA):
This federal law amends the Solid Waste Disposal Act of 1965 and expands on the Resource Recovery Act of 1970 to provide a program that regulates hazardous wastes, to eliminate open dumping and to promote solid waste management programs.

RETRO-FIT:
The placement of an urban structural practice in an existing urban area, which may involve rerouting existing storm sewers and/or relocating existing buildings or other structures.

RIPARIAN:
Belonging or relating to the bank of a lake, river or stream.

RIPRAP:
Broken rock, cobbles, or boulders placed on the bank of a stream to protect it against erosion.

RULE:
Refers to Wisconsin administrative rules. See Wisconsin Administrative Code.

RUNOFF:
Water from rain, snowmelt, or irrigation that flows over the ground surface and returns to streams. Runoff can collect pollutants from air or land and carry them to receiving waters.

SECONDARY IMPACTS:
The indirect effects that an action can have on the health of the ecosystem or the economy.

SECONDARY TREATMENT:
Two-stage wastewater treatment that allows the coarse particles to settle out, as in primary treatment, followed by biological breakdowns of the remaining impurities. Secondary treatment commonly removes 90% of the impurities. Sometimes "secondary treatment" refers simply to the biological part of the treatment process.

SEDIMENT:
Soil particles suspended in and carried by water as a result of erosion.

SEICHES:

Changes in water levels due to the tipping of water in an elongated lake basin whereby water is raised in one end of the basin and lowered in the other.

SEPTIC SYSTEM:

Sewage treatment and disposal for homes not connected to sewer lines. Usually the system includes a tank and drain field. Solids settle to the bottom of the tank. Liquid percolates through the drain field.

SLUDGE:

A byproduct of wastewater treatment; waste solids suspended in water.

SOLID WASTE:

Unwanted or discharged material with insufficient liquid to be free flowing.

STANDARDS:

See water quality standards.

STORM SEWERS:

A system of sewers that collect and transport rain and snow runoff. In areas that have separated sewers, such stormwater is not mixed with sanitary sewage.

SUPERFUND:

A federal program that provides for cleanup of major hazardous landfills and land disposal areas.

SUSPENDED SOLIDS (SS):

Small particles of solid pollutants suspended in water.

SYNERGISM:

The total effect is greater than the sum of the individual effects. For example, the characteristic property of a mixture of toxicants that exhibits a greater-than-additive cumulative toxic effect.

TACs:

Technical advisory committees that assisted in the development of the Remedial Action Plan.

TERTIARY TREATMENT:

See advanced wastewater treatment.

TOP-DOWN MANAGEMENT:

A management theory that uses biomanipulation, specifically the stocking of predator species of fish to improve water quality.

TOTAL MAXIMUM DAILY LOADS:

The maximum amount of a pollutant that can be discharged into a stream without causing a violation of water quality standards.

TOXIC:

An adjective that describes a substance which is poisonous, or can kill or injure a person or plants and animals upon direct contact or long-term exposure. (Also, see toxic substance.)

TOXIC SUBSTANCE:

A chemical or mixture of chemicals which, through sufficient exposure, or ingestion, inhalation of assimilation by an organism, either directly from the environment or indirectly by ingestion through the food chain, will, on the basis of available information cause death, disease, behavioral or immunologic abnormalities, cancer, genetic mutations, or development of physiological malfunctions, including malfunctions in reproduction or physical deformations, in organisms or their offspring.

TOXICANT:

See toxic substance.

TOXIcity:

The degree of danger posed by a toxic substance to animal or plant life. Also see acute toxicity, chronic toxicity and additivity.

TOXIcity REDUCTION EVALUATION:

A requirement for a discharger that the causes of toxicity in an effluent be determined and measures taken to eliminate the toxicity. The measures may be treatment, product substitution, chemical use reduction or other actions that will achieve the desired result.

TREATMENT PLANT:

See wastewater treatment plant.

TROPHIC STATUS:

The level of growth or productivity of a lake as measured by phosphorus content, algae abundance, and depth of light penetration.

TURBIDITY:

Lack of water clarity. Turbidity is usually closely related to the amount of suspended solids in water.

UNIVERSITY OF WISCONSIN-EXTENSION (UWEX):

A special outreach, education branch of the state university system.

VARIANCE:

Government permission for a delay or exception in the application of a given law, ordinance or regulation. Also, see water quality standard variance.

VOLATILE:

Any substance that evaporates at a low temperature.

WASTELOAD ALLOCATION:

Division of the amount of waste a stream can assimilate among the various dischargers to the stream. This limits the amount (in pounds) of chemical or biological constituent discharged from a wastewater treatment plant to a water body.

WASTEWATER:

Water that has become contaminated as a byproduct of some human activity. Wastewater includes sewage, washwater and the water-borne wastes of industrial processes.

WASTE:

Unwanted materials left over from manufacturing processes, refuse from places of human habitation or animal habitation.

WASTEWATER TREATMENT PLANT:

A facility for purifying wastewater. Modern wastewater treatment plants are capable of removing 95% of organic pollutants.

WATER QUALITY AGREEMENT:

The Great Lakes Water Quality agreement was initially signed by Canada and the United States in 1972 and was subsequently revised in 1978 and 1987. It proves guidance for the management of water quality, specifically phosphorus and toxics, in the Great Lakes.

WATER QUALITY LIMITED SEGMENT:

A section of river where water quality standards will not be met if only categorical effluent standards are met.

WATER QUALITY CRITERIA:

A measure of the physical, chemical or biological characteristics of a water body necessary to protect and maintain different water uses (fish and aquatic life, swimming, etc.).

WATER QUALITY STANDARDS:

The legal basis and determination of the use of a water body and the water quality criteria, physical, chemical, or biological characteristics of a water body, that must be met to make it suitable for the specified use.

WATER QUALITY STANDARD VARIANCE:

When natural conditions of a water body preclude meeting all conditions necessary to maintain full fish and aquatic life and swimming, a variance may be granted.

WATERSHED:

The land area that drains into a lake or river.

WETLANDS:

Areas that are inundates or saturated by surface or groundwater at a frequency and duration sufficient to support a variety of vegetative or aquatic life. Wetland vegetation requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs and similar areas.

WISCONSIN ADMINISTRATIVE CODE:

The set of rules written and used by state agencies to implement state statutes. Administrative codes are subject to public hearing and have the force of law.

WISCONSIN FUND:

A state program that helps pay the cost of reducing water pollution. Funding for the program comes from general revenues and bonds and is based on a percentage of the state's taxable property value. The Wisconsin Fund includes these programs:

Point Source Water Pollution Abatement Grant Program - Provides grants for 60% of the cost of constructing wastewater treatment facilities. Most of this program's money goes for treatment plant construction, but three percent of this fund is available for repair or replacement of private, on-site sewer systems.

Nonpoint Source Water Pollution Abatement Grant Program - Funds to share the cost of reducing water pollution. Nonspecified sources are available in selected priority watersheds.

Solid Waste Grant Program - Communities planning for solid waste disposal sites are eligible for grant money. $500,000 will be available each year to help with planning costs.

WISCONSIN NONPOINT SOURCE WATER POLLUTION ABATEMENT GRANT PROGRAM:

A state cost-share program established by the State Legislature in 1978 to help pay the costs of controlling nonpoint source pollution. Also known as the nonpoint source element of the Wisconsin Fund or the Priority Watershed Program.

WISCONSIN POLLUTANT DISCHARGE ELIMINATION SYSTEM (WPDES):

A permit system to monitor and control the point source dischargers of wastewater in Wisconsin. Dischargers are required to have a discharge permit and meet the conditions it specifies.

Priority Watershed Projects in Wisconsin
1993

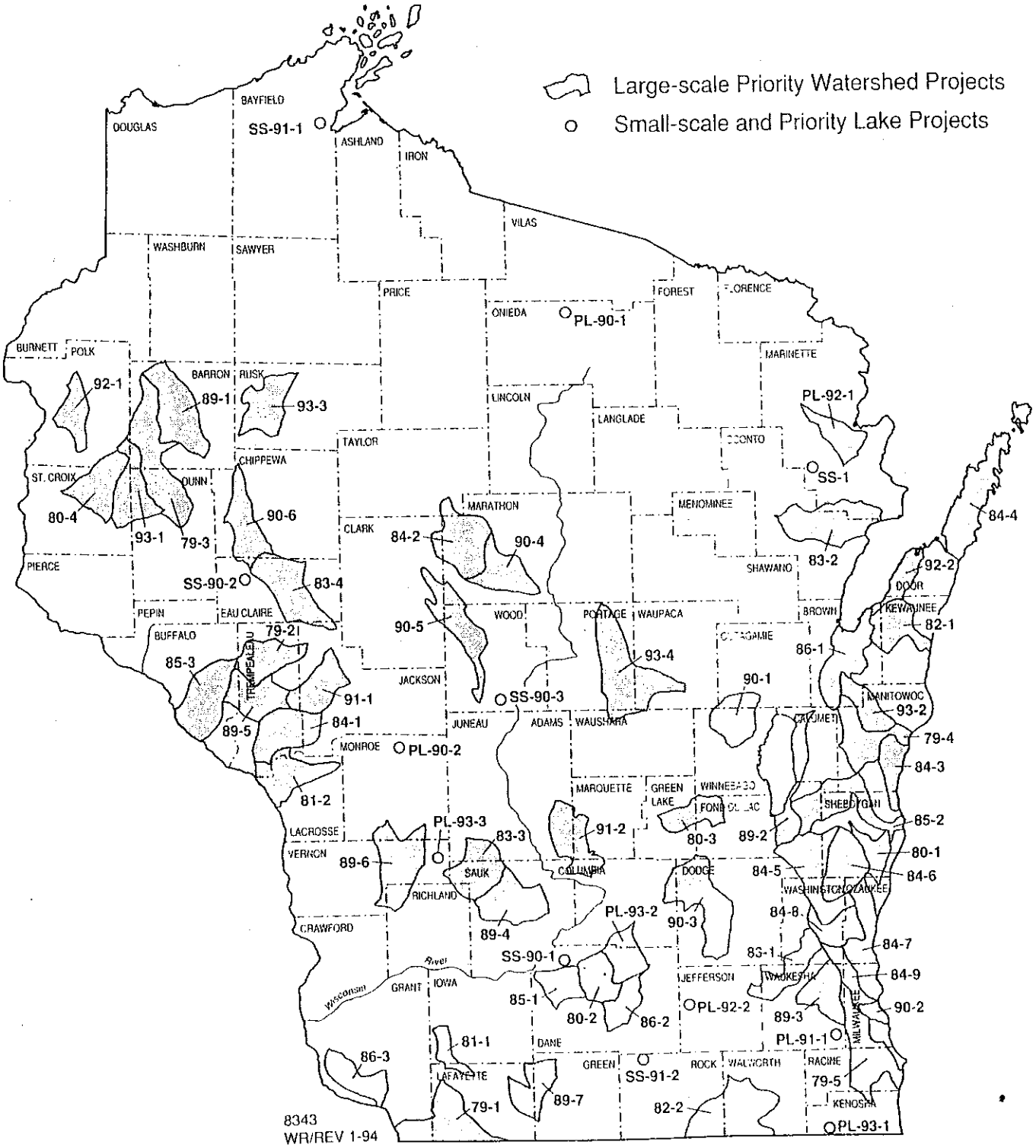
Year Selected-Map Number	Large-scale Priority Watershed Project	County(ies)
79-1	Galena River*	Grant, Lafayette
79-2	Elk Creek*	Trempealeau
79-3	Hay River*	Barron, Dunn
79-4	Lower Manitowoc River*	Manitowoc, Brown
79-5	Root River*	Racine, Milwaukee, Waukesha
80-1	Onion River*	Sheboygan, Ozaukee
80-2	Sixmile-Pheasant Branch Creek*	Dane
80-3	Big Green Lake*	Green Lake, Fond du Lac
80-4	Upper Willow River*	Polk, St. Crox
81-1	Upper West Branch Pecatonica River*	Iowa, Lafayette
81-2	Lower Black River*	La Crosse, Trempealeau
82-1	Kewaunee River*	Kewaunee, Brown
82-2	Turtle Creek	Walworth, Rock
83-1	Oconomowoc River	Waukesha, Washington, Jefferson
83-2	Little River	Oconto, Marinette
83-3	Crossman Creek/Little Baraboo River	Sauk, Juneau, Richland
83-4	Lower Eau Claire River	Eau Claire
84-1	Beaver Creek	Trempealeau, Jackson
84-2	Upper Big Eau Pleine River	Marathon, Taylor, Clark
84-3	Sevenmile-Silver Creeks	Manitowoc, Sheboygan
84-4	Upper Door Peninsula	Door
84-5	East & West Branch Milwaukee River	Fond du Lac, Washington, Sheboygan, Dodge, Ozaukee
84-6	North Branch Milwaukee River	Sheboygan, Washington, Ozaukee, Fond du Lac
84-7	Milwaukee River South	Ozaukee, Milwaukee
84-8	Cedar Creek	Washington, Ozaukee
84-9	Menomonee River	Milwaukee, Waukesha, Ozaukee, Washington
85-1	Black Earth Creek	Dane
85-2	Sheboygan River	Sheboygan, Fond du Lac, Manitowoc, Calumet
85-3	Waumandee Creek	Buffalo
86-1	East River	Brown, Calumet
86-2	Yahara River - Lake Monona	Dane
86-3	Lower Grant River	Grant
89-1	Yellow River	Barron
89-2	Lake Winnebago East	Calumet, Fond du Lac
89-3	Upper Fox River (Ill.)	Waukesha
89-4	Narrows Creek - Baraboo River	Sauk
89-5	Middle Trempealeau River	Trempealeau, Buffalo
89-6	Middle Kickapoo River	Vernon, Monroe, Richland
89-7	Lower East Branch Pecatonica River	Green, Lafayette
90-1	Arrowhead River & Daggets Creek	Winnebago, Outagamie, Waupaca
90-2	Kinnickinnic River	Milwaukee
90-3	Beaverdam River	Dodge, Columbia, Green Lake
90-4	Lower Big Eau Pleine River	Marathon
90-5	Upper Yellow River	Wood, Marathon, Clark
90-6	Duncan Creek	Chippewa, Eau Claire
91-1	Upper Trempealeau River	Jackson, Trempealeau
91-2	Neenah Creek	Adams, Marquette, Columbia
92-1	Balsam Branch	Polk
92-2	Red River - Little Sturgeon Bay	Door, Brown, Kewaunee
93-1	South Fork Hay River	Dunn, Polk, Barron, St. Croix
93-2	Branch River	Manitowoc, Brown
93-3	Soft Maple/Hay Creek	Rusk
93-4	Tomorrow/Waupaca River	Portage, Waupaca, Waushara

Year Selected-Map Number	Small-scale Priority Watershed Project	County(ies)
SS-1	Bass Lake*	Marinette
SS-90-1	Dunlap Creek	Dane
SS-90-2	Lowes Creek	Eau Claire
SS-90-3	Port Edwards - Groundwater Prototype	Wood
SS-91-1	Whittlesey Creek	Bayfield
SS-91-2	Spring Creek	Rock

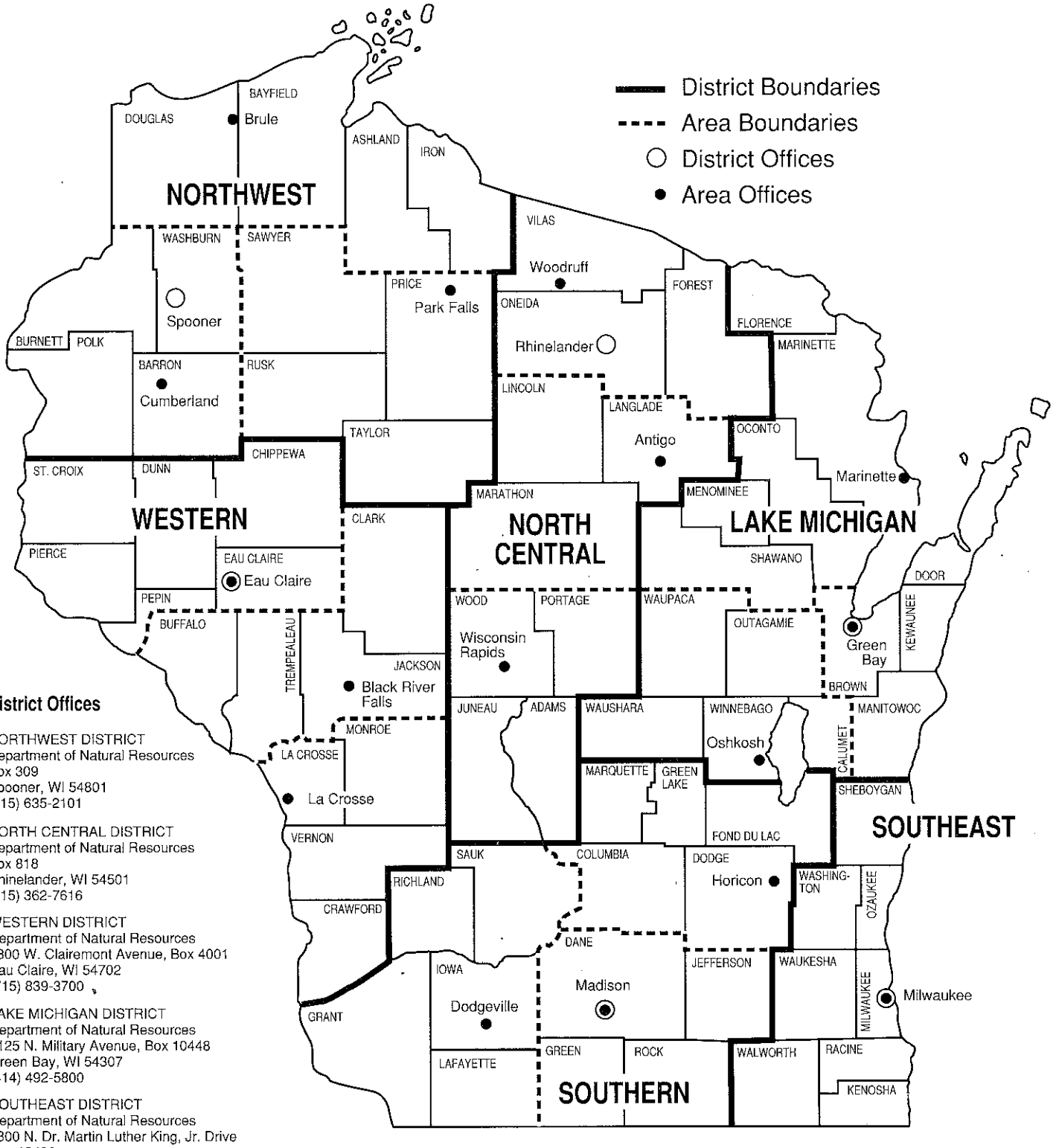
Year Selected-Map Number	Priority Lake Project	County(ies)
PL-90-1	Minocqua Lake	Oneida
PL-90-2	Lake Tomah	Monroe
PL-91-1	Little Muskego, Big Muskego, Wind Lakes	Waukesha, Racine, Milwaukee
PL-92-1	Lake Noquebay	Marinette
PL-92-2	Lake Ripley	Jefferson
PL-93-1	Camp/Center Lakes	Kenosha
PL-93-2	Lake Mendota	Dane, Columbia
PL-93-3	Hillsboro Lake	Vernon

** Project completed*

Priority Watershed Projects in Wisconsin
1993



DNR Field Districts and Areas



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Our Mission:

To protect and enhance our Natural Resources—
our air, land and water;
our wildlife, fish and forests.

To provide a clean environment
and a full range of outdoor opportunities.

To insure the right of all Wisconsin citizens
to use and enjoy these resources in
their work and leisure.

And in cooperation with all our citizens
to consider the future
and those who will follow us.

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DEPT. OF NATURAL RESOURCES

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