Nonpoint Source Control Plan for the Middle Peshtigo-Thunder Rivers Priority Watershed Project

This plan was prepared under the provisions of the Wisconsin Nonpoint Source Pollution Abatement Program by the Wisconsin Department of Natural Resources, the Department of Agriculture, Trade and Consumer Protection, the Marinette Land & Water Conservation Department and the Oconto County Land Conservation Department.

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Nonpoint Source Control Plan for the Middle Peshtigo-Thunder Rivers Priority Watershed Project

The Wisconsin Nonpoint Source Water Pollution Abatement Program

August 1998

This Plan Was Cooperatively Prepared by:

The Wisconsin Department of Natural Resources
Wisconsin Department of Agriculture, Trade and Consumer Protection
and
Marinette County
Land & Water Conservation Department and
Oconto County Land Conservation Department

Publication WT-516-98

For copies of this document please contact:

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List of Acronyms

ACP	Agricultural Conservation Program
BARNY	Barnyard nutrient analysis model
BIM-GEO	DNR Bureau of Information Management-Geographical Unit
BMP	Best Management Practice
CAC	Citizen Advisory Committee
CFSA	Consolidated Farm Services Agency (United States Department of Agriculture)
COD	Chemical Oxygen Demand
COMM	Department of Commerce
CRP	Federal Cropland Reserve Program
CSA	Cost share agreement
DATCP	Wisconsin Department of Agriculture, Trade, and Consumer Protection
DNR	Wisconsin Department of Natural Resources
DOC	Department of Commerce
FFA	Future Farmers of America
FOCS	Field Offices Computing System
FPP	Wisconsin Farmland Protection Program
FSA	Food Security Act
GW	Groundwater
I&E	Information and Education
LCC	Land Conservation Committee
LCD	Land Conservation Department
LWCB	Land and Water Conservation Board
NPM	Nutrient and Pest Management
NPS	Nonpoint Source Program
NRCS	Natural Resource Conservation Service
SHS	Wisconsin State Historical Society
SIP	Stewardship Incentive Program
SOS	Signs of Success monitoring program
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UWEX	University of Wisconsin-Extension
WGNHS	Wisconsin Geological and Natural History Survey
WINHUSLE	Sediment transfer model based on the Universal Soil Loss Equation
WPDES	Wisconsin Pollutant Discharge Elimination System [permit system]
WUWN	Wisconsin Unique Well Number assigned to well sample sites

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

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George E. Meyer, Secretary

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July 24, 1998

Mr. Adolph J. Staidl, Chair
Marinette County Board
N1113 CTY HWY W
Peshtigo, WI 54157

Subject: Middle Peshtigo-Thunder Rivers Priority Watershed Plan

Dear Mr. Staidl:

I am pleased to approve the Middle Peshtigo-Thunder Rivers Priority Watershed Plan prepared through the Wisconsin Nonpoint Source Pollution Abatement Program. This plan meets the intent and conditions of s. 281.65, Wisconsin Statutes, and Chapter NR 120, Wisconsin Administrative Code. This plan has been reviewed by the Department of Agriculture, Trade and Consumer Protection and was approved by the State Land and Water Conservation Board on August 3, 1998. I am also approving this plan as an amendment to the Upper Green Bay Basin Water Quality Management Plan.

I recognize that adequate funding for program implementation has been a concern for several grantees. As we continue to work out these issues, please be assured that agency staff recognize the need for flexibility during this time of change and transition.

I would like to express the Department's appreciation to the Marinette County Land & Water Conservation Department Staff that participated in preparing this plan. The implementation of the Middle Peshtigo-Thunder Rivers Priority Watershed Project will greatly enhance the regional water quality and set a standard for future projects selected as part of the Wisconsin Nonpoint Source Pollution Abatement Program.

Sincerely,

George

— a great project, Congratulations

George E. Meyer
Secretary

cc: Ben Brancel, DATCP
Bill Kowalski, Marinette County LWCD
John Young - NER
Greg Cleereman, Marinette County LWCD
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July 24, 1998

Leland Rimes, Chair
Oconto County Board
301 Washington St.
Oconto, WI 54153

Subject: Middle Peshtigo-Thunder Rivers Priority Watershed Plan

Dear Mr. Rimes:

I am pleased to approve the Middle Peshtigo-Thunder Rivers Priority Watershed Plan prepared through the Wisconsin Nonpoint Source Pollution Abatement Program. This plan meets the intent and conditions of s. 281.65, Wisconsin Statutes, and Chapter NR 120, Wisconsin Administrative Code. This plan has been reviewed by the Department of Agriculture, Trade and Consumer Protection and was approved by the State Land and Water Conservation Board on August 3, 1998. I am also approving this plan as an amendment to the Upper Green Bay Basin Water Quality Management Plan.

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Sincerely,

George

— a great project, Congratulations

George E. Meyer
Secretary

cc: Ben Brancel, DATCP
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Clifford Sellen, Oconto Co. LCC
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Bob Uphoff, LWCB
John Young - NER
Barbara Kneer, DNR, CF/8
Jill Jonas, DNR, WT/2
Len Olson, DATCP

RESOLUTION NO. 98-99-8

ADOPTING THE NONPOINT SOURCE CONTROL PLAN FOR THE MIDDLE PESHTIGO-THUNDER RIVERS PRIORITY WATERSHED PROJECT

WHEREAS, the Middle Peshtigo-Thunder Rivers Watershed was designated by the Department of Natural Resources in 1996 under the Wisconsin Nonpoint Source Water Pollution Abatement Program, and

WHEREAS, this project is a continuation of the Middle Peshtigo-Thunder Rivers Watershed Project and compliments the goals of improved water quality in the Middle Peshtigo-Thunder Rivers, and

WHEREAS, the Marinette County Land & Water Conservation Department in cooperation with the Department of Natural Resources and the Department of Agriculture, Trade and Consumer Protection conducted a detailed inventory of the land use within the watershed in 1996 and 1997, and

WHEREAS, this inventory resulted in the development of a detailed nonpoint source control plan for the watershed, and

WHEREAS, a number of public informational meetings have been conducted throughout the watershed, and an official public hearing was conducted on April 29, 1998, and

WHEREAS, pertinent public comments have been incorporated into the plan, and

WHEREAS, the County wishing to receive cost sharing grants for landowners in the watershed must first adopt the Middle Peshtigo-Thunder Rivers Watershed Plan.

NOW, THEREFORE, BE IT RESOLVED, by the Board of Supervisors of the County of Marinette that the Middle Peshtigo-Thunder Rivers Watershed Nonpoint Source Priority Watershed Plan be adopted and the implementation of the plan begin as soon as possible.

Approved by a majority of a quorum of the Marinette County Board of Supervisors this 26th day of May, 1998.

Adolph Staidl, Chairperson

Don E. Phillips, County Clerk

State of Wisconsin)
County of Marinette) ss.
I, Don E. Phillips, County Clerk in and for the County of Marinette, do hereby certify that the foregoing is a true and correct copy of a resolution adopted by the County Board of Supervisors in said County
on May 26 1998

County Clerk
Marinette Wisconsin

FISCAL NOTE: No fiscal impact in 1998.

RESOLUTION # 35 - 1998

TO: The Honorable Chairman and Members of the Oconto County Board of Supervisors

RE: Adopting the Middle Peshtigo & Thunder River Non Point Source Priority Watershed Plan

WHEREAS, the Middle Peshtigo and Thunder Rivers Watershed was designated by the .....Department of Natural Resources in 1996 under the Wisconsin Nonpoint Source Water Pollution Abatement Program, and

WHEREAS, this project is a continuation of the Middle Peshtigo & Thunder Rivers Watershed Project and compliments the goals of improved water quality in the Middle Peshtigo & Thunder Rivers, and

WHEREAS, the Marinette County Land and Water Conservation Department in cooperation with Oconto Co Land Conservation Division, the Department of Natural Resources and the Department of Agriculture, Trade and Consumer Protection conducted a detailed inventory of the land use within the watershed in 1996 and 1997, and

WHEREAS, this inventory resulted in the development of a detailed nonpoint source control plan for the watershed, and

WHEREAS, Marinette County Land and Water Conservation Department conducted a number of public informational meetings and hearings throughout the watershed, and

WHEREAS, pertinent public comments have been incorporated into the plan, and

WHEREAS, the Counties wishing to receive cost sharing grants for landowners in the watershed must first adopt the Middle Peshtigo & Thunder Rivers Watershed Plan.

NOW, THEREFORE, BE IT RESOLVED, by the Board of Supervisors of the County of Oconto that Middle Peshtigo & Thunder Rivers Watershed Nonpoint Source Priority Watershed Plan be adopted and implementation of the plan begin as soon as possible.

Submitted this 21st day of May, 1998

BY: THE LAND CONSERVATION COMMITTEE

Clifford Sellen — Russel Brock

Everett Carlson — James Schroeder

Bill Grady — Donald Telford

Adopted by:

Vote:

Ayes 28 Nays 0 Absent 3

Reviewed by Corporation Counsel:

Initials of Corp. Counsel — Date Reviewed 4-22-98

STATE OF WISCONSIN
County Oconto } I, Rose Stellmacher do hereby certify that the above is a true and correct copy of the original now on file in the office of the County Clerk and that it was adopted by the Oconto County Board of Supervisors on this date.

Date: 5-21-98 Rose Stellmacher

Middle Peshtigo - Thunder Rivers Priority Watershed

Project Summary

Introduction

The purpose of the Nonpoint Source Control Plan developed for this project is to assess the nonpoint pollution in the Middle Peshtigo-Thunder Rivers Watershed and guide the implementation of pollution prevention and control measures during the next ten years. These prevention and control measures are needed to maintain the excellent water quality in the watershed and to meet specific water resource objectives for the Middle Peshtigo-Thunder Rivers Watershed.

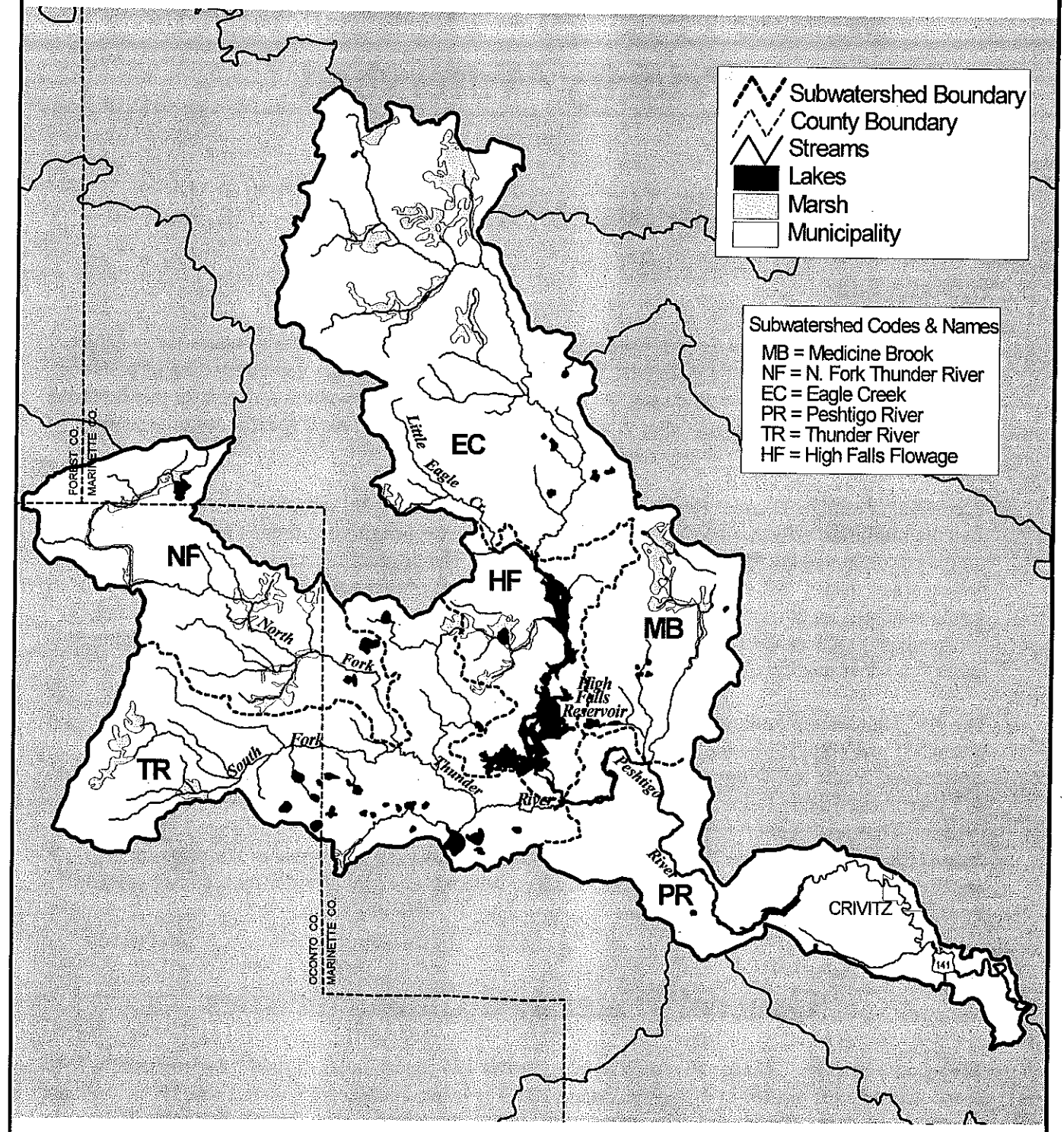
The Middle Peshtigo-Thunder Rivers Watershed is unique in that it has a protection orientation rather than the traditional remediation focus. This project will take a proactive approach to prevent nonpoint source pollution and the loss of fish and wildlife habitat. The primary objective of the project is to protect water quality and reduce existing sources of nonpoint source pollution. The project has a strong emphasis on citizen and landowner education. Watershed residents need to learn how land management practices used in the watershed, and their individual actions and choices, have a direct impact on water quality.

The Nonpoint Source Pollution Control Plan for the Middle Peshtigo-Thunder Rivers priority watershed was prepared by the Department of Natural Resources (DNR), the Department of Agriculture, Trade and Consumer Protection (DATCP), and the Marinette and Oconto Counties Land & Water Conservation Departments. The Land and Water Conservation Board selected the Middle Peshtigo-Thunder Rivers watershed as a priority watershed project in 1995. The State Legislature created the Nonpoint Source Pollution Abatement Program in 1978. The goal of the program is to protect and improve water quality in lakes, streams, wetlands and groundwater by reducing pollutants from urban and rural nonpoint sources.

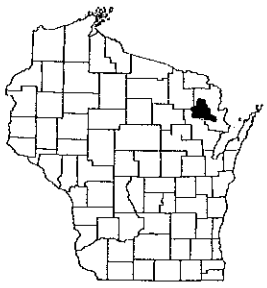
General Watershed Characteristics

The Middle Peshtigo-Thunder Rivers Watershed drains 194-square-miles of land. Approximately 76% of the watershed is located in Marinette County, 23% is located in Oconto County, and 1% is in Forest County in northeast Wisconsin. The watershed is within the Upper Green Bay Basin and drains to Upper Green Bay, and ultimately to Lake Michigan. The watershed is divided into six smaller drainage areas, called subwatersheds, for this planning effort (see map S-1).

Map S-1 Middle Peshtigo-Thunder Rivers Priority Watershed



STUDY AREA



Wisconsin Department of
Natural Resources
Water Division
Bureau of Watershed Management
March 1998

Mapscale 1:228,000

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Forestry is the most prominent land use in the watershed, as listed in table S-1. The year round population in the watershed is approximately 2,900, however, the seasonal population is near 10,000 and is growing. Most of the watershed population lives in single family dwellings outside of incorporated areas. Waterfront development within the watershed has increased 139% since 1976.

Table S-1 Land Uses in the Middle Peshtigo-Thunder Rivers Watershed

Land Use	Acres	Percent
Woodland	87,987	71.0%
Wetland	16,788	13.5%
Developed	7,363	5.9%
Agriculture	5,444	4.4%
Surface Water	3,618	2.9%
Roads	1,604	1.3%
Developed Riparian Land	1,146	0.9%
Total	123,950	100.0%

The Middle Peshtigo-Thunder Rivers Watershed is a popular recreation destination for sight-seers, anglers, hunters, and boaters. The watershed encompasses many miles of Class I trout water, ten water bodies that have been designated as Outstanding Resource Waters, or Exceptional Resource Waters, more than 50 beautiful lakes, and three impoundments on the Peshtigo River.

Lakefront property owners across the state say that "peace and quiet" and "natural beauty and wildlife" are the most important reasons for owning lakefront property. Yet these amenities are rapidly being eliminated by increased development. Violations of Shoreland Zoning due to excessive removal of vegetation are commonplace. Filling of riparian wetlands, removal of aquatic vegetation, and destruction of aquatic and riparian habitats are epidemic.

Local citizenry and officials have difficulty understanding how their personal actions and activities on the land directly impact water quality and the environment. Very few people are against clean water and a healthy environment. The challenge is to educate people and provide the motivation to alter behavior and land use and land management practices, and to preserve and protect the natural resources within the watershed.

Water Quality

Water quality throughout the watershed is in good to excellent condition, and the natural environment is healthy. However, there are serious threats on the horizon to ground and surface water. Proximity to population centers and the existing high quality water resources make the watershed very attractive to recreationists, retirees, and seasonal residents.

Ground water in the watershed is among the most susceptible in the state to contamination due to the soils in the area. The Village of Crivitz has already had to abandon one municipal well because of contamination. Most watershed residents rely on shallow driven sand point wells for home water supplies. These wells are easily contaminated by improper land use and poor management practices.

Riparian development is the greatest threat to surface water quality in the Middle Peshtigo-Thunder Rivers Watershed. Rapid increases in waterfront land prices are driving development pressure ever higher. As a result of increased land prices, otherwise unattractive, wet, rocky, or steep parcels face development. It is more difficult to alter these landscapes without harming nearby water resources. Crucial riparian habitats and wetlands are being lost and water quality is becoming degraded.

Sources of Nonpoint Pollution

The Marinette County Land & Water Conservation Department collected data on developed riparian lots, streambanks, all agricultural lands, and barnyards. These data were used to estimate the pollution potentials for these nonpoint sources. The average amount of sediment and phosphorus from each developed riparian lot was also estimated. The amount of phosphorus (organic) carried in runoff from each barnyard to a receiving stream was calculated and nitrogen from barnyards draining to closed depressions was estimated. The amount of sediment reaching streams from agricultural lands was also determined.

The following is a summary of the inventory results:

Developed Riparian Shoreline Inventory Results

- Two-hundred eighty-two developed riparian lots were assessed.
- At least 26% had moderate or greater shoreline erosion.
- 60% did not meet local shoreland zoning standards, primarily due to excessive removal of shoreline vegetation or structures built within the 75-foot set back.
- Existing developed properties and those under construction were estimated to contribute 590 lbs. of phosphorus to surface waters annually.

Barnyard Runoff Inventory Results

- Sixteen barnyards were assessed.
- These barnyards were found to contribute 119 lbs. of phosphorus to surface waters.
- These barnyards were found to contribute 27,829 lbs. of nitrogen to closed depressions.

Upland Sediment Inventory Results

- 5,444 acres were inventoried.
- 782 tons of cropland sediment is delivered to streams annually.

Wetland Inventory

- The inventory identified 16,788 acres of wetlands. 2,042 acres of wetlands have been drained.

Groundwater Inventory

At this time, groundwater resources in the Middle Peshtigo-Thunder Rivers watershed are generally considered to be good. However, the aquifers are shallow and the soils are sandy and very susceptible to contamination.

The groundwater inventory for the watershed is summarized in table S-2.

Table S-2 Groundwater inventory results in the Middle Peshtigo-Thunder Rivers watershed

	>PAL	>ES	Atrazine Detectable
48 samples taken for nitrate & nitrite	4	2	0
50 samples taken for Atrazine	1	0	3

PAL - preventative action limit for nitrate and nitrite
ES - enforcement standard for nitrate and nitrite

Enforcement Standard (ES) Health Advisory Level: The concentration of a substance at which a facility regulated by COMM, DATCP, DOT or DNR must take action to reduce the concentration of the substance in groundwater.

Preventative Action Limit (PAL): A lower concentration of a contaminant than the Enforcement Standard. The PAL serves to inform WDNR of potential groundwater contamination problems, establish the level at which efforts to control the contamination should begin, and provide a basis for design codes and management criteria.

Water Quality Goals and Pollutant Reduction Objectives

The goal of the Middle Peshtigo-Thunder Rivers watershed project is:

> ***To protect the water resources and fish and wildlife habitat in the watershed, and ultimately the Peshtigo River and Green Bay.***

This goal will be accomplished by meeting the following objectives:

1. Educating citizens, businesses, county, state, federal, and local units of government about how their personal actions and decisions affect water quality.
2. Adopting good riparian stewardship BMPs.
3. Protecting riparian habitat and sensitive littoral areas from recreational use and development.
4. Adopting Best Management Practices (BMPs) for all agricultural activities within the watershed.
5. Ensuring forestry BMPs are implemented on all lands.
6. Improving enforcement of environmental quality related laws, codes, and ordinances on a federal, state, county, and local level.
7. Protecting the cold water nature of watershed streams.
8. Protecting wetlands and headwater areas.
9. Protecting groundwater quality that is a source of water to streams, lakes, wetlands and people.

The following pollution reductions will be targeted throughout the watershed.

Sediment Objectives:

Reduce overall sediment delivered by 44 percent. To meet this objective, the following is needed:

- 40 percent reduction in sediment reaching streams from agricultural croplands in all subwatersheds.
- repair all gully erosion sites and all acute streambank erosion sites
- 55 percent reduction in shoreline and streambank sediment delivered to surface waters.

Phosphorus Objective:

Reduce overall phosphorus loading by 30 percent. To meet this objective, the following is needed:

- 40 percent reduction in phosphorous from barnyards draining to surface waters in all subwatersheds.
- 40 percent reduction in phosphorous from land spread manure.
- 30 percent reduction of urban style lawns in the 75-foot setback on developed riparian properties in the watershed.
- Shoreline Buffers (or the Shoreline Habitat Restoration BMP) will be installed on 75 riparian lots.[1]

[1]The Shoreline Habitat Restoration Interim BMP is currently being reviewed by DNR's Bureau of Watershed Management for its ability to protect water quality. Upon approval, it will be eligible for use in this watershed.

Groundwater Objective:

Protect and enhance the groundwater in the Middle Peshtigo-Thunder Rivers watershed. To meet this objective, the following is needed:

- Properly seal all unused wells within the watershed.
- Encourage the Village of Crivitz to draft a Wellhead Protection Plan and create a Wellhead Protection Ordinance.
- Provide cost sharing for Nutrient and Pest Management for all watershed farmers.

Management Actions

Management actions are described in terms of best management practices (BMPs) that are needed to control nonpoint sources to the pollutant levels described above. Cost-share funds will be available through the Wisconsin Nonpoint Source Water Pollution Abatement Program for certain BMPs. The Marinette County LWCD will contact all landowners who are eligible to receive cost-share funds during the project's implementation. Because most of the watershed lands located within Oconto County are forested, and lie within the boundaries of the Nicolet National Forest, Oconto County LCD staff does not anticipate making landowner contacts for cost share agreements.

Management classifications are determined based on the level of pollution control needed to achieve water quality objectives in the watershed. Specific sites or areas within the watershed are designated as either "critical," "eligible," or "ineligible". Designation as a critical site indicates that controlling that source of pollution is essential for meeting the pollution reduction goals of the project. Nonpoint sources which are classified as eligible, but not critical, contribute less of the pollutant load, but are eligible for cost sharing to further insure that water quality objectives are met. Landowners with eligible sites need not control every eligible source to receive cost-sharing assistance.

Marinette County staff will also examine the need for wellhead protection areas. These are surface and subsurface areas surrounding a water well or well field, supplying a public water system, through which contaminants are reasonably likely to move toward the ground water source.

Shoreline Erosion

All bare and eroding shoreline/stream bank reaches in the watershed will be eligible for BMPs, with an emphasis on controlling erosion to improve fish and wildlife habitat. Priority for installation of BMPs will be given to sites that are actively eroding, have largely non- vegetated surfaces, or have urban style manicured lawns greater than 30 feet wide at the water's edge. Developed lots on watershed lakes and streams that do not meet the Marinette County Shoreland Zoning Ordinance vegetative removal limits will be eligible for cost sharing.

Cropland Erosion

The Water Resources Appraisal for the watershed revealed little evidence of cropland erosion. Agricultural operations are located in just 2 of the subwatersheds in the project, nonetheless, cropland erosion can be controlled to protect water quality. A 40% reduction in sediment from eroding fields is

targeted for agricultural lands. Critical fields are defined as those that are contributing sediment to streams at a rate greater than 0.6 tons/acre/year and have soil loss greater than "T". Approximately 428 acres of cropland have been identified as critical. Controlling nonpoint source pollution from these areas will control an estimated 12.3 percent of the upland sediment load (96 tons) of the watershed. The average sediment delivery rate for all subwatersheds is 0.13/tons/acre/year. Cropland classified as eligible will include land contributing sediment to streams at a rate greater than 0.1 tons/acre/year.

Ground Water

Groundwater in the watershed is generally good at this time. However, watershed soils are shallow and very susceptible to pollution. All abandoned and unused wells are eligible for cost sharing for the well abandonment BMP. The Village of Crivitz will be encouraged to create a well head protection area around their municipal wells in an effort to protect the recharge areas for the wells. All watershed farmers will be eligible for nutrient management cost-sharing.

Barnyard Runoff

The objective for barnyard runoff control in the watershed is to reduce phosphorus loading to streams by a total of 40%. Barnyard sites contributing a phosphorus load greater than 50 lbs. annually will be designated as critical for control. There is one barnyard in the watershed that falls into this category. Barnyard sites that contribute between 20 lbs. and 50 lbs. of phosphorus annually will be considered eligible for cost-sharing. Barnyard sites in this category will need to reduce annual phosphorus loading to less than ten pounds in order to reach the project's phosphorus reduction objective.

Nitrogen is the nutrient of most concern to ground water due its potential impacts on human health. Internally drained barnyards drain to surface depressions or wetlands rather than directly to surface waters. Soils within the watershed are among the most susceptible in the state to ground water contamination. Therefore all internally drained barnyards within the watershed delivering greater than 2000 lbs. of nitrogen/year will be eligible for cost sharing.

Manure Spreading

An operation is eligible for a manure storage facility if a preliminary nutrient management plan developed with the Manure Storage Rating Guide (MSRG) for surface waters demonstrates that manure cannot be feasibly managed during periods of snow covered, frozen and saturated conditions, without the installation of storage practices.

If the runoff from manure at the site is directly impacting surface waters, that site will be considered eligible for cost sharing. A nutrient management plan may also be needed to demonstrate proper utilization of the manure. The sandy soils in the Middle Peshtigo-Thunder Rivers Watershed are among the most susceptible in the state to ground water contamination.

Project Implementation

Project Implementation is scheduled to begin in August, 1998, and will continue for 10 years. Implementation will consist of continuous educational activities for watershed residents, the signing of cost share agreements, and Best Management Practice (BMP) installation. Implementation will focus on the installation of BMPs in developed riparian areas and in agricultural areas.

Project Cost Estimates

Project cost estimates are based on projections developed by agency planners and local staff. Historically, the actual expenditures for projects are less than estimated costs.

Table S-3 Cost Estimates for the Middle Peshtigo-Thunder Rivers Priority Watershed Project.

Eligible Activity	Total Cost	State Share
Cost Sharing	$1,010,594	$696,775
Easements	$75,000	$75,000
Marinette County Staffing	$985,000	$985,000
Educational Activities	$110,000	$110,000
Totals	$2,180,594	$1,866,775

Disclaimer

Meeting project pollution reduction goals and objectives, as well as those for Information and Education, depends on maintaining the funding and staffing levels called for in the Nonpoint Source Pollution Control Plan for the Middle Peshtigo - Thunder Rivers Watershed. The current Financing Plan for Priority Watershed Projects does not provide sufficient funding to reach the goals and objectives of the plan. Until funding levels are increased, meeting plan goals will not be possible.

Information and Education

Currently, water quality in the Middle Peshtigo-Thunder Rivers watershed is good, and the local environment is healthy. However, there are serious threats to surface and ground water on the horizon. Local citizens need to be aware of the possible threats to water quality. A strong information and education plan is the most important component of this protection oriented watershed project.

The overall goal of the information & education activities for the watershed is:

> ***Residents of the watershed will make decisions and take actions that provide long term protection for surface and groundwater in the Middle Peshtigo-Thunder Rivers Watershed.***

This will be accomplished through the following objectives:

1) Assist rural and village residents, especially riparian landowners, in minimizing the impact of nutrients, sediment, and other pollutants from their properties and septic systems on water quality. Help these residents understand the connection between their actions on the land and water quality.

2) Create a sense of stewardship and appreciation for local water resources while providing the skills and knowledge to preserve them.

3) Assist local government officials and citizens to better understand the benefits of land use planning, shoreland zoning, and septic system ordinances.

4) Assist farmers, contractors, and loggers in minimizing the impact of nutrients, sediment, and other pollutants on water quality.

5) Develop strategies and resources to increase environmental awareness in local schools.

6) Create a recognition program for landowners who install best management practices and for those whose property was being managed in an environmentally friendly manner before implementation of the watershed project began.

7) Form partnerships with local stakeholders interested in protecting water and environmental quality.

Project Evaluation and Monitoring

The evaluation strategy for the project involves collecting, analyzing, and reporting information to track progress in three areas.

1. **Administrative:** This category includes the progress in providing technical and financial assistance to eligible landowners, and carrying out the education activities identified in the plan. The Marinette County LWCD will track the progress in this area and report to the WDNR and DATCP annually.

2. **Pollutant Reduction Levels:** The Marinette County LWCD will calculate the reductions in nonpoint source pollutant loadings resulting from changes in land use practices and report to the WDNR and DATCP at an annual review meeting.

3. **Watershed Resource Evaluation Monitoring:** Limited funds and the intensive staffing needed to properly evaluate water quality changes prohibits monitoring each watershed individually. DNR may choose to conduct monitoring activities periodically during the project and at the end of the project.

CHAPTER ONE
Purpose, Legal Status and General Description

Wisconsin Nonpoint Source Water Pollution Abatement Program

The State Legislature created the Wisconsin Nonpoint Source Water Pollution Abatement Program in 1978. The goal of the Program is to improve and protect the water quality of streams, lakes, wetlands, and groundwater by reducing pollutants from urban and rural nonpoint sources. The 194-square-mile Middle Peshtigo-Thunder Rivers Watershed is located in Marinette, Oconto, and Forest Counties. It was designated a "priority watershed" in 1995, and planning began in 1996. The primary objective of this project is to protect and enhance the water quality of the surfacewater and groundwater in the Middle Peshtigo-Thunder Rivers Watershed. The Middle Peshtigo-Thunder Rivers is part of the Upper Green Bay Basin.

Nonpoint sources of pollution in the watershed include: erosion from developing areas, runoff from established riparian lands, eroding agricultural and timber harvesting areas, eroding streambanks and roadsides and runoff from livestock wastes and agricultural practices. Pollutants from nonpoint sources are carried to the surface water or groundwater through rainfall runoff or seepage, and snow melt.

The following is an overview of the Nonpoint Source (NPS) Priority Watershed program:

- The Department of Natural Resources (DNR) administers the program in cooperation with the Department of Agriculture, Trade and Consumer Protection (DATCP). Wisconsin is divided into 333 discrete Hydrologic units called watersheds. These watersheds are assessed for water quality concerns as part of a comprehensive basin planning program. Watersheds with a high degree of water quality impairment from nonpoint sources of pollution become eligible for consideration as a priority watershed project. As directed by the state legislature, these high-ranking watersheds must be planned by 2015. Designation as a priority watershed project enables special financial support to local governments and private landowners in the watershed to reduce nonpoint source pollution.
- A priority watershed project is guided by a plan such as this one, prepared cooperatively by the DNR, DATCP and local units of government, with input from a local citizen's advisory committee. Project staff will evaluate the conditions of surface water and groundwater, and inventory the types of land use and nonpoint sources of pollution throughout the watershed. The priority watershed plan assesses nonpoint and other sources of water pollution and identifies best management practices (BMPs) needed to control pollutants to meet specific water resource objectives. The plan guides implementation of these practices to improve water quality.
- Upon approval by state and local authorities, local units of government implement the plan. Water quality improvement is achieved through mandatory and voluntary implementation of nonpoint source controls (BMPs) and the adoption of ordinances. Landowners, land renters,

counties, cities, villages, towns, sanitary districts, lake districts, and regional planning commissions are eligible to participate.

- Technical assistance is provided to aid in the design of BMPs. State level cost-share assistance is available to help offset the cost of installing these practices. Eligible landowners and local units of government are contacted by the local staff to determine their interest in installing the BMPs identified in the plan. Signed cost-share agreements list the practices, costs, cost-share amounts and a schedule to install management practices. Municipal governments are also assisted in developing and installing BMPs to reduce urban pollutants.
- Informational and educational activities are developed to encourage participation.
- The DNR and DATCP review the progress of the counties and other implementing units of government, and provide assistance throughout the ten-year project. The DNR monitors improvements in water quality resulting from control of nonpoint sources in the watershed.

Legal Status of the Nonpoint Source Control Plan

The Middle Peshtigo-Thunder Rivers Priority Watershed Plan was prepared under the authority of the Wisconsin Nonpoint Source Water Pollution Abatement Program described in Section 281.65 of the Wisconsin Statutes and Chapter NR 120 of the Wisconsin Administrative Code. It was prepared through the cooperative efforts of the DNR, DATCP, Marinette County Land & Water Conservation Department, Oconto County Land Conservation Department and the Middle Peshtigo-Thunder Rivers Citizens Advisory Committee.

This watershed plan is the basis for the DNR to enter cost-share and local assistance grants with agencies responsible for project implementation and will be used as a guide to implement measures to achieve desired water quality conditions. If a discrepancy occurs between this plan and the statutes or the administrative rules, or if statutes or rules change during implementation, the statutes and rules will supersede the plan. This watershed plan does not in any way preclude the use by local, state or federal governments of normal regulatory procedures developed to protect the environment. All local, state and federal permit procedures must be followed. In addition, this plan does not preclude the DNR from using its authority under chapters 280 to 300 of the state statutes to regulate significant nonpoint pollution sources in the project area.

This priority watershed plan was approved by DNR following approvals by the Oconto County Land Conservation Committee, the Marinette County Land Conservation Committee and the Land and Water Conservation Board.

Amendments to the Plan

This plan is subject to the amendment process under NR 120.08(4) for substantive changes. The Department of Natural Resources will decide with the local sponsors if a proposed change will require a formal plan amendment.

Relationship of the Nonpoint Source Control Plan to the Stormwater Discharge Permit Program

Wisconsin's Pollution Discharge Elimination System (WPDES) Storm Water Permit Program is administered by DNR's Bureau of Watershed Management under Section 283 of the Wisconsin Statutes and Ch. NR 216 Wis Admin. Code. This program is regulatory and not grant dependent and applies to certain classes of dischargers statewide as identified in NR 216. However, in some cases, permit activities are similar to activities identified in the watershed plan. If this is true, then nonpoint source implementation grants may be used to fund permit activities. Examples include: construction site erosion control, stormwater ordinance development, and stormwater management plans. Practices to control construction site erosion and stormwater runoff from new development are not eligible for cost-sharing. In industrial areas, cost sharing is available as specified in NR 120.17 — only in the nonindustrial parts of facilities where a problem has also been identified in the priority watershed plan.

Priority Watershed Project Planning and Implementation Phases

Planning Phase

The planning phase of the Middle Peshtigo-Thunder Rivers Priority Watershed project began in 1996. The following information gathering and evaluation activities were completed during this stage:

- Determine the conditions and uses of groundwater, streams, and lakes.
- Inventory types of land uses and severity of nonpoint sources affecting groundwater, streams and lakes.
- Evaluate the types and severity of other factors which may be affecting water quality. Examples include discharges from municipal wastewater treatment plants and natural or endemic stream conditions. (This has been completed through the ongoing integrated resource management planning efforts in the Upper Green Bay Basin.)
- Determine nonpoint source controls and other measures necessary to improve and/or protect water quality.
- Prepare and gain approval of a program for local implementation of the project so that plan recommendations would be carried out.

Implementation Phase

The implementation phase of the Middle Peshtigo-Thunder Rivers Priority Watershed Project began following review of the draft priority watershed plan, a public hearing, and approval by the Oconto County Board, the Board of Supervisors for Marinette County, DNR, and the Land & Water Conservation Board. Public review during plan development occurred primarily through the efforts of the Middle Peshtigo-Thunder Rivers Citizen Advisory Committee.

During the implementation phase:

- DNR enters local assistance agreements with local units of government that have 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, the Marinette County LWCD and Oconto County LCD contact eligible landowners about their interest in installing best management practices identified in the plan.
- In the urban portions of the watershed, the DNR or its designee contacts local units of government to discuss in detail the required actions for implementing the plan recommendations.
- In rural areas, the landowner signs a cost-share agreement with the one of the counties that outlines the practices, costs, cost-share amounts and a schedule for installation of management practices. Practices are scheduled for installation after an agreement is signed. Practices must be maintained for at least 10 years. Easements purchased by WDNR must be perpetual. Easements purchased by any other eligible unit of government, and funded by DNR, must be for at least 20 years.

Location and Community Information

The Middle Peshtigo-Thunder Rivers Watershed is a 194-square-mile drainage basin found approximately 70 miles north-northwest of Green Bay (map 1-1). Approximately 76% of the watershed is located within Marinette County, 23% is in Oconto County, and 1% is in Forest County. This watershed is among the most popular recreation areas in northeast Wisconsin. It contains many miles of Class I trout water, beautiful lakes, and High Falls Flowage, a large, heavily used impoundment. The portion of the watershed within Marinette county is mostly rural and forested in nature. Only 4.4% of the land use in the entire watershed area is in agriculture. There are no agricultural operations in Oconto County. Most of the land in Oconto County is held by the Nicolet National Forest. The Middle Peshtigo-Thunder Rivers Watershed is within the Upper Green Bay Basin.

The Middle Peshtigo-Thunder River Watershed is at a crossroads in terms of water quality and the environment. Water quality is still good and the local environment healthy. However, there are serious threats on the horizon to groundwater and surface water. Proximity to population centers and high quality water resources make the watershed very attractive to tourists, retirees, and seasonal residents.

Ground water in the watershed is among the most susceptible in the state to contamination. The Village of Crivitz has already had to abandon one municipal well because of contamination. Most watershed residents rely on shallow driven sand point wells for home water supplies. These wells are easily contaminated by improper land use and bad management practices.

Development is the greatest threat to surface water quality in the Middle Peshtigo-Thunder Rivers Watershed. Rapid increases in waterfront land prices are driving development pressure ever higher. The amount of privately held riparian land has increased by 139% since 1976. In addition to increases in land prices, otherwise unattractive wet, rocky, or steep parcels face development. It is more difficult to alter these landscapes without harming nearby water resources, especially as many land

owners fail to realize the impacts that land use can have on water quality (Bernthal & Jones, 1997). Almost 100 percent of the drained wetlands in the watershed are found in nonagricultural areas. Most of the drainage activities have occurred in stream corridors or riparian areas. Crucial riparian habitat and wetlands are being lost and water quality is becoming degraded.

Lakefront property owners across the state say that "peace and quiet" and "natural beauty and wildlife" are the most important reasons for owning waterfront property (Czarneski 1996, Shifferd 1996, Korth, et al., 1994). Yet we are rapidly eliminating those amenities from our lake shores. Violations of local Shoreland Zoning ordinances due to excessive removal of vegetation are commonplace. Filling of riparian wetlands, removal of aquatic vegetation, and destruction of aquatic and riparian habitat are epidemic. User conflicts between anglers, skiers and jet skiers, swimmers, property owners, wildlife observers, and neighbors are on the rise as we compete for finite resources. These conflicts will only increase as access to the watershed improves.

Local citizenry and officials don't always realize the impact that their activities on the land have on water resources and environmental quality. Very few people are against clean water and a healthy environment. The challenge is to educate people and provide the motivation to alter their behavior, land use, and land management practices to preserve and protect the natural resources we value.

Civil Divisions

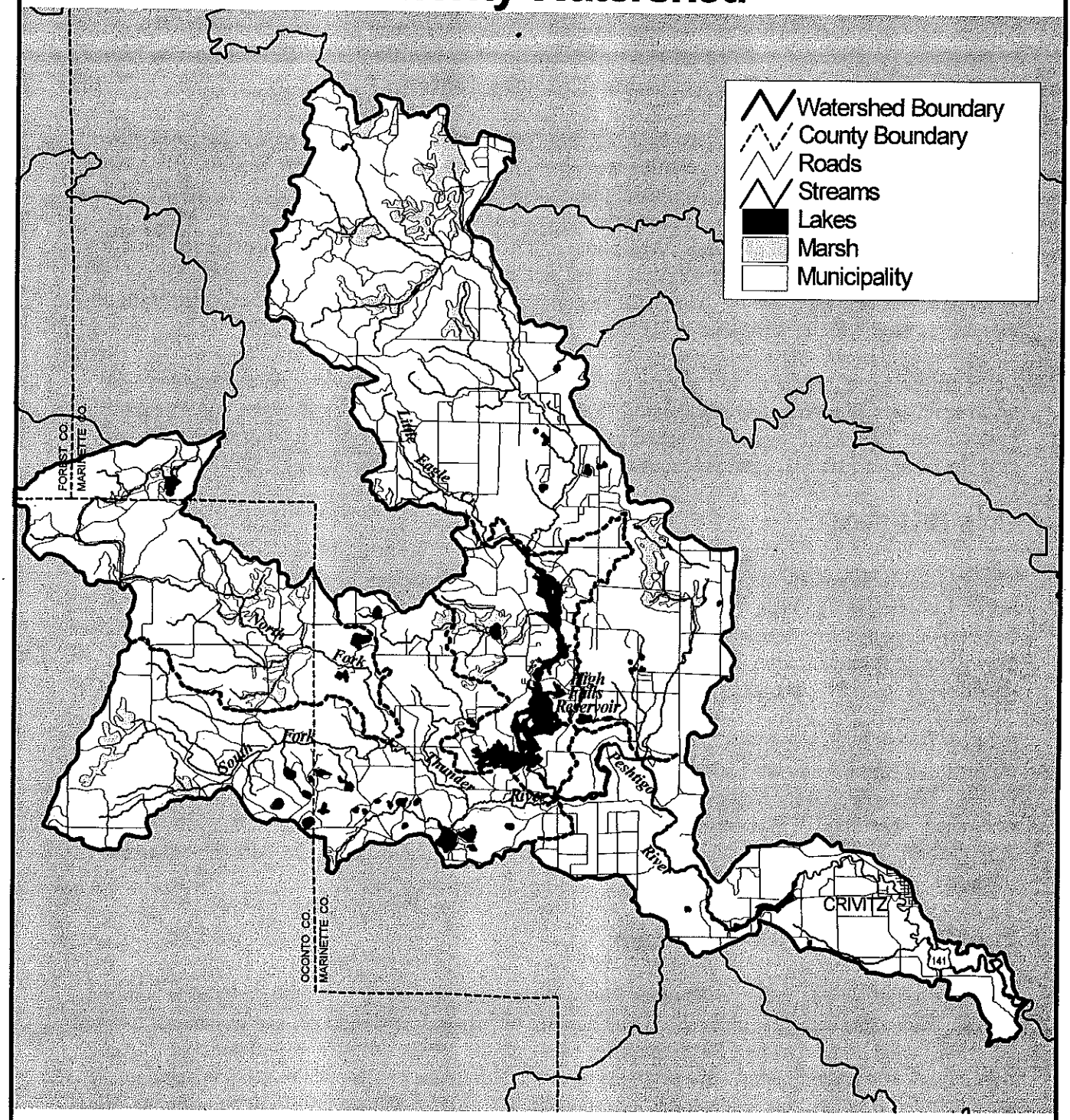
The Middle Peshtigo-Thunder Rivers Watershed lies within Marinette (76%), Oconto (23%), and Forest Counties (1%). In Marinette County, portions of the town of Athelstane, Silver Cliff, Stephenson, and Beaver are within the watershed. The east ends of Riverview and Lakewood Townships in Oconto County and a small portion of Wabeno Township in Forest County also fall within the watershed. The village of Crivitz is the only incorporated area in the watershed.

Publicly owned lands within the watershed total 57,190 acres, or about 46% of the watershed. The western part of the watershed, mostly in Oconto County, encompasses 26,640 acres of Nicolet National Forest. Marinette County land covers 27,170 acres of the northern and south-central portions of the watershed. The State of Wisconsin owns several scattered parcels of land in the watershed which total 3,380 acres. Wisconsin Public Service Corporation owns 7,035 acres along the Peshtigo River and its flowages. See map 1-1 for civil divisions.

Population Size and Distribution

The year-round Middle Peshtigo-Thunder Rivers Watershed population is about twenty-nine hundred people. However, there are many times that number of seasonal, recreational, and occasional users of the watershed. In the Town of Stephenson for example, the 1990 Census of Population and Housing showed that 806 housing units were occupied year-round by their owners while 2,653 housing units were held by seasonal, recreational, and occasional users. Many of these units will be occupied year-round as their owners retire to the watershed. Population in the watershed has increased about 10.7 percent since 1980. Regional trends suggest that the watershed's population will continue to expand.

Map 1-1. Middle Peshtigo and Thunder River Priority Watershed



STUDY AREA

Wisconsin Department of
Natural Resources
Water Division
Bureau of Watershed Management
March 1998

Mapscale 1:228,000

N
W E
S

0 5 10 Miles

Land Uses

Rural land uses predominate in the watershed. Woodland is the most important land use, comprising 71.0 percent. Woodland is most commonly used for recreation. Hunting and fishing are very popular recreational activities. Agricultural land comprises 4.4% of the land use in the watershed, and dairy farming is the primary agricultural activity. Farming activity within the watershed is generally declining. Developed land occupies about 7.2 percent of the watershed (table 1-1) and has increased by more than 100 percent since 1976.

Table 1-1 Land Uses in the Middle Peshtigo-Thunder Rivers Watershed

Land Uses	Acres	Percent
Agricultural	5,444	4.4%
Woodland	87,987	71.0%
Developed	7,363	5.9%
Developed Riparian	1,146	0.9%
Roads	1,604	1.3%
Surface Water	3,618	2.9%
Wetland	16,788	13.5%
Total Land Use	123,950	100.0%

Source: DNR & Marinette County LWCD

Development Trends

Waterfront development is increasing rapidly in the watershed, and has increased 139% since 1976. Lakefront property values are also on the increase. On some Marinette County Lakes, minimum size lots sell for as much as $100,000. This same trend is being followed state wide. The *Northern Lakes and Shorelands* study (WDNR, 1996) supports this trend. Some of the findings of this study are listed below.

- Statewide, since the 1960s, approximately 60% of previously undeveloped, privately held lakes, 10 acres or larger have been developed with one or more dwellings.
- All remaining lakes 10 acres and larger will be developed within 20 years. This will occur much sooner if the current high rate of development continues unabated.
- From 1960 to 1995 the total number of dwellings on the 235 lakes monitored for the report increased by 216%
- The average overall density of development in Wisconsin has increased by 60% since 1960.

The *Northern Lakes and Shorelines* study and others suggest that saturation has occurred on developable waterfront property. The number of local building permits has increased dramatically while the number of lots remained stagnant (Marcouiller, Preissing, et al., 1996). This lack of buildable lots has led to buying developed property, removing any existing structures and rebuilding completely. This is a costly and environmentally damaging action. Another trend is the conversion of recreational homes to four season retirement homes (Marcouiller, Green, et al., 1996). This is often accompanied by extensive remodeling. Converting these older properties to four-season homes has lead to much greater habitat loss, runoff pollution and visual obtrusiveness.

Today, developed riparian properties consist of larger areas of manicured, urban style lawn, more impervious surfaces, larger houses, and much more intensive maintenance. From the 1940's, the average riparian lot has seen the amount of lawn increase by over 600%, impervious surfaces increased by more than 500%, and nutrients and sediment increase by 600% and 450%, respectively (Sorge and Panuska, 1997).

The greatest threat to the ecological integrity of Middle Peshtigo-Thunder River Watershed Lakes is the development of the riparian area. A survey of riparian development was conducted by boat by Marinette County LWCD staff. Two-hundred seventy developed riparian lots in Marinette and Oconto counties were surveyed. Of these, only 108 or 40%, met current county zoning ordinances. Excessive cutting and removal of natural vegetation in the 50-foot strip adjacent to the Ordinary High Water Mark (OHWM) constituted the majority of the zoning violations.

A direct correlation between the degree of riparian development and degraded water quality has been well established. In 1995, a paleolimnological study of Thunder Lake was conducted by the WDNR. A sediment core was used to document water quality changes that have occurred in the last 150 years (Garrison, 1997). The report summary stated:

> "Thunder Lake has historically had excellent water quality with low nutrients and high water clarity. This water quality is beginning to decline, most likely because of shoreline development in the last 10-15 years. Although logging in the late 1800's likely resulted in considerable disturbance in the watershed, it did not result in increases of inlake nutrient levels nearly as much as recent shoreline development. This recent development has also been more destructive than the initial cottage development in the 1950's and 60's."

Pressure to develop wet, steep, and rocky areas has increased, especially lake shore wetlands. Filling of wetlands for development is a problem in Marinette County. The functional values of wetlands have been well documented. These areas are critical to many wildlife species and have been shown to protect water quality. Riparian wildlife habitat is becoming increasingly fragmented. Many species have been impacted by the loss of quantity and quality of habitat. Bird, mammal, and amphibian species have been extirpated from many localities because of habitat loss and human disturbance. Habitat fragmentation places many shoreline dependent species at greater risk of exposure to predation.

Fisheries have suffered from the removal of overhanging cover, woody debris, and aquatic vegetation from the near shore area for beaches, docks, and access. Removal of these materials cause the loss of spawning and nursery areas, ambush sites for game fish, and habitat for aquatic insects, which are an important food source. A Canadian study (Collins, 1997) found that feeding rates by fish are seven times higher along undeveloped shorelines compared with lakeside lawns.

Economy

The economy within the Middle Peshtigo-Thunder River Watershed is heavily dependent on tourism and to a lesser degree light industry and agriculture. Tourism generates more than $50 million in Marinette County annually. A social and economic survey conducted in Marinette County found that between 70 and 80 percent of recreational users said clean water is an important factor in choosing to vacation in Marinette County.

High Falls Flowage may be the most heavily used body of water in the county. The flowage, along with the other high quality lakes and trout streams in the watershed attracts a disproportionate number of tourist dollars to watershed restaurants, resorts, and businesses. Protecting water quality in the region is essential to sustaining a robust economy.

CHAPTER TWO

Watershed Conditions and Nonpoint Sources of Pollution

This chapter discusses the physical characteristics, existing conditions, nonpoint sources, objectives and management categories for the water resources in the priority watershed. Information is presented for each subwatershed and by pollution source.

Physical Setting

Climate and Precipitation

The frequency, duration and amount of precipitation influence surface and groundwater quality and quantity, soil moisture content, runoff characteristics, and the physical condition of waterways. The Middle Peshtigo-Thunder Rivers Watershed lies in the continental zone which is characterized by winters which are long, cold and snowy and summers which are mostly warm with periods of hot humid conditions. Winter mean temperatures average 16 degrees Fahrenheit (F). Winter low temperatures average 5 degrees F. The average mean summer temperature is 66 degrees F, with an average high temperature of 79 degrees F. Mean annual precipitation for the region is about 33 inches of rain and melted snow; the majority falls as thunderstorms during April through September. Most runoff occurs in February, March, and April when the land surface is frozen and soil moisture is highest.

Topography

The landscape in the watershed is primarily the result of continental glaciation. Two prominent quartzite knobs, or hills, McCaslin Mountain and Thunder Mountain protrude through the glacial deposits on the west side of the watershed. Most of the watershed consists of several nearly level to very steep out wash plains, with one that is pitted in the western part. The majority of lakes in the watershed occur in this pitted outwash area. The remainder of the watershed is gently sloping to very steep end moraines that mark the edge of the Langlade Lobe that entered the watershed from the west and the Green Bay Lobe that entered from the east. Elevation ranges from 1,632 feet on McCaslin Mountain to 660 feet in the southeast corner of the watershed.

High Falls Flowage, near the center of the watershed, is the largest body of water in the watershed at approximately 1,500 acres.

Geology

The Middle Peshtigo-Thunder Rivers Watershed is underlain by two major bedrock formations. The western part of the watershed consists of Precambrian igneous and metamorphic bedrock with many outcrops. The eastern part is underlain by Cambrian sandstone and dolomite that has some outcrops along the Peshtigo River.

Soils

Areas Dominated by Soils Formed in Glacial Outwash

Two soil associations that formed in glacial outwash make up most the Middle Peshtigo-Thunder Rivers Watershed.

- Menahga Association- Nearly level to steep, excessively drained sandy soils on outwash plains.
- Pence-Padus Association - Nearly level to very steep, well drained, loamy soils in outwash plains, stream terraces, moraines, kames, and eskers.

The major soils in these associations are used primarily for woodland with a few areas used for cultivated crops and pasture. The main concerns in managing woodland on Menahga soils are seedling mortality, and equipment limitations and controlling water erosion on steeper areas in these associations. Crop yields on cultivated areas of Menahga soils are limited by low available water capacity and are also subject to soil blowing. These soils are poorly suited to septic tank absorption fields because of poor filtering capacity and the danger of groundwater pollution.

Areas Dominated by Soils Formed in Glacial Till

There is one association formed in the western part of the watershed.

- Sarona-Keweenaw-Kennan Association - Nearly level to very steep, well drained, loamy soils on moraines.

The major soils in this association are used primarily for woodland. The main concern on the less sloping areas of Sarona and Kennan soils is equipment limitations because of low strength during wet seasons. Controlling water erosion and equipment limitations are concerns on steeper areas of these soils. The less sloping areas of Sarona and Kennan soils are moderately suited to septic tank absorption fields.

Areas Dominated by Soils Formed in Glacial Till and Outwash

Only one soil association, formed in either glacial till or outwash, is found in the project area. Three small areas are in the central and eastern part of the watershed.

- Mancelona-Emmet-Menahga Association - Nearly level to excessively drained, sandy and loamy soils primarily on end moraines.

The major soils in this association are used for woodland, cultivated crops or pasture. The main concerns in managing woodland are seedling mortality on Menahga soil and equipment limitations on Emmet soil because of low strength during wet periods. Soil erosion and equipment limitations are also concerns on the steeper soils in this association. Crop yields are limited on Mancelona and Menahga soils because of low available water capacity. Controlling water erosion is a concern on cultivated areas of Emmet soils. Emmet soil is moderately suited to septic tank absorption fields because of moderate permeability. Mancelona and Menahga soils are poorly suited to septic tank absorption fields because of poor filtering capacity and the danger of ground water pollution.

Areas Dominated by Soils Underlain by Bedrock

One association is dominated by soils underlain by igneous and metamorphic bedrock that also has many outcrops. Three small areas occur in the watershed.

- Ishpeming-Michigamme-Rock Outcrop Association - Gently sloping to moderately steep, somewhat excessively to well drained, sandy and loamy soils, and rock outcrops, on outwash plains and moraines.

The major soils in this association are used primarily for woodland. The main concern in managing for woodland on these soils is equipment limitations because of low strength on Michigamme soils and the many bedrock outcrops that occur throughout the association. The soils in this association are poorly suited to septic tank absorption fields because of the shallowness to bedrock.

Water Resource Conditions and Goals

This section describes the general conditions of the surface and groundwater resources in the Middle Peshtigo-Thunder Rivers watershed. It describes the classifications used for Wisconsin's waters, then describes the surface water and recreational resources in the watershed. Descriptions of subwatersheds are also included and several tables provide summaries of the watershed's resources. Tables 2-1 and 2-2 in this section summarize the surface water resources of the watershed. Groundwater resources and quality are also discussed.

Water Use Classifications

Surface water quality standards and criteria are expressions of the conditions considered necessary to support biological and recreational uses. Water quality standards for recreational and biological uses are contained in Chapters NR 102, NR 104, and NR 105 Wisconsin Administrative Code.

Besides these standards, other criteria were used to assess the suitability of surface waters for recreational and biological uses. Data characterizing stream size and accessibility were used to help determine the suitability and types of recreation a stream can support. Information on current recreational use of surface waters (provided by users at public access points and discussions with local officials) is also used to assess suitability of surface waters for recreation. Use classifications and supporting water quality standards used in evaluating water resource conditions are discussed below.

Biological Stream Use

Wisconsin streams are classified according to the biological uses desired for each stream. These classifications are listed for each stream in the water quality management plans developed for each basin, in the subwatershed discussions. Stream classification determines allowable pollutant loads to the system. Resources are classified as one of the following:

COLD = Coldwater Communities include surface waters capable of supporting a community of coldwater fish and other aquatic life or serving as a spawning area for coldwater fish species.

WWSF = Warmwater Sport Fish Communities include surface waters capable of supporting a community of warmwater sport fish and/or serving as a spawning area for warmwater sport fish.

WWFF = Warmwater Forage Fish Communities include surface waters capable of supporting an abundant diverse community of forage fish and other aquatic life.

LFF = Limited Forage Fish Communities include surface waters of limited capacity because of low flow, naturally poor water quality or poor habitat.

ORW = Outstanding Resource Waters have the highest value as a resource, excellent water quality and high quality fisheries. They currently do not receive wastewater discharges and point source discharges will not be allowed in the future unless the quality of such a discharge meets or exceeds the quality in the receiving water. This classification includes national and state wild and scenic rivers and the highest quality Class I trout streams in the state.

ERW = Exceptional Resource Waters have excellent water quality and valued fisheries but may already receive wastewater discharges or may receive future discharges necessary to correct environmental or public health problems. This classification includes about 1,400 trout stream segments not classified as Outstanding Resource Waters.

Trout streams carry a separate designation found in "Wisconsin Trout Streams" (DNR Publication number. 6-3600(80)) and Outstanding/Exceptional Resource Waters, Wisconsin Administrative Code NR 102.20 and NR 102.11. Trout classes are:

Class I trout streams are high quality, and populations are sustained by natural reproduction.

Class II trout streams have some natural reproduction but may need stocking to maintain a desirable fishery.

Class III trout streams have no natural reproduction and require annual stocking of legal-size fish to provide sport fishing.

Table 2-1 Classifications and conditions for the streams of the Middle Peshtigo-Thunder Rivers Watershed.

Stream Name	Length (mi.)	Biological Use/Miles	Classification	Use Problems Source/Impacts
Peshtigo River	34	WWSF/29 mi CLASS II/5 mi		BDAM/HAB, MIG
Medicine Brook	9	CLASS I	ERW	
Joy Creek	2	WWSF		
Thunder River	8	CLASS II		
Thunder Lake Outlet	1	CLASS II		BDAM/HAB, MIG
Thunder Lake Inlet	5	CLASS II		
Handsaw Creek	8	CLASS I/2.3 mi CLASS II/5.7 mi	ERW	BDAM/HAB, MIG
N. Fork Thunder River	15	CLASS I	ORW	BDAM/HAB, MIG
Frieda Creek	1	CLASS II		
Mountain Creek	<1	CLASS II		
E. Thunder Creek	7	CLASS I		BDAM/HAB, MIG
Smith Creek	1	CLASS I		BDAM/HAB, MIG, FLOW
W. Thunder Creek	2	CLASS I		BDAM/HAB, MIG, FLOW
S. Fork Thunder River	5	CLASS I		BDAM/HAB, MIG, FLOW
Forbes Creek	5	CLASS I		BDAM/HAB, MIG, FLOW
Hay Creek	6	CLASS I		BDAM/HAB, MIG, FLOW
Woods Lake Outlet	2	WWFF		BDAM/HAB, MIG, FLOW
Eagle Creek	21	CLASS I		BDAM/HAB, MIG, FLOW
Little Spring Creek	2	CLASS II		BDAM/HAB, MIG, FLOW
Marbou Creek	1	COLD		BDAM/HAB, MIG, FLOW
Homestead Creek	3	CLASS II		BDAM/HAB, MIG, FLOW
Campbell Creek	2	CLASS I		BDAM/HAB, MIG, FLOW
Little Eagle Creek	6	CLASS I		BDAM/HAB, MIG, FLOW

LEGEND:

Limiting Factors
- HAB - Habitat (lack of cover, sedimentation, scouring etc.)
- BDAM - Beaver dam levels
- DAM - Cultural dam

Observed or Potential Sources
- FLOW - Flooding or fluctuating water
- MIG - Fish migration interference

Table 2-2 Water resource conditions for the Named Lakes of the Middle Peshtigo-Thunder Rivers Watershed.

Lake	Area (ac)	Depth (ft)	Lake Type	Access	% Upland	Riparian Ownership and Development
Angle Sec 11, T33N, R18E	1.3	8	seepage	W	90	Shoreline owned by 1 landowner.
Borth Sec 9, T32N, R18E	9.6	31	seepage	W	100	Intensively developed since 1970, 90% of lake shoreline is subdivided.
Bottle Sec 8, T32N, R18E	6.2	12	drainage	R	100	<10% of shoreline in private ownership.
Boundary Sec 7, T32N, R18E	37	19	drainage	BR	>90	>90% of the lake is in **Oconto County**. Very heavily developed.
Campbell Sec 30, T35N, R18E	4.2	6	spring	T	70	100% of shoreline owned by Marinette County.
Cedar Sec 12, T32N, R17E	20	5	seepage	?	<40	Lake is in **Oconto County**, little development.
Deer Sec 29, T34N, R19E	13.4	34	seepage	?	100	Heavily developed, subdivided sometime after 1980.
Dell Sec 12, T32N, R17E	35	10	seepage	W	<10	In **Oconto County**, majority of the shoreline is in public ownership.
Eagle Sec 15, T32N, R18E	56.3	30	seepage	?	>85	Heavily developed and subdivided with increasing back lot development and nearby subdivisions.
Forbes Spring Sec 29, T33N, R17E	2	2	drainage			Lake is in **Oconto County**.
Frieda Lake Sec 20, T33N, R18E	65	23	spring	N	80	Shoreline is owned by the Thunder Mountain Ranch Co.
Frying Pan Lake Sec 6, T32N, R18E	27.6	47	seepage	W	60	50% of shoreline owned by 2 landowners. High development potential.
Harwell Lake Sec 36, T34N, R18E	14.5	25	seepage	N	100	Shoreline owned by 2 landowners. High development potential.
Hazel Lake Sec 8, T32N, R18E	2.8	12	seepage	W	0	Entire shoreline in Marinette County ownership.
Heart Sec 25, T34N, R18E	3.8	6	seepage	N	70	Entire shoreline owned by 1 landowner.
High Falls Reservoir Sec 36, T33N, R18E	1,497	54	drainage	BR	>90	Majority of the shoreline is owned by Wisconsin Public Service Corporation. Many smaller subdivisions are near the flowage. One of Marinette County's most important recreational resources.
Homestead Lake Sec 36, T35N, R17E	4.1	14	spring	N	95	Entire shoreline owned by 1 landowner.
Huber Lake Sec 17, T33N, R18E	29.1	8	drainage	N	70	Majority of the shoreline is owned by Paust's Resort and 1 other landowner. High development potential.

Lake	Area (ac)	Depth (ft)	Lake Type	Access	% Upland	Riparian Ownership and Development
Island Lake Sec 15, T32N, R18E	8.9	10	seepage	N	70	Heavily developed since 1970, subdivided with heavy back lot development. Participated in Lake Mgmt. Planning Grant program
Johnson Falls Flowage	153	35	drainage	N	70	71 dwellings on shore. 20% of shoreline owned by Wisconsin Public Service Commission.
Joy Lake Sec 32, T33N, R19E	11.4	16	drainage	N	100	Entire shoreline is owned by 1 landowner. High development potential.
Kahles Pond Sec 6, T33N, R19E	1.2	3	seepage	N	0	Entire shoreline owned by 1 landowner.
Kiss Lake Sec 18, T32N, R18E	4.3	15	spring	N	90	Entire shoreline owned by 1 landowner.
Kiss Lake Sec 31, T33N, R19E	40.1	22	spring	N	100	Entire shoreline owned by 3 landowners (one is Juul Lake Corporation). High development potential.
Ledge Lake Sec 1, T32N, R17E	34	19	seepage	N	<40	Lake is in **Oconto County**, little development.
Little Perch Lake Sec 11, T32N, R18E	13.5	26	seepage	N	100	Lake subdivided in 1993, rapidly becoming developed.
Little Spring Lake Sec 36, T34N, R18E	3.3	6	spring	N	0	Entire shoreline owned by 1 landowner.
Lost Lake Sec 31, T34N, R19E	19.1	20	seepage	N	85	Entire shoreline has been subdivided.
Marl Lake Sec 30, T32N, R20E	4.5	3	seepage	N	100	Entire shoreline owned by 2 landowners.
McCaslin Sec 33, T34N, R17E	74.2	9	seepage	N	>80	Moderately developed, possible failing sanitary systems and zoning violations. Currently participating in Lake Mgmt. Planning Grant program.
Mirror Lake Sec 8, T32N, R18E	4.7	10	seepage	N	0	The entire shoreline is owned by 2 landowners.
Mountain Lake Sec 30 T33N, R18E	26	26	spring	N	100	The entire shoreline is owned by 1 landowner. High development potential.
Old Veteran Lake Sec 12, T33N, R18E	10.0	18	seepage	R	100	Marinette County owns the entire shoreline, 16 camping units maintained at Old Veterans Lake Campground.
Rollins Lake Sec 8, T32N, R18E	5.4	27	seepage	N	85	Entire shoreline owned by 2 landowners.
Sand Lake Sec 9, T32N, R18E	13.3	23	spring	T	100	Entire shoreline owned by Marinette County, Camp Bird is on the lake.

Lake	Area (ac)	Depth (ft)	Lake Type	Access	% Upland	Riparian Ownership and Development
Sandstone Flowage	158	37	drainage	BR	100	95% of shoreline owned by Wisconsin Public Service Corporation.
Spring Lake Sec 13, T34N, R18E	12.7	11	seepage	N	50	Entire shoreline owned by 1 landowner. High development potential.
Squaw Lake Sec 34, T33N, R18E	36	11	drainage	N	>90	75% of the shoreline is subdivided, 25% owned by one landowner.
Star Lake Sec 15, T33N, R19E	4.9	3	seepage	N	0	Subdivided in plat book, but no development yet.
Taylor Lake Sec 19, T35N, R18E	4.7	9	spring	BR	40	Entire shoreline is owned by Marinette County.
The Spring Sec 9, T32N, R18E	6	23	seepage	N	90	Moderate development, some potential for further development.
Thunder Lake Sec 15, T32N, R18E	134	62	drainage	BR	>90	Heavily developed with recent subdivision of the north and west shores. Zoning violations present. Recently participated in the Lake Mgmt. Planning Grant program.
Wonder Lake Sec 6, T32N, R18E	8	28	seepage	N	85	Entire shoreline owned by the Iroquois Club (private).
Woods Lake Sec 23, T33N, R18E	45.5	27	drained	N	65	>75% of the shoreline owned by Paust's Resort. Balance privately owned as well.

Note that all lakes are located in Marinette County unless otherwise noted.

LEGEND:

Lake Types:
Drained Lakes- Have both an inlet and an outlet.
Seepage Lakes- Have no inlet or outlet. The principal source of water is runoff augmented by groundwater inflow.
Spring Lakes- Have no inlet but do have an outlet. Primary source of water is groundwater flowing into the bottom of the lake.
Drainage Lakes- Have no inlet but do have a continuously flowing outlet. Primary source of water is runoff and direct drainage from surrounding land.

Access Types:
BR - Boat Ramp - Has a defined public boat launching facility which may or may not have parking.
T - Walk-In Trail - Partially developed, excludes a boat ramp, and is publicly owned.
W - Wilderness - Publicly owned lake with no defined walk-in trail to the water.
R - Roadside - A public road with a marked right-of-way extending to the water provide a limited degree of access. No facilities.
N - No Access - There is no public access. All shoreline privately owned.
? - Unknown - Availability of public access is unknown.

Surface Water and Recreational Resources

For the purposes of this project, the Middle Peshtigo-Thunder Rivers Watershed is subdivided into six individual subwatersheds. Each subwatershed conveys surface water to the Middle Peshtigo River. Major tributaries, associated streams, wetlands, the reservoir and subwatershed divides are shown in map 1-1. See tables 2-1 and 2-2 for the general conditions of major water resources in the Middle Peshtigo-Thunder Rivers Watershed.

Subwatersheds in the Middle Peshtigo-Thunder Rivers Watershed

Eagle Creek	(EC)
North Fork Thunder River	(NF)
Thunder River	(TR)
High Falls Flowage	(HF)
Medicine Brook	(MB)
Peshtigo River	(PR)

Streams

The Middle Peshtigo-Thunder River Watershed is in Marinette and Oconto Counties with a small section in Forest County. A large section of the watershed in Oconto County is within the Nicolet National Forest Boundary. Marinette County and Wisconsin Public Service Corporation (WPSC) own large sections of the watershed. The major streams in the watershed include the Peshtigo River, Thunder River, North Fork Thunder River, Eagle Creek, Little Eagle Creek, and Medicine Brook. High Falls Reservoir is also included.

The watershed exhibits excellent to good water resource conditions largely because of its rural undeveloped nature. The presence of humic and fulvic acids (picked up from organic matter, such as leaves or wood) gives the rivers a brownish color and decreases clarity; however, the color is not an indicator of a water quality problem. During non-runoff periods, the streams are fed by groundwater and run clear. Wetlands are numerous and border many miles of streams and rivers in the watershed. Land use in the watershed is mostly forest, rural residential, and recreational with some agriculture concentrated in the Medicine Brook and Peshtigo River subwatersheds.

The undeveloped shorelines, along with the variety of bends, rocks, and riffle substrate provide good aquatic habitat, although the shifting sand substrate in some watershed streams can somewhat limit available habitat. Reservoir and river shorelines throughout the basin are mostly gently sloping and well vegetated, with little evidence of excessive erosion. In some stream reaches, the predominant sand substrate made macroinvertebrate sample collection impossible; however, where samples were attained, they generally indicate excellent to very good water quality with only possible slight organic pollution.

Depressed dissolved oxygen levels were recorded in the upper reaches of Medicine Brook and directly below both the High Falls and Johnson Falls dams. Oxygen fluctuations below the state standard of 6 mg/l in Medicine Brook were caused by photosynthesis and respiration of aquatic plants in the stream. The oxygen problem below the dams will be addressed through the Hydroelectric relicensing process.

Stream conditions in the Middle Peshtigo-Thunder River watershed are generally very good. Nutrient and sediment loading from nonpoint source pollution may not be affecting the physical, chemical, or biological uses of the watershed streams at this time. Aquatic habitat could be improved through habitat improvement projects in the stream corridor. However, the water resources in the watershed are facing increasing pressure from development. As prime lakefront locations are developed, streamfront property will become more attractive. Another concern is contamination of groundwater which is an important water source for most watershed streams.

Most streams in the Middle Peshtigo-Thunder Rivers Watershed are cold and classified as trout waters. The watershed contains approximately 114 miles of classified trout waters, 31 miles of warm water sport fishery, and two miles of warm water forage fishery. Monitoring conducted by WDNR water resources and fisheries' staff showed that the streams are meeting their highest potential use. Overall, nonpoint source pollution is not currently a critical problem in the watershed.

Natural Buffers in the Stream Corridor

The Middle Peshtigo-Thunder River Watershed streams are beginning to see increased development pressure due to the development saturation of prime lake locations. Water quality in streams is linked to and dependent on adjacent uplands and wetlands in the stream corridor, both structurally and through food web connections. Streams are perhaps even more dependent than lakes on the quality of the riparian areas because of the ratio of shoreline to water surface area. Natural, vegetated shoreline buffers are critical to maintain the high quality water resources noted above. Shoreland development must be conducted in a way that maintains the integrity of natural buffer systems.

A high quality natural buffer is vital to stream health. Organic material, such as leaves and twigs, that falls from shoreland vegetation forms the base of the food web in most streams. Removal of the shoreline buffer removes much of the source of these materials.

Shoreline buffer vegetation also cools water through shading. Removal of shoreline vegetation can cause significantly higher peak stream water temperatures and the degree of daily variation. Warmer water can hold less dissolved oxygen. These factors stress aquatic life, especially trout which need low water temperatures and high levels of dissolved oxygen.

Shoreland buffers reduce bank erosion and maintain the integrity of the stream channel. This prevents the steam from becoming wider and shallower. The stream then becomes warmer and loses game fish habitat. Loss of stream side vegetation results in lower base flow and greater flow peaks.

Middle Peshtigo-Thunder River Watershed Lakes

There are 43 named lakes, three named flowages, and 50 unnamed lakes in this watershed. The lakes range in size from less than one acre to 135-acres. Johnson Falls Flowage, Sandstone Flowage, and especially High Falls Flowage represent the focal points of this watershed from a recreational standpoint. High Falls Flowage covers 1,498 acres and has 22.26 miles of shoreline. It receives drainage from a 551-square mile portion of the Upper Green Bay Basin, and is the second largest body of water in Marinette County. The flowage is a very high quality recreational resource, offering picnicking, boating and year-round fishing opportunities. Wisconsin Public Service Corporation owns the shoreline surrounding the flowages and dams and maintains it in a natural condition.

Watershed lakes generally maintain good water quality. However, total phosphorus concentrations on some lakes are high enough to support algae growth and cause aquatic macrophyte problems.

Most of these lakes support warm water fish communities. A number of small spring lakes support cold water fisheries. A few, most notably Thunder and Sand Lakes, support both cold water and warm water fish communities. The flowages are large and provide a desirable warm water fish community to anglers. Besides the warm water fishery, brown trout are known to over winter in the Johnson Falls Flowage and migrate from the flowage into the Thunder River in the late spring. Similar movement by trout in streams tributary to High Falls and Sandstone Flowages could be expected.

Much of the riparian development within the watershed is concentrated at Thunder, Eagle, Boundary, Lost, and Deer Lakes and Sandstone Flowage. A paleolimnological sediment core taken in Thunder Lake shows a decline in water quality, most likely a result of shoreline development in the last 10-15 years. Though logging in the late 1800's likely resulted in considerable disturbance in the watershed, it did not result in increases of in lake nutrient levels nearly as much as recent shoreline development. Recent development has also been more destructive than the initial cottage development in the 1950's and 60's.

The greatest threat to the ecological integrity of watershed lakes is the development of the riparian area. Several lakes are heavily developed and are lined with properties that do not meet county or state zoning ordinances for set-back from the ordinary high water mark, minimum lot size, filling and grading, or amount of clearing. Many other lakes within the watershed are at risk of development in the near future. Some have already been subdivided.

Natural Buffers and the Littoral Zone

A natural buffer is the strip of land that forms the transitional area from the aquatic to upland ecosystems. It provides a neutral area between surface waters and cultural areas. Natural buffers provide the overhanging vegetation, woody debris, and detritus that contribute to habitat complexity. Buffers also provide resting sites and hunting perches for birds and insects. An intact littoral zone and buffer community minimizes shoreline erosion. Plant stems and leaves break waves and reduce their energy. Aquatic and near shore plants anchor soil in place with their root systems. Healthy vegetation traps sediment and nutrients, improving water quality and extending the littoral zone further out in to the lake.

The current model for development of lake shoreline often entails extreme modification of the shoreline and the littoral zone. The littoral zone is the near shore area where water depth allows light to reach the lake bottom and support the growth of aquatic plants. In undeveloped lakes, this is the area of greatest diversity and density of aquatic life. A great degree of complexity in this area provides the best quality habitat. Habitat complexity is provided by rock, aquatic plants, terrestrial plants hanging into the water, woody debris, and organic detritus. Removal of these materials simplifies the habitat. Structures such as sand beach or sea wall reduce complexity and provide poor habitat.

Natural vegetation is cut from the shoreline, woody debris such as fallen trees are removed from the water, and aquatic plants are cut and removed. Natural landscapes are replaced with sand beach, docks, boat houses, lawn, and concrete. These changes affect the health of the lake in profound ways.

Many game fish species such as northern pike, largemouth bass, muskellunge, and panfish depend on littoral zone habitats during their life cycles. Fish numbers and diversity are strongly dependent on the quality of the littoral zone and shoreline. Amphibians, reptiles, and aquatic insects are also dependent on a viable littoral zone. These creatures depend on a complex habitat to provide breeding, spawning, feeding, and hiding areas. Just as in streams, shoreline vegetation provides the basis of the littoral zone food web by dropping leaves and woody materials in to the water. These materials are the food source for the microorganisms and aquatic insects that higher aquatic life forms depend on.

Wetlands

Wetlands are valuable natural resources. They provide wildlife habitat, fish spawning and rearing areas, recreation, storage of runoff and flood flows and removal of pollutants. Wetlands in the watershed are mainly in stream corridors and flood plains. Flood plain wetlands support fur bearers and waterfowl populations and may provide seasonal habitat for sport fish.

A wetland inventory was done to identify existing and modified or converted wetlands for protection from degradation or potential restoration (table 2-3). The focus of the inventory was on wetlands that are presently degraded, or have been degraded in the past, through drainage, grazing, cropping, or other activities causing water storage loss, and build up of sediments. Data were collected on 212 wetlands (16,788 acres), with an average of 79.2 acres per site. Wetland headwaters and corridors exist for most of the watershed streams. Forested or scrub/shrub wetlands predominate in these areas. Data were gathered from Natural Resource Conservation Service maps, air photos, and the DNR wetland inventory maps. Guidelines for wetland restoration, which will be a component of this project, are outlined at the end of this chapter.

Draining wetlands for agriculture is not currently a problem in the watershed. However, as a shortage of suitable upland building sites grows, riparian wetlands are under greater pressure for draining or filling. Almost 100 percent of the drained wetlands in the watershed are found in non-agricultural areas, in stream corridors or riparian areas.

Table 2-3 Wetland Inventory Summary: Middle Peshtigo-Thunder River Watershed

Subwatershed	Drained wetlands	Upland	Wetland		Total Acres
	number of acres	number of acres	number of		
			sites	acres	
Eagle Creek	36	29,154	51	6,763	35,973
High Falls	1,539	9,155	27	976	11,674
Medicine Brook	0	10,188	29	1,011	11,205
North Fork Thunder River	172	16,403	37	2,810	19,390
Peshtigo River	8	17,236	28	1,448	18,787
Thunder River	287	22,765	40	3,780	26,842
Totals	2,042	104,991	212	16,788	123,871

Recreation

The watershed's streams, lakes, wetlands, and reservoirs offer diverse and high-quality recreational opportunities. The most popular water-based activities are fishing, boating, and canoeing. Other popular recreational activities are wildlife observation, hiking, hunting, and trapping.

High Falls Reservoir is used for a wide range of recreational activities. It is important because its size and water quality draws many people from across Wisconsin and Illinois. The shoreline is almost entirely owned by the Wisconsin Public Service Corporation (WPSC) which maintains it in nearly pristine condition. Recreational facilities on the reservoir include a large Marinette County park on the west shore with a swimming beach, campground, picnic area, and scenic cliffs. The Town of Stephenson maintains a park at Boat Landing Number Three. The facilities consist of a beach area and parking. A playground and picnic area are planned in future expansions. There is one private resort on High Falls Reservoir and several excellent boat landings maintained by WPSC.

Groundwater Resources

Groundwater is the main source of drinking water in the Middle Peshtigo-Thunder Rivers Priority Watershed. Groundwater is stored underground in pore spaces and cracks within the soil and rock layers. Unconsolidated material and rock layers which hold groundwater are called aquifers. Aquifers receive and store water and discharge groundwater to lakes, streams, and wetlands.

Since 1936, the State of Wisconsin has required well drillers to document well construction and rock and soil layers encountered during well installation. Information from geologic logs, driller construction reports and Wisconsin Geological and Natural History Survey (WGNHS) reports are included below.

The geology of the watershed consists of Pleistocene age (25,000 to 9500 years ago) glacially deposited gravel, sand, silt, and clay overlying Cambrian age sandstone (570-500 million years ago) which rests on Precambrian crystalline rock (Oakes and Hamilton, 1973). In the northern portion of the watershed,

the glacial sediments directly overly the Precambrian granites, and metamorphosed volcanic and sedimentary rocks (Dutch, 1980). Private wells draw water from the Cambrian sandstone aquifer (Foth & Van Dyke, Nov. 1988). Many private residences rely on sandpoint wells driven into shallow unconsolidated areas.

Direction of Groundwater Flow

Groundwater flows from recharge areas such as hills and exposed bedrock to discharge areas such as lakes, rivers, and wetlands. Regional recharge areas are typically farther from discharge areas. In the Middle Peshtigo-Thunder Rivers Watershed regional groundwater flow occurs in the Cambrian sandstone and the glacial sediments which are interconnected and act as one aquifer (Oakes and Hamilton, 1973). The direction of regional flow is southeast toward Green Bay. Recharge areas for local groundwater flow are generally closer to discharge areas. Local groundwater flow follows the topography. Groundwater discharges into either the Peshtigo or Thunder Rivers.

Groundwater Quality

Forty-eight private well samples were analyzed for nitrate+nitrite and fifty samples were analyzed for Atrazine using the triazine screen. Sample analysis shows that four samples exceeded the preventive action limit (PAL) of 2 mg/L. Two additional samples exceeded the enforcement standard (ES) for nitrate+nitrite if 10 mg/L. Forty-two sample results were below the PAL of which 10 samples showed no detection of nitrate+nitrite. The highest level of nitrate+nitrite detected was 20 mg/L. Sample results do not show a pattern of groundwater contamination.

Fifty private well samples were analyzed for the pesticide atrazine using the triazine screen. Forty-six sample results showed no detection of triazine. Three sample results had detection's below the PAL for atrazine plus metabolites of 0.3 Ug/L and one sample result equaled the PAL. No sample results exceeded the atrazine ES. Sample results do not indicate a pattern of ground water contamination (see table 2-4).

Table 2-4 Groundwater Inventory Results

# of Samples	>PAL	>ES	Atrizine Detectable
48 samples taken for nitrate & nitrite	4	2	0
50 samples taken for atrazine	1	0	3

Enforcement Standard (ES) Health Advisory Level: The concentration of a substance at which a facility regulated by COMM, DATCP, DOT or DNR must take action to reduce the concentration of the substance in groundwater.
Preventative Action Limit (PAL): A lower concentration of a contaminant than the Enforcement Standard. The PAL serves to inform WDNR of potential groundwater contamination problems, establish the level at which efforts to control the contamination should begin, and provide a basis for design codes and management criteria.

No samples were collected for Coliform bacteria or hazardous substances such as volatile organic compounds. Coliform bacteria can be a drinking water problem where septic systems, land spreading of manure or barnyards are up gradient (generally uphill) from a private well. Bacteria can enter the drinking water supply along the well casing of improperly constructed wells. In general, wells with high levels of bacteria can be rehabilitated.

Volatile organic compounds generally enter a well from nearby leaking underground gasoline or other fuel storage tanks and spills. Once these compounds are in the groundwater, they are difficult to clean up. Usually, the contaminated wells have to be abandoned and a new well drilled. Sites where these contaminants are present are listed below under Potential Groundwater Quality Problems.

Water Supplies

The Village of Crivitz has two municipal wells. The newer well draws water from the Cambrian sandstone aquifer. Well number 1 was constructed in 1979 in glacial sand and gravel. It is fifty feet deep. Over the years the nitrate concentration in the well increased until in 1986 the DNR sent the village a letter of noncompliance. In 1988, an additional well was installed northeast of the village. Well number 2 is 172 feet deep and taps the Cambrian sandstone aquifer. No wellhead protection plan exists for the Village of Crivitz, however, and potato farming is expanding within the recharge area for the new well. Potato farming requires that nitrogen be added to the soil. This nitrogen could seriously affect the water quality of well number 2 over time. It is recommended that a wellhead protection plan and ordinance be adopted by the village to protect the investment they have in the newer well.

Potential Groundwater Quality Problems

Previously identified potential groundwater quality problems in the Middle Peshtigo-Thunder Rivers Watershed are provided below. These sites were listed in DNR's Bureau for Remediation and Redevelopment Tracking Systems which lists superfund sites, solid and hazardous waste disposal sites, leaking underground storage tank sites and reported spill sites (table 2-5).

Table 2-5 Leaking Underground Storage Tanks & Spill Sites in the Middle Peshtigo-Thunder River Priority Watershed

Site Name	Type	QQ	Q	Section	Twsp	Range
N. Maiden Lake Rd & Lost Ln	Spill	SW	NE	7	32	
Remic's Resort	LUST	NW	SE	22	32	
Graetz Mfg. Inc.- WBS	LUST	SW	SW	32	31	
Graetz Mfg. Inc.- WBS	LUST	SW	SW	32	31	
Johnny's Market	LUST	SE	SW	32	31	
Duke's Service	LUST	SE	NE	21	32	
Fermanich Phillips 66	LUST	SW	NW	22	32	
Gateway Tavern	LUST	SE	NW	22	32	
Left Foot Lk- North Side	Spill	SE	SW	33	32	

Conclusions

Groundwater quality in the Middle Peshtigo-Thunder River Watershed is generally considered good although the supply is limited because the Cambrian sandstone and Pleistocene sediments are interconnected. The Village of Crivitz has no Wellhead Protection Plan to protect the municipal water supply. Nitrate+nitrite and triazine well sample analytical results show that groundwater is being impacted by human activities in a limited way. However, the aquifers are shallow and surface soils are sandy. This could lead to increased risk of groundwater contamination should farming increase or practices change. Nutrient and pest management can help protect groundwater.

Recommendations

1) The Village of Crivitz should be encouraged to have a Wellhead Protection Plan and Wellhead Protection ordinance to protect their investment in the relatively new well drilled in 1988.
2) Cost sharing for Nutrient and Pest Management should be offered to all farmers in the watershed as the permeable soils and shallow groundwater in the watershed are vulnerable to contamination.

Water Quality Goals and Project Objectives

The Marinette County LWCD and Oconto County LCD staff, with assistance from the DNR and DATCP, developed water quality goals and project objectives for the watershed. Objectives for each subwatershed are included in the next section. Details can be found in the Middle Peshtigo-Thunder Rivers Project Appraisal Report (Gansberg, 1997) available through WDNR's Northeast Region Office.

Following is the overall water resource's goal for the project:

Protect the water resources and fish and wildlife habitat in the watershed and ultimately the Peshtigo River and Green Bay by meeting the following objectives.

1. Educating citizens, businesses, county, state, federal, and local units of government about how personal actions and decisions affect water quality regarding:
    - A) Septic systems.
    - B) Forestry activities.
    - C) Riparian stewardship.
    - D) Recreational use impacts.
    - E) Zoning ordinances, laws, and codes.
    - F) Fertilizer and pesticide use on lawns.
    - G) Construction runoff from homes and roads.
    - H) Value of wetlands, habitat, and biotic integrity.
    - I) Land use planning.
    - J) Agricultural activities.
    - K) Exotic species.

2. Encouraging citizens to adopt good riparian stewardship BMPs such as:
    - A) Using low phosphate fertilizers and limiting their use on lakeshore property lawns.
    - B) Using construction erosion control measures for development both on the lakeshore and within the lake drainage basin.
    - C) Properly maintaining septic systems so that they are functioning correctly and up to code.
    - D) Installing porous paving materials for roads, drives, and water access.
    - E) Protecting and stabilizing eroding shorelines.
    - F) Installing naturally vegetated buffers along shorelines to replace manicured lawns.
    - G) Protecting and restoring riparian wetlands.
    - H) Preserving undeveloped shoreline on lots undergoing development.
    - I) Improving the construction of public access sites in an effort to reduce erosion.

3. Protecting riparian habitat and sensitive littoral areas from recreational use and development.

4. Adopting Best Management Practices (BMPs) for all agricultural activities within the watershed, focusing on:
   - A) Nutrient and pesticide management to protect both surface and ground water.
   - B) Reducing soil loss and erosion.
   - C) Protection of wetlands and ground water recharge areas.
   - D) Protection of stream corridors.
   - E) Manure management and storage.
   - F) Protection and enhancement of shoreline and streambank areas and fish and wildlife habitat.
   - G) Proper abandonment techniques for wells, animal lots, and manure storage facilities.

5. Ensuring forestry BMPs are implemented on all lands, including:
   - A) Proper handling of fuels, lubricants, waste, and spills.
   - B) Cutting and harvest practices that are consistent with local county shoreland /wetland zoning ordinances and Riparian Management Zones (RMZ).
   - C) Road building that reduces the width, number, and length of roads to limit the total area disturbed. Limiting the number of stream crossings and proximity to Riparian Management Zones.
   - D) Using harvesting/skidding techniques and landing locations that reduce erosion.
   - E) Relying on trained and experienced personnel to plan and implement prescribed burns.
   - F) Properly applying insecticides, herbicides, and fungicides.
   - G) Promoting the use of the Forestry BMP Field Manual (Holaday, 1996).
   - H) Displaying extra diligence in applying forestry BMPs when operating within wetlands.

6. Improving enforcement of environmental quality related laws, codes, and ordinances on a federal, state, county, and local level.

7. Protecting the cold water nature of watershed streams by:
   - A) Controlling beaver populations.
   - B) Protecting cold water springs.
   - C) Supporting run-of-river mode of operation for hydroelectric dams.
   - D) Protecting riparian cover and habitat.
   - E) Ensuring forestry and agricultural BMPs are adopted and used.

8. Protecting wetlands and headwater areas.

9. Protecting groundwater quality that is a source of water to streams, lakes, wetlands and people by:
   - A) Sealing unused wells following correct procedures.
   - B) Properly applying chemicals, pesticides and nitrate fertilizers at appropriate rates.
   - C) Removing leaking underground storage tanks.
   - D) Properly siting and maintaining wells to prevent bacteria and virus contamination.

10. Controlling construction site erosion by:
   - A) Providing information and education to local developers and builders.
   - B) Providing information and education to citizens who are building in riparian areas.

11. Develop stormwater plans for the city of Crivitz.

The water quality conditions needed to support the goals for streams and lakes are the basis for determining the type and level of nonpoint source control to be implemented under the priority watershed project.

Project objectives are identified and listed for each subwatershed and for rural and urban nonpoint sources of pollution throughout this chapter. A summary of pollutant reduction goals can be found on page 83.

Subwatershed Discussions

This section describes the physical and water quality conditions for each subwatershed in the Middle Peshtigo-Thunder Rivers Priority Watershed Project (see map S-1). Discussions for each subwatershed are broken into four parts: a general description, water quality conditions, the nonpoint source pollutants impairing the subwatershed, and objectives for the subwatershed. A more detailed description of each watershed can be found in the Middle Peshtigo-Thunder Rivers Priority Watershed Surface Water Resource Appraisal Report, (Gansberg, 1997), available through WDNR's Northeast Region Office. Tables 2-1 and 2-2 summarize the subwatershed conditions.

Appraisal Methods

Following is a brief description of monitoring activities conducted from May 1993 to August 1996 for the surface water resource appraisal (Gansberg, 1997). Monitoring procedures are consistent with the quality assurance/quality control "Field Procedures Manual" (WDNR, 1988). Previous monitoring results from the Department of Natural Resources Water Resources and Fisheries Management files are referred to in the discussion section of this report.

Macroinvertebrate

Aquatic macroinvertebrates were collected at nine sites in the watershed using a D-frame net in Spring and Fall 1993 and Spring 1996. Sample results were evaluated using the Hilsenhoff Biotic (HBI) Index (Hilsenhoff, 1987) and Ephemeroptera, Plecoptera, Trichoptera (EPT) Index (Plafkin et al, 1989). The HBI provides a relative measure of organic loading to the stream. Percent EPT is the percent Ephemeroptera, Plecoptera, Trichoptera genera out of the total number of genera in a sample. These insect orders are generally known to be intolerant of pollution.

Habitat Evaluations

Stream aquatic habitat conditions were evaluated throughout the watershed in the summer and fall using the stream habitat evaluation guidelines developed by Ball (1982). A matrix was used to numerically rank physical habitat characteristics that may limit the quantity and quality of aquatic life.

Dissolved Oxygen/Temperature

Continuous dissolved oxygen and temperature meters were placed in four streams for two week periods. In addition, grab samples were taken at several other locations. Wisconsin Administrative Code NR 102 establishes minimum dissolved oxygen water quality standards to maintain favorable aquatic life. For cold water streams the standard is 6 mg/l. For warm water streams the standard is 5 mg/l.

Water Chemistry Samples

Water chemistry samples were collected on four streams during snowmelt and rain runoff events in 1993 and 1996. Samples were analyzed for ammonia, nitrates, total and dissolved phosphorus, suspended solids, and biochemical oxygen demand.

Lake Evaluation

Seven lakes within the watershed were monitored between 1992 and 1996. Numerous water chemistry parameters were evaluated. Trophic State Indices (TSI) values were calculated for several lakes. The TSI measures the trophic state of a lake and is based on total dissolved phosphorus concentrations, Secchi depth (a measure of water clarity), and chlorophyll a concentrations. Trophic state is split into three main categories:

Oligotrophic Lakes-	Clear, deep, and free of weeds and algae blooms. Low in nutrients and do not support large fish populations.
Mesotrophic Lakes-	Lie between the two extremes of productivity. May be devoid of oxygen in late summer.
Eutrophic Lakes-	High in nutrients. Usually weedy or subject to frequent algae blooms, or both. May support a large but often undesirable fish population susceptible to winter kill.

(Adapted from Shaw, et al., 1994)

A paleolimnological core was obtained at Thunder Lake from bottom sediments. The core was segmented and for each segment, age was estimated, diatom species diversity and numbers were estimated, and nutrient levels were determined. Sediment age and nutrient levels were tied to know land use patterns. Diatom information is an indicator of water quality.

Marinette County LWCD staff conducted a survey of riparian land use in the watershed on the most heavily developed lakes. The survey noted shoreline characteristics, riparian zone habitat, and structures.

Fishery Surveys

Trout stream surveys were conducted by electroshocking. All sport and forage species were collected and recorded. Fish assemblages were used to assess environmental degradation using the Index of Biotic Integrity (IBI) (Lyons, 1996) on three watershed streams.

All watershed streams have been surveyed and classified in the past. Data from past monitoring was heavily used in the preparation of the Surface Water Resource Appraisal Report. Although some of the data is thirty years old, it was considered reliable. A fishery investigation was conducted in the Medicine Brook subwatershed in 1996, and brown and brook trout were found to be present in good numbers. Additionally, two sites were surveyed by DNR fisheries staff on the North Fork Thunder River in 1996. This survey also found healthy populations of brown and brook trout.

Lakes were surveyed with fyke nets and boom shocking gear. The flowages were surveyed in the early 1990's in this manner.

Eagle Creek Subwatershed (EC)

Description

The riverine portion of the Eagle Creek Subwatershed begins at section 18, T27N, R18E and ends at the Peshtigo River at the mouths of Little Eagle Creek (SW 1/4 of section 2, T33N, R18E) and Eagle Creek (NW 1/4 of section 12, T33N, R18E). The Eagle Creek Subwatershed drains an area of 35,970 acres, or 29 percent of the total watershed area (see map 2-1).

Water Quality Conditions

Campbell Creek is a 2-mile-long Class I trout stream. It is designated as Exceptional Resource Water (see page 14 for an explanation of stream classifications). Campbell Creek is the outlet of Campbell Lake and is tributary to Homestead Creek.

Homestead Creek is the outlet of Homestead Lake and is classified as Class II trout water. This is a small, 3-mile-long tributary to Eagle Creek.

Eagle Creek is classified as Class I trout stream and Outstanding Resource Water. This creek is 21-miles long and discharges to the Peshtigo River just above High Falls Reservoir. Aquatic habitat rated good to fair several times. Eagle Creek and its tributaries travel through significant wetlands. This probably accounts for the accumulation of silt and soft sediment in the creek bed. Two macroinvertebrate samples collected in 1980 found very good and excellent water quality. A sample in 1993 found excellent water quality with an EPT of 38 percent.

A meter was installed in Eagle Creek near the mouth at Eagle Road for two weeks in the summer of 1996. It showed very good dissolved oxygen levels with an average water temperature of 59□F.

chemistry samples collected during snow melt and a rain runoff event found low concentrations of nutrients and biochemical oxygen demand although suspended solids were slightly elevated during the snow melt event. This is probably naturally occurring in a subwatershed of this size.

A fishery survey was conducted on Eagle Creek in 1996. Two stations were sampled. One station ran through state owned property in T34N-R18E. The other station was just to the north. Intensive stream improvement was done on the state owned property and a good population of brook trout was found, even though the area receives heavy fishing pressure. This area of the stream had an IBI score of 70, which is a good integrity rating.

Little Spring Creek is a 2-mile-long Class II trout stream that discharges to Eagle Creek. This creek is the outlet of Little Spring Lake.

Marbou Creek is classified as Cold water. The 1-mile-long outlet of Marbou Lake discharges to Eagle Creek.

Little Eagle Creek is classified as Class I trout water and an Outstanding Resource Water. It received fair aquatic life habitat ratings on two separate occasions. The small stream size and sandy substrate limit available habitat, although both brook and brown trout are present. A macroinvertebrate sample collected in 1980 received a very good water quality rating, but received an excellent rating in 1996. Continuous dissolved oxygen and temperature monitoring in Little Eagle Creek at CTH C for two weeks in summer 1996 found cool water temperatures (mean 52 F) and good dissolved oxygen levels.

Eleven named lakes are found in the subwatershed (see table 2-6). They are small seepage and spring lakes. Fisheries data is limited because only three of the lakes have public access. Five lakes support warm water sport fish communities and two are known to support trout. All but three of the lakes have at least one development on the shoreline.

Lost Lake was also monitored in 1996 as part of the priority watershed appraisal process. The TSI data shows that the lake, while variable, stays in the mesotrophic zone. Secchi depth readings were good and averaged almost 13 feet in 1996. The temperature and dissolved oxygen data suggest stratification and formation of the thermocline at approximately 4 meters. In 1996 the dissolved oxygen concentrations remained high enough, year round, to support aquatic life. A survey of riparian land use on Lost Lake, conducted by the Marinette County LWCD in 1996, found 39 developed lots on the 0.80 miles of shoreline. Twenty-three, or 59 percent, of these lots met county zoning standards. The most common reasons for failing to meet zoning standards were structures built within the seventy-five-foot set back or excessive cutting and removal of vegetation within the zone adjacent to the Ordinary High Water Mark (OHWM).

Deer Lake was also surveyed by the Marinette LWCD in 1996 to determine riparian land uses on the lake. Fifteen developed lots were found, of which four, or 26.6% were meeting zoning ordinances. The most common reasons for failing to meet standards were the same as Lost Lake: structures were built within the seventy-five-foot set back or excessive clearing of natural vegetation had taken place.

Following is a brief summary of the Marinette County Zoning Standards:

1) Minimum lot sizes of 100 feet average width and 20,000 square feet for unsewered lots.

2) Seventy-five foot set backs from the ordinary high water mark (OHWM) for all structures except piers, boat hoists, and boat houses. Decks, gazebos, screen porches, and other accessory structures must be set back.

3) No more than 30 feet of trees shrubbery in any 100 feet, as measured along the OHWM, may be clear cut, to a depth of 50 feet. No single clear-cut strip may exceed 10 feet in width.

4) In areas that have not been clear cut, selective cutting only shall be permitted. Such cutting shall leave sufficient trees and shrubbery to: screen uses and structures to the landward side as seen from the water during the summer months; prevent erosion; retard the flow of pollutants; and preserve natural beauty.

5) Filling, dredging, and grading activities require permits.

Table 2- 6 Eagle Creek Subwatershed Named Lakes

Lake	Area (ac)	Depth (ft)	Lake Type	Access	Upland %	Riparian Ownership & Comments
Campbell Sec 30, T35N, R18E	4.2	6	spring	Y	70	100% of shoreline owned by Marinette county.
Deer Lake Sec 29, T34N, R19E	13.4	34	seepage	?	100	Heavily developed, subdivided sometime after 1980.
Harwell Lake Sec 36, T34N, R18E	14.5	25	seepage	N	100	Shoreline owned by two landowners. High development potential.
Heart Lake Sec 25, T34N, R18E	3.8	6	seepage	N	70	Entire shoreline owned by 1 landowner.
Homestead Lake Sec 36, T35N, R17E	4.1	14	spring	N	95	Entire shoreline owned by 1 landowner.
Kahles Pond Sec 6, T33N, R19E	1.2	3	seepage	N	95	Entire shoreline owned by one landowner.
Little Spring Lake Sec 36, T34N, R18E	3.3	6	spring	N	0	Entire shoreline owned by one landowner.
Lost Lake Sec 31, T34N, R19E	19.1	20	seepage	N	90	Moderately developed.
Marbou Lake Sec 25, T34N, R18E	19.3	7	spring	N	90	Moderately developed.
Spring Lake Sec 13, T34N, R18E	12.7	5	seepage	N	50	Entire shoreline owned by one landowner. High development potential.
Taylor Lake Sec 19, T35N, R18E	4.7	9	spring	Y	40	Entire shoreline is owned by Marinette County.

Lake Types: Seepage Lakes - Have no inlet or outlet. The principal source of water is runoff augmented by groundwater inflow.
Spring Lakes - Have no inlet but do have an outlet. Primary source of water is groundwater flowing into the bottom of the lake.

Nonpoint Source Pollutants

- Each of an estimated 95 developed riparian properties is delivering an average of 0.20 lbs. of phosphorus and 90 lbs. of sediment to surface waters. Riparian property without a natural buffer has been found to have lower aesthetic values and substantially decreased benefits to wildlife.
- Phosphorus and nitrogen from nonconforming septic systems adjacent to surface waters have the potential to negatively affect water quality.
- Logging and road building activities in riparian zones that do not follow state best management practices have been shown to impact water quality and aquatic habitat.
- The Eagle Creek Subwatershed contains no agricultural operations.

Water Resource Objectives

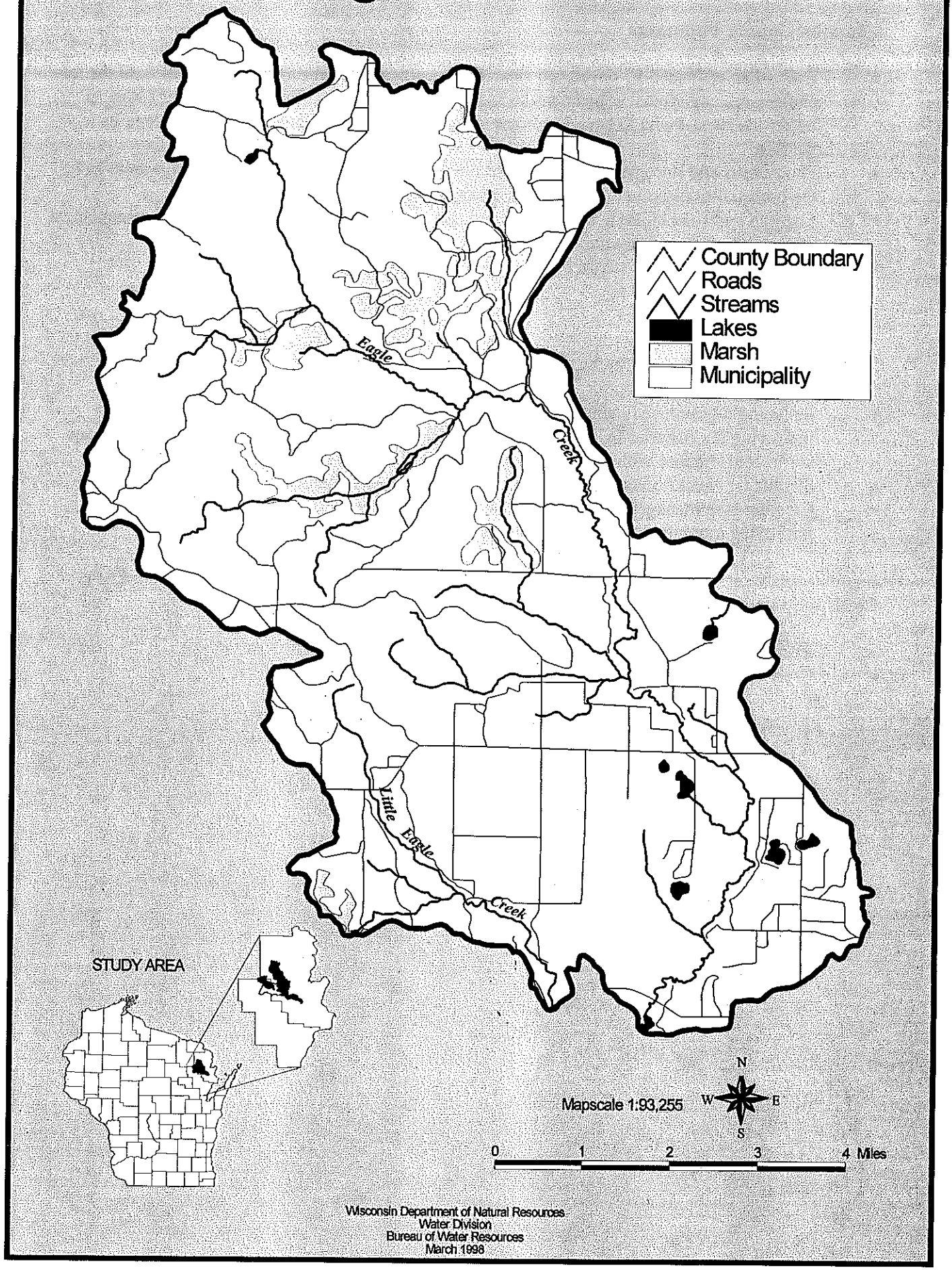
Protect and improve water quality by:

- Reducing nutrient, sediment and organic matter delivery to Deer and Lost Lakes, while improving the fisheries by installing natural buffers on at least 20 percent of those properties not in conformance with county zoning ordinances.
- Stabilizing streambanks at critical locations to reduce instream sedimentation.
- Creating lake management plans for Deer and Lost Lakes.
- Improving enforcement of county shoreland zoning ordinances.

Improve coldwater fishery habitat (increase game fish and intolerant species numbers) in the Eagle Creek Subwatershed by:

- Reducing sediment loading from watershed streams.
- Creating fish habitat improvements.

Map 2-1. Eagle Creek Subwatershed



Wisconsin Department of Natural Resources
Water Division
Bureau of Water Resources
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High Falls Flowage Subwatershed (HF)

Description

The riverine portion of the High Falls Flowage Subwatershed begins below the Caldron Falls Dam (NE 1/4 of section 10, T33N, R18E) and ends at the confluence with Thunder River (NE 1/4 of section 12, T32N, R18E). The High Falls Flowage Subwatershed drains an area of 11,678 acres, or 9 percent of the total watershed area (see map 2-2).

Water Quality Conditions

The Peshtigo River in this subwatershed is classified as Warm Water Sport Fish Communities. Wisconsin Public Service Corporation (WPSC) applied to the Federal Energy Regulatory Commission (FERC) to relicense the Caldron Falls and High Falls Hydroelectric Facilities. In conjunction with the relicensing application, WPSC has completed several studies to determine the impacts of the hydroelectric projects on water quality. Water chemistry sampling in both the flowage and tail water, continuous dissolved oxygen and temperature monitoring in the tail water, impoundment sediment sampling, and macrophyte surveys in the impoundments were done. These studies show very good water quality in the reservoirs and Peshtigo River, except that there are dissolved oxygen problems directly below the High Falls dam. Total nutrient concentrations are in a range indicating good water quality (FERC, 1996). While many issues are being addressed though the relicensing process, a main concern about water quality is that the hydroelectric facilities operate in run-of-river mode. Eliminating the peaking mode will improve water quality, habitat, and reduce erosion that occurs below the dams.

Woods Lake Outlet is classified as Warm Water Forage Fish Communities. This 2-mile-long stream flows from Woods Lake to High Falls Flowage. The substrate is predominantly sand with few riffles present. A macroinvertebrate sample collected at Parkway Road received a good water quality rating with only 29 percent EPT genera present. Woods Lake Outlet's corridor is wetland.

Three named lakes and one flowage are in this subwatershed (see table 2-7).

Old Veteran's Lake is a small 10-acre lake with a warm water fish community of walleye, largemouth bass and panfish. It has public access with a county campground.

Angle Lake is a 1.3 acre lake with forage fish species. It has a depth of only 8 feet and may experience winter kill. It has public access.

Wood's Lake has a warm water sport fish community. A resort is found on the shoreline although it does not have public access.

Table 2-7 High Falls Flowage Subwatershed Named Lake

Lake	Area (ac)	Depth (ft)	Lake Type	Access	Upland %	Riparian Ownership & Comments
Angle Lake Sec 11, T33N, R18E	1.3	8	seepage	W	90	The shoreline is owned by 1 landowner.
High Falls Reservoir Sec 36, T33N, R18E	1497	54	drainage	BR	>90	Majority of the shoreline is owned by Wisconsin Public Service Corporation. Many smaller subdivisions are near the flowage. This is one of the county's most important recreational resources.
Old Veteran Lake Sec 12, T33N, R18E	10.0	18	seepage	Y	100	Marinette County owns the entire shoreline, 16 camping units maintained at Old Veterans Lake Campground.
Woods Lake Sec 23, T33N, R18E	45.5	27	drained	N	65	>75% of the shoreline owned by Paust's Resort and the balance is privately owned as well.

Lake Types: Seepage Lakes - Have no inlet or outlet. The principal source of water is runoff augmented by groundwater inflow.
Drained Lakes - Have both an inlet and an outlet.
Drainage Lakes - Have no inlet but do have a continuously flowing outlet. Primary source of water is runoff and direct drainage from surrounding land.

Access Types: BR - Boat Ramp - Has a defined public boat launching facility which may or may not have parking.
W - Wilderness - Publicly owned lake with no defined walk-in trail to the water.

High Falls Flowage is one of the key warm water sport fish communities used by anglers in this area of Wisconsin. Many surveys of water quality and aquatic life are on file. The sport fishery has remained relatively stable for the past forty years. One difference may be an increase in the muskellunge population and a decrease in the walleye population (these are not related or dependent on each other). Muskellunge have increased because in time they have come down from Caldron Falls Flowage over the dam. Explanations for the changes in the walleye population are not as clear. They may not relate directly to water quality, but may include very high boating activity during the open water season and water flows during critical spawning periods.

Due to the tremendous amount of boating activity that occurs during the open water season, many user conflicts between anglers and non anglers (primarily water and jet skiers) exist. Both groups take their toll on aquatic life in the flowage. High speed travel by both groups causes disturbance of vegetation and bottom sediment, and increased shoreline erosion. Operation of motors causes noise pollution and results in trace amounts of petroleum entering the water. Little documentation exists on specific effects of this heavy boat traffic. Further research is needed.

Medicine Brook Subwatershed (MB)

Description

The riverine portion of the Medicine Brook Subwatershed begins at the middle of the western edge of section 4, T33N, R19E and ends at the Peshtigo River (NW 1/4 of section 12, T33N, R18E). The Medicine Brook Subwatershed drains an area of 11,204.37 acres, or 9 percent of the total watershed area (see map 2-3).

Water Quality Conditions

Medicine Brook is classified as a Class I trout stream and Outstanding Resource Water. Habitat evaluations conducted along the stream at several locations ranked aquatic habitat as good to fair. The variety of sand, rubble, bends, and bank cover provides adequate habitat. Silt has accumulated in slow areas and inside bends. Macroinvertebrate samples were collected at High Falls Road on three separate occasions. All samples received excellent water quality ratings, indicating no apparent organic pollution present. A sample collected in the spring of 1993 had 43 percent EPT genera present while a sample taken in the fall had 56 percent.

Continuous dissolved oxygen monitoring was conducted in the upper reaches (Moonshine Hill Road) and the lower reaches (High Falls Road) for two weeks in August, 1996. Water temperatures and dissolved oxygen levels were much more variable in the upper reaches than in the lower reaches. Also, temperatures were much higher and dissolved oxygen significantly lower in the upper reaches. Dissolved oxygen levels fell slightly below the 6 mg/l state standard on a daily basis at Moonshine Hill Road. These diel fluctuations are caused by periphyton and aquatic plant photosynthesis and respiration. The shallow stream depth and limited bank cover contribute to these readings. Water chemistry samples collected during four runoff events at High Falls Road found low levels of nutrients, biochemical oxygen demand, and suspended solids.

A fishery investigation of Medicine Brook was conducted at two sites in 1996. Brown trout are the dominant sport fish species present. Brook trout are also present in good numbers. An IBI was calculated for the two sites. A score of 80 was calculated for the stream segment extending from the mouth to just upstream of High Falls Road. A score of 100 was calculated for the segment extending from CTH X to Newton Lake Road. Both ratings are excellent. These study results were compared with those from 1955 and 1965. Although there were some differences, most notably in year class strength, the fishery looks much as it did thirty or forty years ago.

Joy Creek is classified as Warm Water Sports Fish Community. Joy Creek originates at Kiss Lake, flows through Joy Lake and discharges to the Peshtigo River. This small stream occasionally dries up in the summer.

Only three named lakes are found in this subwatershed ranging from 5 to 40 acres in size (see table 2-8). None of the lakes has public access. Only limited information is available on the fisheries. Kiss and Joy Lakes are known to support warm water sport fisheries. Star Lake is a small seepage lake with a maximum depth of three feet. It may be a possible winter kill lake.

Table 2-8 Medicine Brook Subwatershed Named Lakes

Lake	Area (ac)	Depth (ft)	Lake Type	Access	Upland %	Riparian Ownership & Comments
Joy Lake Sec 32, T33N, R19E	11.4	16	drainage	N	100	Entire shoreline is owned by 1 landowner. High development potential.
Kiss Lake Sec 31, T33N, R19E	40.1	22	spring	N	100	The entire shoreline is owned by 3 landowners (one is Juul Lake Corporation). High development potential.
Star Lake Sec 15, T33N, R19E	4.9	3	seepage	N	0	The lake is subdivided in the plat book, but no development yet.

Lake Types: Seepage Lakes - Have no inlet or outlet. The principal source of water is runoff augmented by groundwater inflow.
Spring Lakes - Have no inlet but do have an outlet. Primary source of water is groundwater flowing into the bottom of the lake.
Drainage Lakes - Have no inlet but do have a continuously flowing outlet. Primary source of water is runoff and direct drainage from surrounding land.

Water Resource Goals and Objectives

The following goals and objectives are recommended for the water resources of the Medicine Brook subwatershed:

Nonpoint Source Pollutants

- The Medicine Brook Subwatershed contains 3 animal lots which contribute 119.4 pounds of phosphorus to surface waters annually.
- Each of an estimated 38 developed riparian properties is delivering an average of 0.20 lbs. of phosphorus and 90 lbs. of sediment to surface waters. Riparian property without a natural buffer has been found to have lower aesthetic values and substantially decreased benefits to wildlife.
- The upland sediment delivery in the Medicine Brook Subwatershed is 48 tons annually, from 943 acres of crop land.

Water Resource Objectives

Protect and improve water quality by:

- Reducing the delivery of nutrient, sediment and organic matter from agricultural operations, barnyards and feedlots to Medicine Brook.
- Stabilizing streambanks at critical locations to reduce instream sedimentation.
- Maintaining riparian buffers by excluding cattle from stream corridors.
- Repairing gully erosion.

Water Resource Goals and Objectives

The following goals and objectives are recommended for the water resources of the High Falls Reservoir subwatershed:

Nonpoint Source Pollutants

- Erosion and disturbance of sediment caused by boat and personal water craft traffic.
- Each of an estimated 23 developed riparian properties is delivering an average of 0.20 lbs. of phosphorus and 90 lbs. of sediment to surface waters. Riparian property without a natural buffer has been found to have lower aesthetic values and substantially decreased benefits to wildlife.
- Peaking mode hydroelectric facility operation degrades water quality, reduces available aquatic habitat, and increases erosion.
- Sediment and nutrients from watershed boat landings.
- The High Falls Subwatershed contains no agricultural operations.

Water Resource Objectives

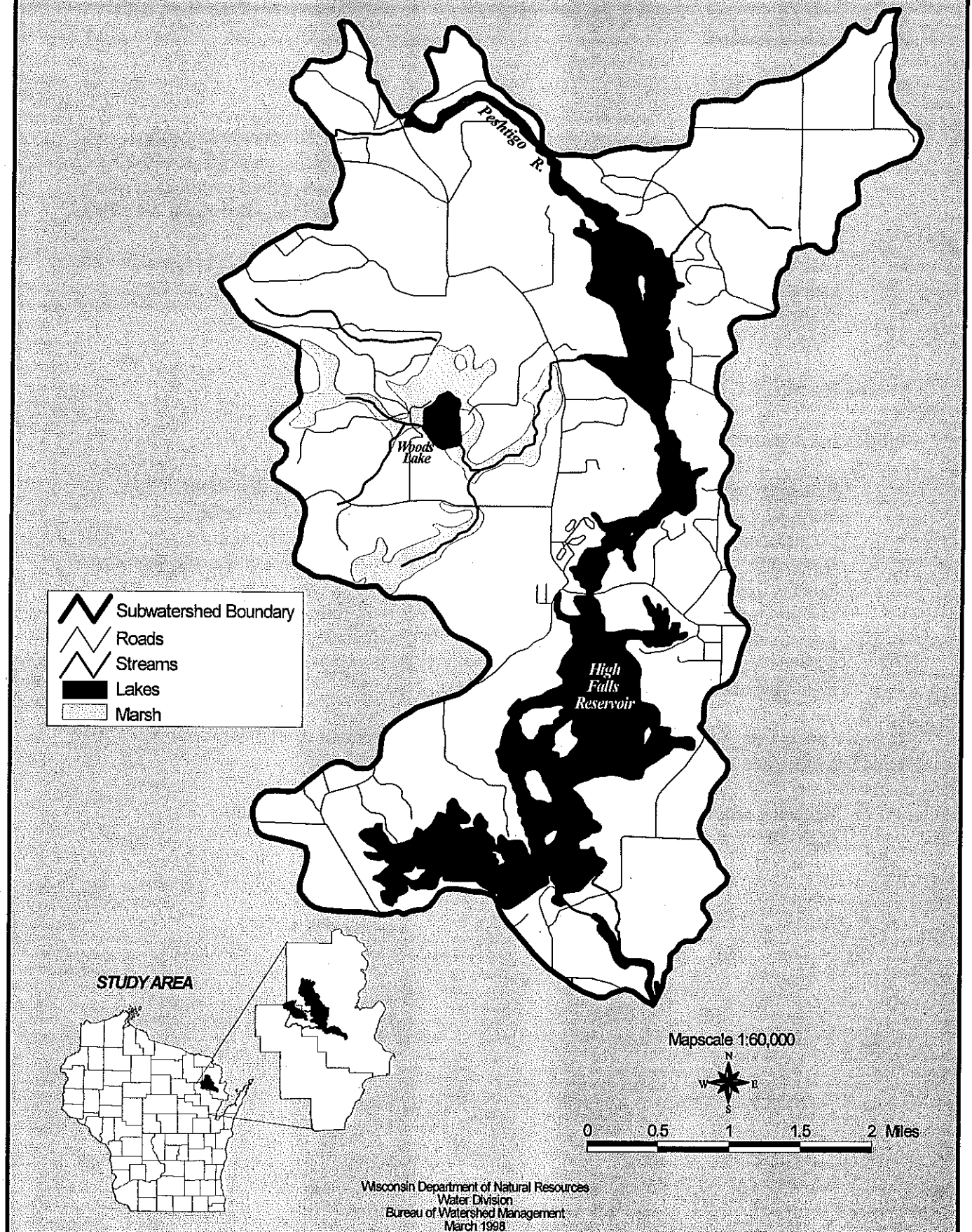
Protect and improve water quality by:

- Reducing nutrient, sediment and organic matter delivery to the Peshtigo River.
- Stabilizing streambanks at critical locations to reduce instream sedimentation.
- Maintaining the run-of river mode during hydroelectric facilities operation.
- Designating sensitive areas and regulating watercraft to protect key aquatic and shoreline habitats from disturbance and erosion.
- Encouraging timber operations to adopt logging and road building best management practices.
- Encouraging Wisconsin Public Service Corporation to maintain ownership of High Falls and Caldron Falls Flowages shoreline (or alternatively pass ownership to the State of Wisconsin) to maintain public access and prevent development.

Improve warmwater fishery habitat (increase game fish and intolerant species numbers) in the High Falls Subwatershed by:

- Reducing sediment, nutrient and organic loading from watershed streams.
- Maintaining stable water levels downstream of High Falls Dam.

Map 2-2. High Falls Flowage Subwatershed



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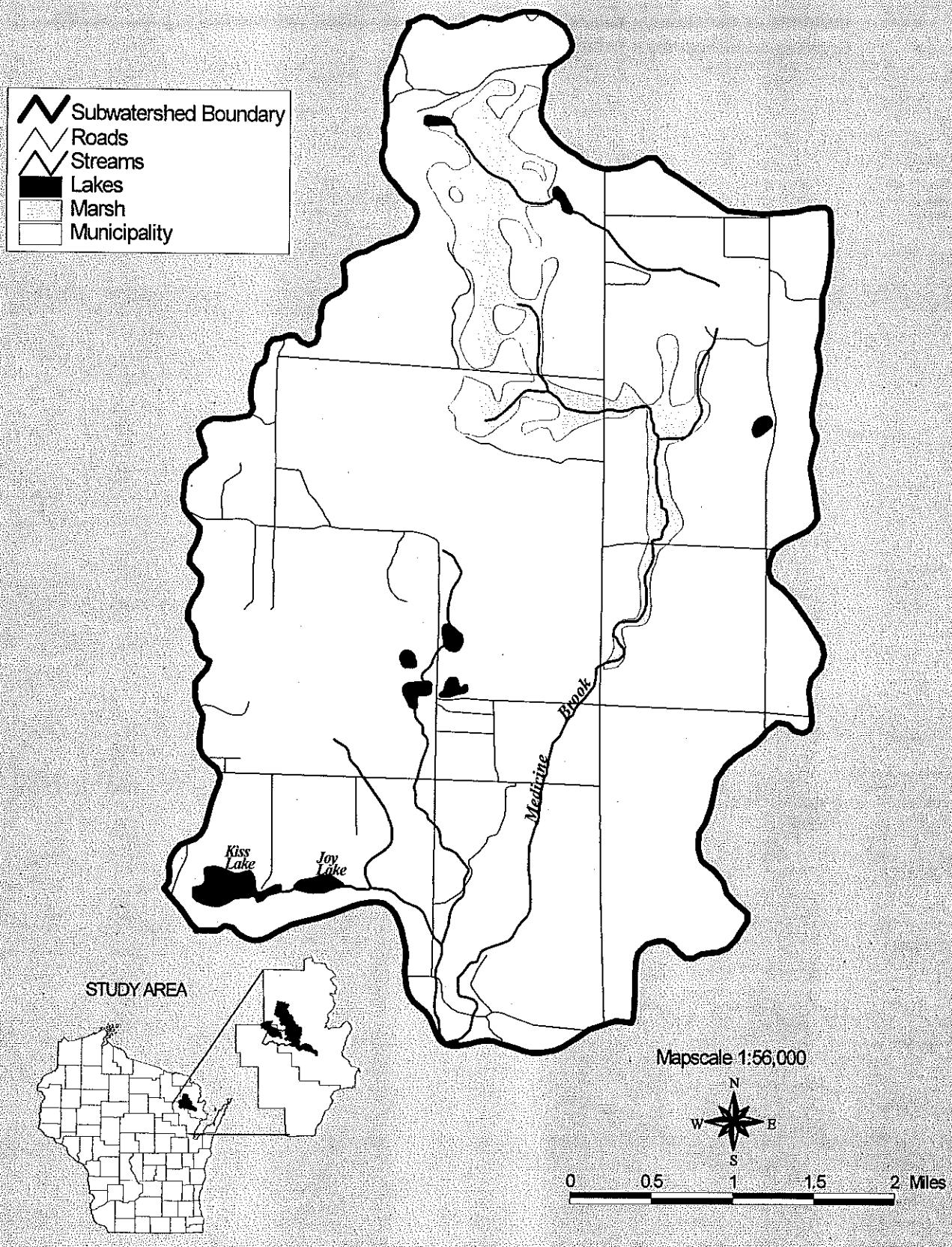
Improve coldwater fishery habitat (increase game fish and intolerant specie numbers) in the Medicine Brook Subwatershed by:

- Installing or maintaining natural buffers to reduce sediment, nutrient and organic loading.
- Creating additional trout habitat.

Map 2-3. Medicine Brook Subwatershed



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North Fork Thunder River Subwatershed (NF)

Description

The riverine portion of the North Fork Thunder River Subwatershed begins at the SW 1/4 of section 1, T33N, R16E and ends at the Thunder River (SE 1/4 of section 32, T33N, R18E). The North Fork Thunder River Subwatershed drains an area of 19,389 acres, or 15.7 percent of the total watershed area. The majority of this subwatershed lies in Oconto County (see map 2-4).

Water Quality Conditions

North Fork Thunder River Subwatershed consists of West Thunder Creek, East Thunder Creek, Smith Creek, Mountain Creek, Frieda Creek, North Fork Thunder River, and several unnamed tributaries. McCaslin Lake, Mountain Lake, Frieda Lake, Three Little Lakes (see table 2-9) and several small unnamed lakes are also in this subwatershed.

North Fork Thunder River is classified as Class I trout stream and Outstanding Resource Water. This stream joins the South Fork of the Thunder River to form the Thunder River. The North Fork received excellent to good aquatic life habitat ratings. Rocks, gravel, sand, and the wooded corridor provide adequate habitat for fish and other aquatic life. A macroinvertebrate sample collected at Thunder Mountain Road received an excellent water quality rating indicating no apparent organic pollution present. The EPT was 65 percent in a sample taken in fall 1993. Cryptosporidium and Giardia (both enteric protozoan pathogens) samples were collected monthly from December 1993 to October 1994 at Thunder Mountain Road. Cryptosporidium was detected only once. Giardia was detected twice although no correlation could be made between the presence/absence of these pathogens and land use (Archer, et al., 1995).

WDNR Fisheries staff surveyed two sites on the North Fork Thunder River in 1996. Both brook trout and brown trout were found. An excellent IBI score of 100 was calculated for the site upstream of Mountain Road. A study conducted by WDNR fisheries staff showed that a brown trout migrated nine miles from its summer habitat in the North Fork to spend the winter months in the Johnson Falls Flowage. This shows the importance of watersheds unobstructed by dams or natural barriers.

East Thunder, West Thunder, Smith, Spring, Mountain, and Frieda Creeks are all small streams making up the head waters of the North Fork Thunder River. These streams are important components to the system. All contain brook and brown trout and provide cold water to the North Fork Thunder River.

East Thunder Creek is classified as Class I trout water and Outstanding Resource Water. It received only good and fair aquatic life habitat ratings because of the small size of the creek and predominantly sand substrate. A macroinvertebrate sample collected at CTH F received an excellent water quality rating with an EPT of 57 percent.

West Thunder Creek is classified as Class I trout water and Exceptional Resource Water. The sandy substrate and small size limits available habitat for aquatic life, thus, received a good habitat rating.

Smith Creek is classified as Class I trout water and Exceptional Resource Water. This 1-mile-long creek has no known nonpoint source related problems.

Spring Creek has not been classified. This small intermittent stream originates in Forest County and discharges to a wetland. There is no access to this stream and the entire area is forested.

Mountain Creek is the outlet of Mountain Lake which discharges to North Fork Thunder River. It is classified as Class II trout water.

Frieda Creek is the outlet of Frieda Lake and discharges to the North Fork Thunder River. It is classified as Class II trout water.

McCaslin Lake is located in the northwest corner of the subwatershed. Its TSI values fall into the mesoeutrophic range. Total phosphorus levels are quite high and support algae growth which limited Secchi depths to an average of less than seven feet. Aquatic macrophytes are present at nuisance levels.

The temperature and dissolved oxygen profiles indicate that McCaslin Lake does not stratify. The lake has sufficient dissolved oxygen concentrations throughout the year to support aquatic life due to aeration sponsored by the McCaslin Lake Rehabilitation District. See the appendix for results of monitoring.

A survey of riparian land use found 27 developed lots around the lake shore. Fifteen, or 55.6% met county zoning ordinances. Structures built within the 75-foot setback and excessive clearing of vegetation were the most common reasons for failing to meet ordinance requirements.

Table 2-9 lists the named lakes in this subwatershed. Lack of access precluded investigation on the lakes other than McCaslin, which was monitored under a WDNR Lake Planning Grant.

Table 2-9 North Fork Thunder River Subwatershed Named Lakes

Lake	Area (ac)	Depth (ft)	Lake Type	Access	Upland %	Riparian Ownership & Comments
Frieda Lake Sec 20, T33N, R18	65	23	spring	N	80	Shoreline is owned by the Thunder Mountain Ranch Co.
McCaslin Lake Sec 33, T34N, R17E	74.2	9	drainage	N	>80	Moderately developed, possible failing sanitary systems and zoning violations. Currently participating in Lake Mgmt. Planning Grant program.
Mountain Lake Sec 30 T33N, R18E	26	26	spring	N	100	The entire shoreline is owned by 1 landowner. High development potential.
Three Little Lakes Sec 34, T34N, R17E	2.5	11	drainage	N	25	McCaslin Lake drains into these connected lakes. Ground water recharge area. Shoreline mostly owned by one land owner.

Lake Types: Spring Lakes - Have no inlet but do have an outlet. Primary source of water is groundwater flowing into the bottom of the lake.
Drainage Lakes - Have no inlet but do have a continuously flowing outlet. Primary source of water is runoff and direct drainage from surrounding land.

Nonpoint Source Pollutants

- Riparian property without a natural buffer has been found to have increased rates of erosion and nutrient delivery, lower aesthetic values, and decreased benefits to wildlife.
- Forty-four percent of the riparian lots inventoried by LWCD staff failed to meet Marinette County Zoning Ordinances.
- Each of the estimated 60 developed riparian properties in the subwatershed are delivering an average of 0.20 lbs. of phosphorus and 90 lbs. of sediment to surface waters. Riparian property without a natural buffer has been found to have lower aesthetic values and substantially decreased benefits to wildlife.
- There are no agricultural operations within the subwatershed.

Water Resource Objectives

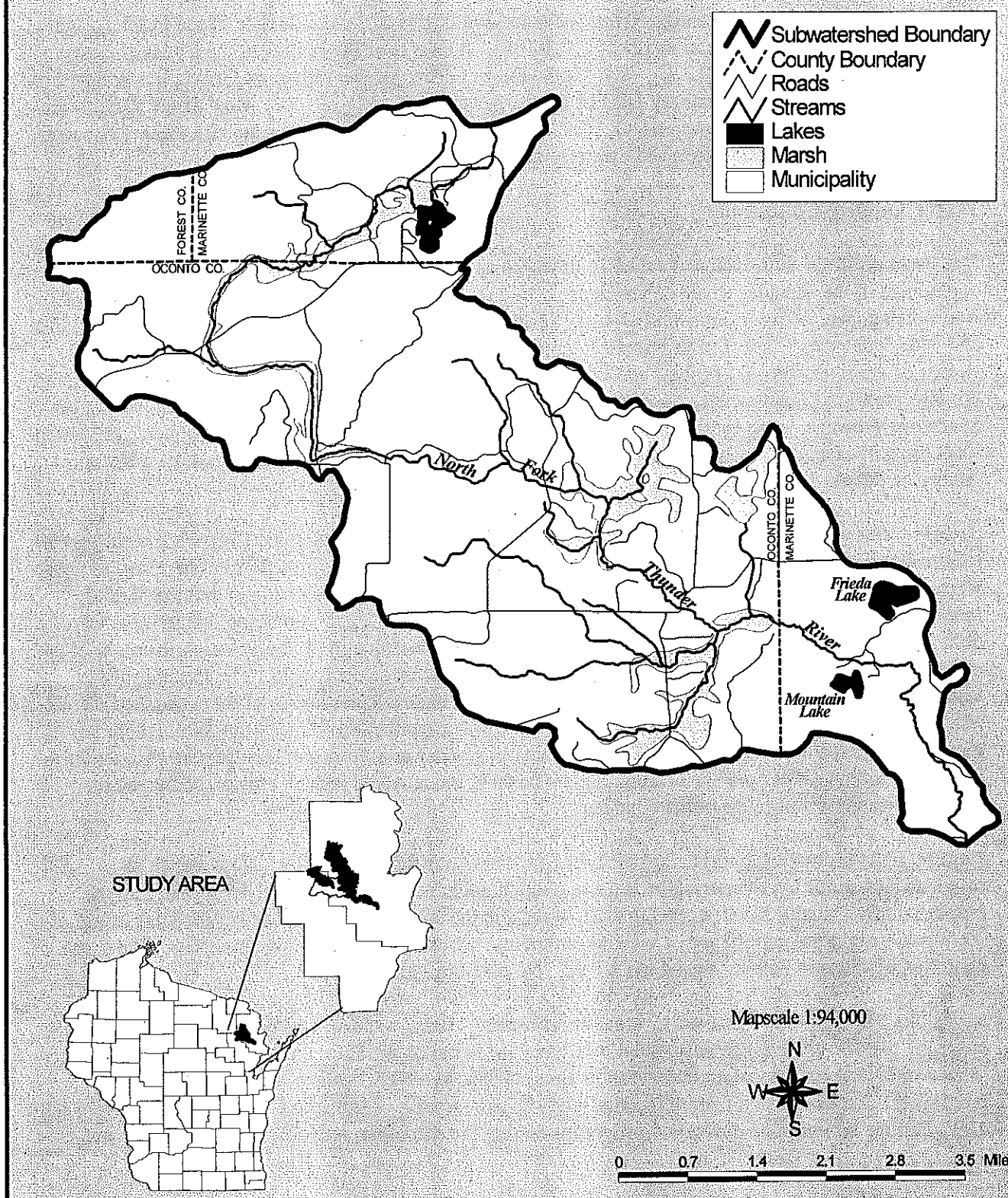
- Protect and improve water quality by:
- Adding additional fishery habitat to subwatershed streams currently limited by sandy substrates.
- Stabilizing banks at critical locations to reduce sedimentation.
- Ensuring forestry BMPs are followed.

- Limiting the impacts of beaver dam construction, maintaining flows of subwatershed streams.
- Implementing the recommendations of the McCaslin Lake Management Plan.
- Stabilizing and revegetating eroded shoreline.
- Replacing manicured lawn with natural vegetation.

Improve warmwater fishery habitat (increase game fish and intolerant species numbers) in McCaslin Lake by:

- Reducing sediment, nutrient and organic loading from watershed streams and riparian properties.

Map 2-4. North Fork Thunder River Subwatershed



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Peshtigo River Subwatershed (PR)

Description

The riverine portion of the Peshtigo River Subwatershed begins at the confluence of the Peshtigo and Thunder Rivers (NE 1/4 of section 12, T32N, R18E). It ends near the border of the Town of Beaver (NE 1/4 of section 1, T31N, R20E). The southwestern portion of the Village of Crivitz lies within this subwatershed. The Crivitz Sanitary District discharges to the Peshtigo River. Most of the agricultural activity takes place in this subwatershed. Peshtigo River Subwatershed drains an area of 18,789 acres, or 15.2 percent of the total watershed area (see map 2-5).

Water Quality Conditions

The Peshtigo River in this subwatershed is classified as a Warm Water Sport Fish Community from the confluence of the Thunder River downstream to Johnson Falls Hydroelectric Project. The 5 miles of free-flowing river between Johnson Falls and Spring Rapids has historically been a fly fishing only area and is designated as Class II trout water. Regulations now simply require artificial lures only on this stretch of the river. Brook, brown, and rainbow trout are the main attraction although smallmouth bass are also present. Downstream, the river becomes a warm water fishery and forms the headwaters of Sandstone Flowage. This section of the river runs approximately two miles. The ten-mile river section from the tailwaters of Sandstone Flowage to the confluence of the Outlet supports a warm water sport fishery (see table 2-10).

Several water quality studies have been conducted by Wisconsin Public Service Corporation during the relicensing of the Johnson Falls and Sandstone Rapids hydroelectric facilities. Water chemistry samples were obtained from both the flowage and tail water. Continuous dissolved oxygen and temperature monitoring was conducted in the tail waters, while sediment sampling, and macrophyte surveys were done in the impoundments. These studies show very good water quality in the Peshtigo River, with the exception of dissolved oxygen problems directly below the Johnson Falls dam. The Peshtigo River exhibits good overall water quality, largely because of the undeveloped nature of the watershed. Total nutrient concentrations are in a range indicating good water quality (FERC, 1996). While there are many issues being addressed, the main issue concerning water quality is that the hydroelectric facilities operate in a run-of-river mode. Eliminating the peaking mode would reduce erosion below the dams and significantly stabilize the aquatic habitat.

Johnson Falls Flowage supports a primarily warm water sportfish community. However, it also provides habitat for overwintering brown trout which emigrate into the Thunder River and into the North Branch Thunder River when the water warms in the spring. This emphasizes the dual nature of many waters and the importance of viewing watershed habitats as a whole and connected. The entire shoreline of Johnson Falls is owned by WPSC. No dwellings are present.

Sandstone Flowage supports a warm water sport fishery. Bass, walleye, and panfish dominate the sportfish species. At least 69 residential dwellings are found on the shoreline. Shaffer Park Motel & Restaurant is the only commercial operation along the shore. WPSC runs a campground for their employees. An inventory of shoreline land use was conducted by Marinette County LWCD staff in fall 1997. Of the seventy-one developed properties dotting the shoreline, only 13, or 18 percent, met

county shoreland zoning ordinances. Most of the nonconformance was due to set backs of less than 75 feet, excessive cutting and removal of vegetation within fifty feet of the shore, or both.

User conflicts between anglers, property owners, and boaters are becoming a problem on the flowage.

Table 2-10 Peshtigo River Subwatershed Named Lakes

Lake	Area (ac)	Depth (ft)	Lake Type	Access	Upland %	Riparian Ownership & Comments
Johnson Falls Flowage Sec 32, T33N, R19E	67.8	40	drainage	BR	100	Majority of shoreline is owned by Wisconsin Public Service Corporation. There are several small in-holdings along the shore.
Kirby Lake Sec 22, T32N, R19E	5.3	36	seepage	N	90	Shoreline owned by 3 landowners.
Marl Lake Sec 30, T32N, R20E	4.5	3	seepage	N	100	Shoreline owned by two landowners.
Sandstone Flowage Sec 24, T32N, R19E	152.6	39	drainage	BR	>75	Majority of shoreline is owned by Wisconsin Public Service Corporation. There are many small in-holdings along the shore.

Lake Types: Seepage Lakes - Have no inlet or outlet. The principal source of water is runoff augmented by groundwater inflow.
Drainage Lakes - Have no inlet but do have a continuously flowing outlet. Primary source of water is runoff and direct drainage from surrounding land.

Access Type: BR - Boat Ramp - Has a defined public boat launching facility which may or may not have parking.

Nonpoint Source Pollutants

- The Peshtigo River Subwatershed contains 15 animal lots which contribute 409 pounds of phosphorus [organic], annually.
- The upland sediment delivery in the Peshtigo River Subwatershed is 734 tons, annually, from 4,511 acres of cropland.
- Over application of nitrogen fertilizers may be contaminating ground water.
- Each of an estimated 86 developed riparian properties is delivering an average of 0.20 lbs. of phosphorus and 90 lbs. of sediment to surface waters. Riparian property without a natural buffer has been found to have lower aesthetic values and substantially decreased benefits to wildlife.
- Eighty-two percent of the riparian lots inventoried by LWCD staff failed to meet Marinette County Zoning Ordinances.

Water Resource Objectives

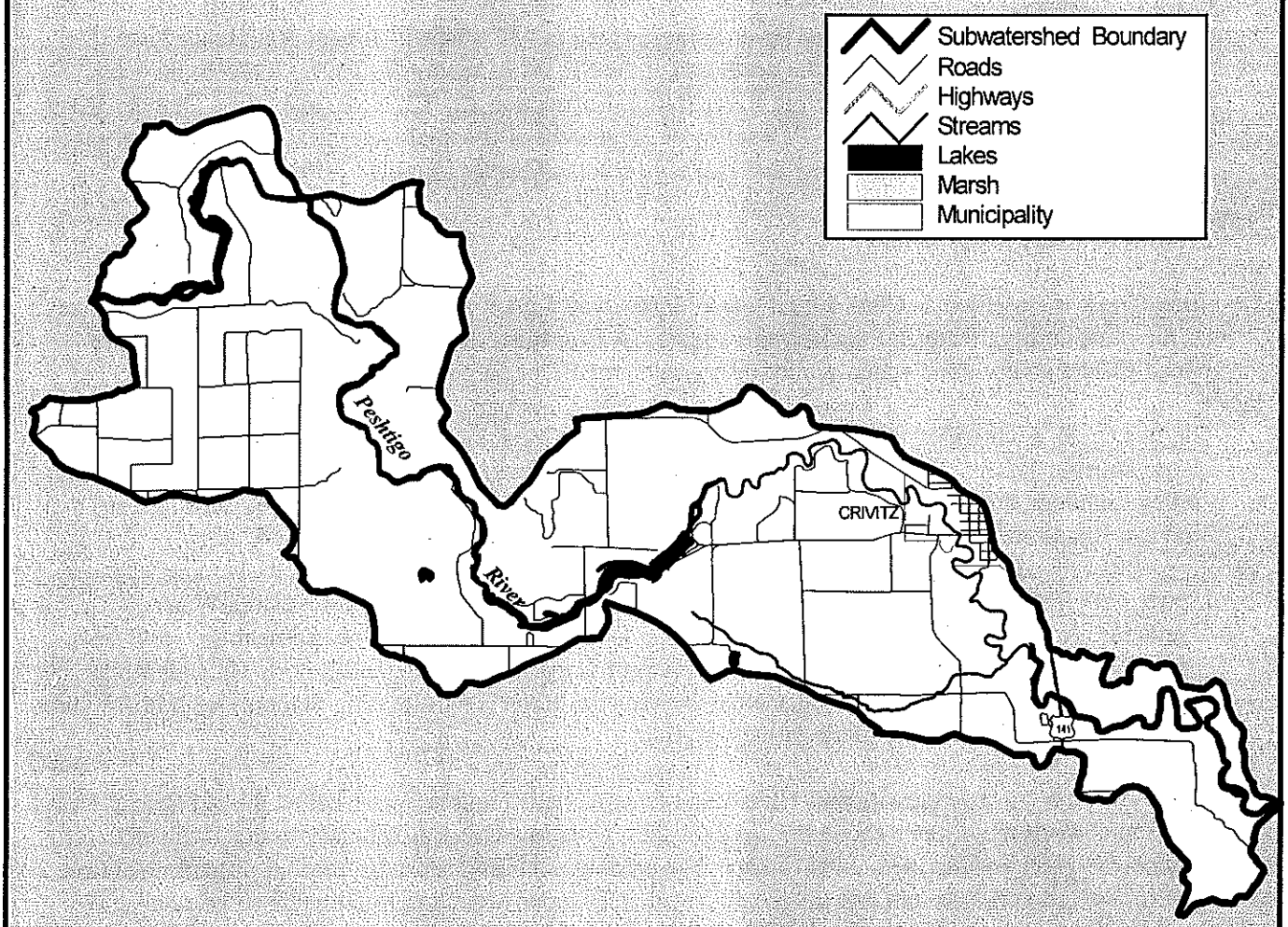
Protect and improve water quality by:

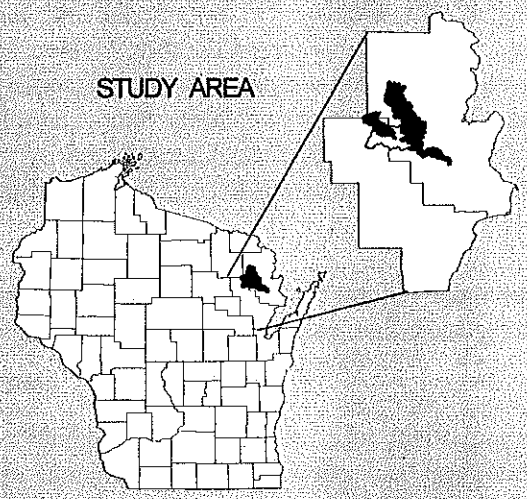
- reducing nutrient, sediment and organic matter delivery to the Peshtigo River.
- stabilizing streambanks at critical locations to reduce instream sedimentation.
- replacing riparian lawn with naturally vegetated buffers.
- properly sealing all unused wells.
- promoting a well head protection plan for the Village of Crivitz.
- designating sensitive areas and protecting them with slow or no wake boating regulations.
- minimizing user conflicts on Sandstone Flowage.

Improve warmwater fishery habitat (increase game fish and intolerant species numbers) in the Peshtigo River Subwatershed by:

- reducing sediment, nutrient and organic loading from watershed streams

Map 2-5. Peshtigo River Subwatershed





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Thunder River Subwatershed (TR)

Description

The riverine portion of the Thunder River Subwatershed is "Y" shaped. It begins at Huber Lake (S 1/4 of section 7, T33N, R18E) to the north and at the SE 1/4 of section 7, T32N, R17E to the west. The subwatershed ends at the Peshtigo River (NE 1/4 of section 12, T32N, R18E). The Thunder River Subwatershed drains an area of 26,845 acres, or 22 percent of the total watershed. About half of this subwatershed is in Marinette County and half is in Oconto County (see map 2-6).

Water Quality Conditions

Hay Creek is classified as Class I trout water. It received a good aquatic life habitat rating. Small size is the most limiting factor influencing this stream. A macroinvertebrate sample collected at LaFave Road earned a very good water quality rating with an EPT of 56 percent.

Forbes Creek is classified as Class I trout water. Forbes Creek and Hay Creek join to form the South Fork Thunder River. This small stream starts at Forbes Springs. It received a good aquatic life habitat rating, although no macroinvertebrate samples could be obtained because of the sandy substrate at LaFave Road crossing.

South Fork Thunder River is classified as Class I trout water and Exceptional Resource Water. Wetlands are numerous. The Thunder River State Fish Rearing Station is located near the confluence of the North Fork. This facility has a WPDES permit to discharge to the South Fork Thunder River. Brook trout are found above the waterfall at the Thunder River Trout Rearing Station. Both brook and brown trout are found downstream of the waterfall.

Handsaw Creek is also classified as Class I and Exceptional Resource Water below the old Beitzal Dam site and Class II trout water above the old dam site. Handsaw Creek is tributary to the Thunder River. It received good aquatic life habitat ratings. The predominant sand substrate made it difficult to collect macroinvertebrates although one sample collected at Thunder Mountain Road received an excellent water quality rating with 52 percent EPT genera. Water chemistry samples collected during two runoff events at Thunder Mountain Road showed low levels of nutrients, biochemical oxygen demand, and suspended solids. In the 1920's two dams were constructed on Handsaw Creek creating Huigen Lake and significantly enlarging Squaw Lake. These dams were constructed without permits. Necessary repairs to the dams required permits, which were denied. The dams were eventually removed which reestablished a free flowing Handsaw Creek as it was fifty years ago. Handsaw Creek primarily supports brook trout. The free flowing condition is a clear benefit to its trout fishery and that of the Thunder River as well.

Thunder Lake Inlet and Outlet flow to and from Thunder Lake and are both cold waters. The Inlet is classified as Class II while the Outlet is Class III. Thunder Lake Inlet received good and fair aquatic habitat ratings.

Thunder River is classified as Class II trout water. Thunder River received good aquatic habitat ratings several times. This large river has adequate size, substrate, and bank cover to support abundant aquatic life. A macroinvertebrate sample collected at Caldron Falls Road received an excellent water quality

rating with an EPT of 62 percent. Water chemistry samples collected during two runoff events at Caldron Falls Road showed low levels of nutrients, biochemical oxygen demand, and suspended solids.

There are twenty-one named lakes in this subwatershed, ranging from two to 135-acres in size (see table 2-11). The eleven with public access also support most of the development. Most have warm water sport fisheries consisting primarily of largemouth bass and panfish. Notable exceptions are Forbes Springs, Sand Lake, and Thunder Lake. Forbes Springs is a spring pond supporting brook trout. Sand and Thunder Lakes are two story lakes supporting both cold water and warm water fish communities. Brook, brown, and rainbow trout can be found in these lakes. The rainbow trout can be traced to stockings made by the WDNR.

Thunder Lake was monitored in 1992, along with Eagle and Island Lakes under a WDNR lake planning grant, by a private consultant. Temperature and dissolved oxygen profiles show the thermocline is at roughly eighteen feet. Early to mid summer oxygen levels are highest just below the thermocline. Oxygen concentrations do not dip below five ppm until at least a 33-foot depth is reached. Water clarity and quality at Thunder Lake is quite good. TSI values were in the mesotrophic range. Secchi depths greater than 24 feet have been noted and averaged 17.4 in 1992.

Eurasion water milfoil (*Myriophyllum spicatum*) is a submersed aquatic plant native to Europe and Asia. It spreads mainly through fragmentation, spreading widely. Once established, it forms dense stands, out competing native plants, and threatening the integrity of aquatic communities. Eurasion water milfoil is present in Thunder Lake. It currently does not threaten water quality.

The greatest threat to the ecological integrity of Thunder Lake is the development of the riparian area. A survey of riparian development was conducted by boat in 1996. Two miles of shoreline contained 58 developed lots. Of these, 35 or 60.3% did not meet county zoning ordinances. On Thunder Lake, most of the zoning violations were for excessive cutting and removal of natural vegetation in the 50-foot strip adjacent to the Ordinary High Water Mark.

Thunder Lake has historically had excellent water quality with low nutrients and high water clarity (Garrison, 1997). Water quality is beginning to decline, most likely because of shoreline development in the last 10-15 years. Although logging in the late 1800's resulted in considerable disturbance in the watershed, it did not result in increases of inlake nutrient levels nearly as much as recent shoreline development. Recent development has also been more destructive than the original cottage development in the late 1950's and 60's.

Eagle Lake is generally mesotrophic, although the TSI for Secchi depth was in the oligotrophic range (15.7 ft. Average). Temperature and dissolved oxygen profiles indicate little stratification. Dissolved oxygen levels remained above the levels that would stress fish. The development survey of Eagle Lake's 1.69 miles of shoreline found 29 developed lots, of which 24 lots (82.7%) met zoning standards.

Island Lake is shallow and generally mesotrophic. This lake is heavily developed. Shallow depth and high TSI values suggest that it is at risk for seriously degraded water quality due to eutrophication.

Boundary Lake was monitored in 1996 as part of the water quality appraisal conducted for the priority watershed. This lake is solidly mesotrophic. The depth of Boundary Lake relative to its fetch is not great enough to cause stratification. Dissolved oxygen concentrations remain high enough, throughout

the year, to support aquatic life. A shoreline land use survey conducted by the Marinette County LWCD in 1996 on Boundary Lake revealed 46 developed lots along the 0.9 mile shoreline. Of these, 10 lots, or 21.7% met current zoning standards. Those that failed to meet the standards generally had structures within the 75-foot setback or excessive clearing within the 35-foot margin adjacent to the lake.

Little Perch Lake shoreline is almost completely undeveloped. However, it was recently sub-divided into 23 lots and may soon be completely ringed by dwellings. TSI values indicate the lake is already mesotrophic. Given its small size, relatively shallow depth, lack of a flushing mechanism, and degree of potential development, this lake faces a severe risk of increased rates of eutrophication. Currently, plant growth is relatively sparse. Secchi depths were variable, but averaged approximately 12 feet.

Little Perch Lake does not stratify. In late winter, dissolved oxygen concentrations were low enough to be of concern. However, good numbers of largemouth bass and sunfish species were visible and active during all summer sampling.

The Thunder River Subwatershed contains some of the more heavily developed lakes in the Middle Peshtigo-Thunder Rivers Priority Watershed. Water quality data is lacking for most lakes in the subwatershed.

Table 2-11 Thunder River Subwatershed Named Lakes

Lake	Area (ac)	Depth (ft)	Lake Type	Access	Upland %	Riparian Ownership & Comments
Brtho Lake Sec 9, T32N, R18E	9.6	31	seepage	W	100	Intensively developed since 1970.
Bottle Lake Sec 8, T32N, R18E	6.2	12	drainage	Y	100	<10% of shoreline in private ownership.
Boundary Lake Sec 7, T32N, R18E	37	19	drainage	BR	>90%	>90% of the lake is in **Oconto County**. Very heavily developed.
Cedar Lake Sec 12, T32N, R17E	20	5	seepage		<40	Lake is in **Oconto County**, little development.
Dell Lake Sec 12, T32N, R17E	35	10	seepage	W	<10	Lake is in **Oconto County**, majority of the shoreline in public ownership.
Eagle Lake Sec 15, T32N, R18E	56.3	30	seepage	Y	>85	Heavily developed and subdivided with increasing back lot development and nearby subdivisions.
Forbes Spring Sec 29, T33N, R17E	2	2	drainage	W	60	Lies in **Oconto County**.
Frying Pan Lake Sec 6, T32N, R18E	27.6	47	seepage	W	60	50% of shoreline owned by two landowners. High development potential.
Hazel Lake Sec 8, T32N, R18E	2.8	12	seepage	W	0	Entire shoreline in Marinette County ownership.
Huber Lake Sec 17, T33N, R18E	29.1	8	drained	N	70	Majority of the shoreline is owned by Paust's Resort and 1 other landowner. High development potential.
Island Lake Sec 15, T32N, R18E	8.9	10	seepage	N	70	Heavily developed since 1970. Subdivided with heavy back lot development. Previously participated in Lake Mgmt. Planning Grant program.
Kiss Lake Sec 8, T32N, R18E	4.3	15	spring	N	90	Entire shoreline owned by 1 landowner.

Table 2-11 Thunder River Subwatershed Named Lakes (cont.)

Lake	Area (ac)	Depth (ft)	Lake Type	Access	Upland %	Riparian Ownership & Comments
Ledge Lake Sec 1, T32N, R17E	34	19	seepage	?	<40	Lake is in **Oconto County**, little development.
Little Perch Lake Sec 11, T32N, R18E	13.5	26	seepage	N	100	The lake was subdivided in 1993, and is rapidly becoming developed.
Mirror Lake Sec 8, T32N, R18E	4.7	10	seepage	N	0	Entire shoreline is owned by two landowners.
Rollins Lake Sec 8, T32N, R18E	5.4	27	seepage	N	85	Entire shoreline owned by two landowners.
Sand Lake Sec 9, T32N, R18E	19.5	32	spring	Y	100	Entire shoreline owned by Marinette County. Camp Bird is located on the lake.
Squaw Lake Sec 34, T33N, R18E	36	11	drainage	Y	>90	75% of the shoreline is subdivided, 25% owned by one landowner.
The Spring Sec 9, T32N, R18E	6	23	seepage	N	90	Moderate development, some potential for further development.
Thunder Lake Sec 15, T32N, R18E	134	62	drainage	Y	>90	Heavily developed with recent subdivision of the north and west shores. Many zoning violations present. Has recently participated in the Lake Mgmt. Planning Grant program.
Wonder Lake Sec 6, T32N, R18E	8	28	seepage	N	85	Entire shoreline owned by the Iroquois Club.

Lake Types:
Drained Lakes - Have both an inlet and an outlet.
Seepage Lakes - Have no inlet or outlet. The principal source of water is runoff augmented by groundwater inflow.
Spring Lakes - Have no inlet but do have an outlet. Primary source of water is groundwater flowing into the bottom of the lake.
Drainage Lakes- Have no inlet but do have a continuously flowing outlet. Primary source of water is runoff and direct drainage from surrounding land.

Access Types:
BR - Boat Ramp - Has a defined public boat launching facility which may or may not have parking.
T - Walk-In Trail - Partially developed, excludes a boat ramp, and is publicly owned.
W - Wilderness - Publicly owned lake with no defined walk-in trail to the water.
R - Roadside - A public road with a marked right-of-way extending to the water provide a limited degree of access. No facilities.
N - No Access - There is no public access. All shoreline privately owned.

Nonpoint Source Pollutants

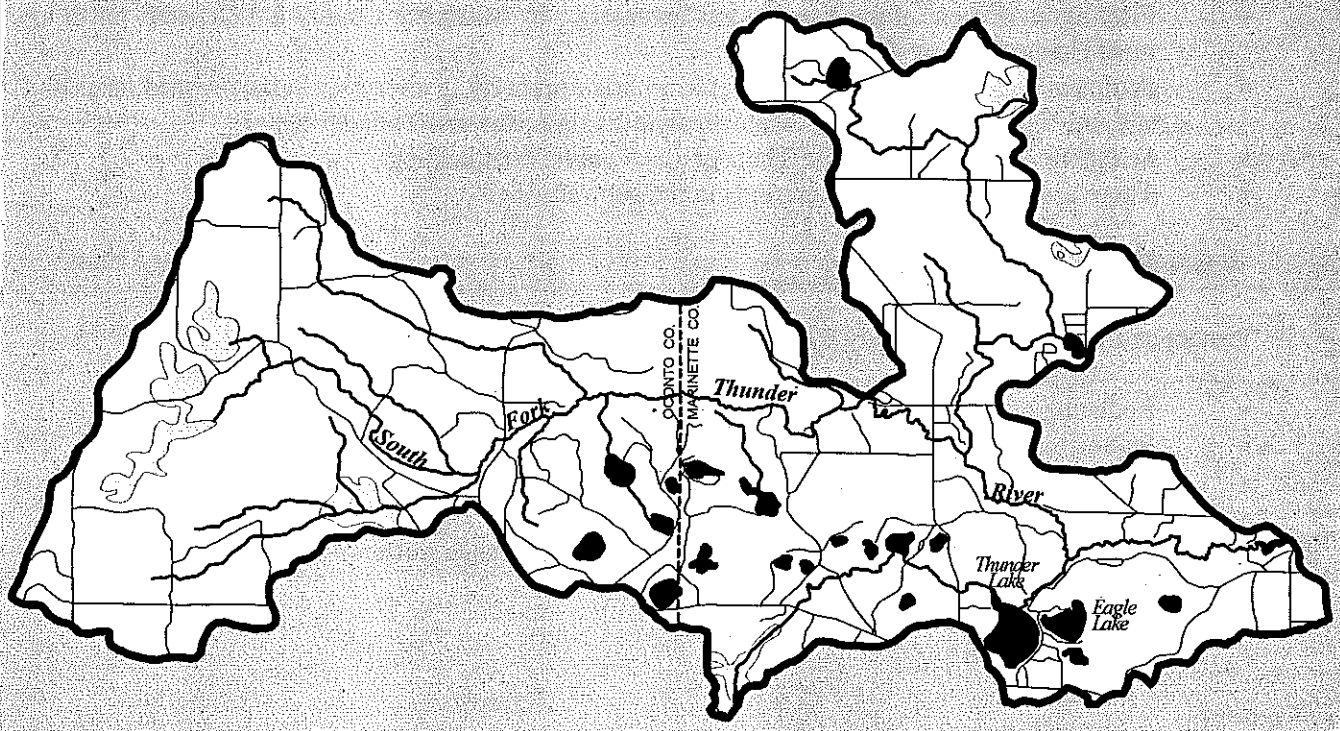
- Each of an estimated 228 developed riparian properties is delivering an average of 0.20 lbs. Of phosphorus and 90 lbs. of sediment to surface waters. Riparian property without a natural buffer has been found to have lower aesthetic values and substantially decreased benefits to wildlife.
- Fifty-seven percent of the riparian lots inventoried by Marinette County LWCD staff failed to meet County Zoning Ordinances.
- Sediment and nutrients from unbuffered riparian property is impacting subwatershed lakes and streams, including Boundary, Thunder, and Eagle Lakes and Thunder River.
- Sediment and runoff from the Thunder Lake public boat landing.
- There are no agricultural operations in the subwatershed.

Water Resource Objectives

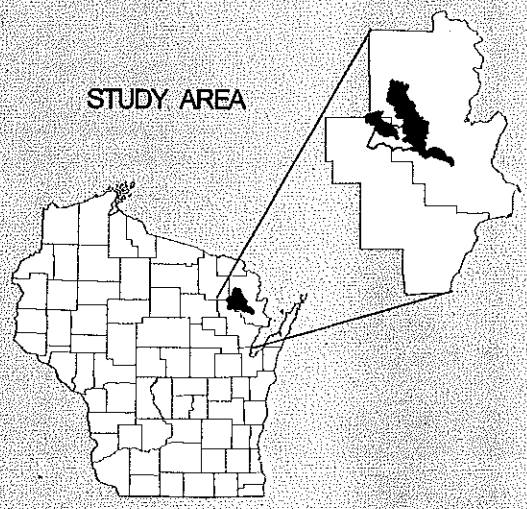
Protect and improve water quality by:

- Reducing nutrient, sediment and organic matter delivery to Thunder Lake.
- Stabilizing streambanks at critical locations to reduce instream sedimentation.
- Protecting sensitive shoreline areas through easements, or land acquisition.
- Installing practices to control sediment and runoff at the Thunder Lake boat landing.
- Replacing manicured riparian lawn with naturally vegetated buffers.

Map 2-6. Thunder River Subwatershed



Subwatersheds
County Boundary
Roads
Streams
Lakes
Marsh
Municipality



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March 1998

Rural Inventory Results, Runoff Pollutants, and Cost-Share Eligibility Criteria

This section describes the nonpoint source inventories, objectives and cost-share eligibility criteria for each pollutant source. These sources include: barnyard runoff; agricultural nutrients; and sediments from upland areas, gully erosion, streambank erosion, and shoreline erosion. The Middle Peshtigo-Thunder Rivers watershed project is a protection oriented project, and 71% of the watershed is in woodland. Agricultural operations make up only 4.4% of the are total land use in the watershed, and are located entirely in the Medicine Brook and Peshtigo River subwatersheds.

Management Categories

Cost-share funds for installing pollutant control measures will be targeted at sites which contribute the greatest amounts of pollutants and habitat degradation (barnyards, manure stacks, manure spreading, upland fields, streambank and sites experiencing shoreline erosion or streambank habitat degradation). Management categories define which nonpoint sources are eligible for financial and technical assistance. They are based on pollution and habitat degradation generated by a source and the feasibility of controlling the source. Specific sites or areas within the watershed project are designated as either "critical," "eligible," or "ineligible." Designation as a critical site indicates that controlling that source of pollution is essential for meeting the water quality objectives for the project. Nonpoint sources which are eligible but not critical contribute less of the pollutant load, but are included in cost sharing eligibility to insure further that water quality objectives are met. Landowners with eligible sites need not control every eligible source to receive cost-share assistance.

Management category eligibility criteria are expressed as tons of sediment delivered to surface waters from eroding uplands and shoreline, loss of riparian habitat due to development, pounds of phosphorus [organic] delivered to surface waters, and feet of streambank trampled by cattle. Any newly created sources requiring controls after the signing of a cost-share agreement must be controlled at the landowners expense.

The criteria used to define these management categories will be verified and/or updated at the time that the county staff visits a site. A source may change management categories depending on the conditions found at the time of the site visit. It is important to note that a management category may be revised until the time the landowner implements a BMP which will control the source of pollution. Any increase in the level or the creation of a new source of pollution resulting from a change in land use or management which renders the installed BMP ineffective and/or requires new controls must be controlled at the landowner's expense during the cost-share agreement operation and maintenance period.

The Marinette County Land & Water Conservation Department will assist landowners in applying the majority of BMPs. Practices range from alterations in land management (such as changes in riparian stewardship, manure-spreading, and logging) to engineered structures (such as shoreline stabilization, logging roads, and manure storage facilities). Practices are tailored to specific landowner situations. There are no agricultural operations in the Oconto County portion of the watershed. LCD staff there will focus mostly on encouraging the proper use of Forestry BMPs and on information and education efforts for employees of timber operations and other citizens.

Critical Management Category

Nonpoint sources included in the critical management category contribute a significant amount of the pollutants impacting surface waters. Critical sites are those sites where BMPs must be applied to have a reasonable likelihood of achieving the project's water quality objectives. These sites are designated by both numeric and descriptive criteria. Landowners with sites that meet the established critical site criteria are required by law to address those sites by reducing the nonpoint source pollutant load to an acceptable level. However, nonpoint source pollutant reduction in the Middle Peshtigo-Thunder Rivers Priority Watershed will be achieved mainly through voluntary participation. Pollutant load reduction can occur solely through the action of the landowner with guidance from county staff or through watershed participation.

Each site will be field verified before receiving notification as a critical site, with the findings sent to the appropriate WDNR Regional Office. Landowners interested in receiving cost-share assistance for the installation of BMPs will need to sign a cost-share agreement with the Marinette County Land & Water Conservation Department of the Oconto County Land Conservation Department.

On-site visits will be conducted within a 6-month period. The purpose of the visit will be to verify that the location still meets the criteria for critical sites. Notification of landowners with known critical sites will begin 6 months following plan approval and will continue through the completion of the inventory. Notification will include the following information:

- The 36-month period in which landowners are eligible for the full level of state cost-sharing, after which the cost-share rate decreases by 50 percent.
- The potential consequences that a landowner may face if no action is taken as defined in either Chapter NR 243 for animal waste, or s. 281.20 (1)(3), are receiving a notice of discharge, being required to have a WPDES permit, or being issued a notice of intent.
- The right to appeal the designation of a critical site through a written request to the Marinette or Oconto County Land & Water Conservation Committee within 60 days of receipt of the notification letter. See also the "Appeal Process" section.

Eligible Management Category

Specific nonpoint sources of pollution in this category contribute less significantly to water quality degradation. These sites are eligible for technical and cost-share assistance but are not as critical to reaching water quality objectives.

Ineligible Management Category

Other sites which do not contribute significant amounts of pollutants are not eligible for cost share assistance under the priority watershed project. The exceptions are sites that can achieve 50% reductions of phosphorus or nitrogen by installing clean water practices. Other DNR programs (e.g., wildlife and fisheries management) can, if warranted, assist county project staff to control these sources as tools of the integrated resource management plan for the watershed. Other local, state, or federal programs may also be applicable to these lands.

Agricultural Operations in the Middle Peshtigo-Thunder Rivers Watershed

There are a total of 9 agricultural operations in the watershed which may be eligible for cost sharing for BMPs through the priority watershed program. All 9 of the operations are located in 2 of the subwatersheds; Medicine Brook and Peshtigo River. However, the soils throughout the watershed are very susceptible to groundwater contamination. Barnyard work may be necessary on some of the watershed's farming operations, and the proper abandonment of wells throughout the watershed is necessary to protect groundwater in the Middle Peshtigo-Thunder Rivers watershed.

Barnyard Runoff

As previously stated, the Middle Peshtigo-Thunder Rivers watershed project is a protection oriented project, and 71% of the watershed is in woodland. Agricultural operations make up only 4.4% of the are total land use in the watershed. Therefore, barnyards are not a concern in most of the watershed, but runoff carrying pollutants from barnyards and other confined livestock areas is a source of pollutants. All barnyards within the watershed are located in the Medicine Brook and Peshtigo River subwatersheds. There are no barnyards that are causing pollution in the section of the watershed that lies in Oconto County. Barnyard runoff is detrimental because of high BOD (biological oxygen demand), COD (chemical oxygen demand), bacteria, phosphorus, nitrogen, salts and sediment.

Nitrogen is the nutrient of most concern to ground water due to its potential impacts on human health. Internally drained barnyards drain to surface depressions or wetlands rather than directly to surface waters. Eleven internally drained yards were identified in the Middle Peshtigo-Thunder Rivers Watershed. Soils within the watershed are among the most susceptible in the state to ground water contamination. Eligibility of internally drained lot is based on a site-by-site analysis where significant groundwater contamination was determined to be likely. It is estimated that approximately 8 of the internally drained barnyards have the potential to cause significant groundwater contamination and will be eligible for either clean water BMPs or full barnyard systems. If a barnyard was omitted and its eligibility as an internally drained lot was not identified during the planning phase, field investigations will be conducted jointly by county project staff, DNR watershed management staff, and DATCP staff.

Phosphorus is the nutrient of primary concern to surface waters because it is the limiting nutrient for plant growth in most natural water bodies. Phosphorus is also the nutrient most amenable to control, and therefore will be the target for most of the agricultural best management practices. Most of the oxygen-demanding pollutants and nutrients associated with these operations drain via concentrated flow to closed depressions, wetlands, and creeks.

The project objective for barnyard runoff control is to reduce phosphorus loading by a total of 40 percent (see table 2-12). Based upon experience, it was determined that a total of 75 percent of this reduction will be obtained solely through voluntary participation. Barnyard sites contributing a phosphorus load greater than 50 lbs. annually will be designated as a critical site for control. There is only one barnyard in this category in the entire watershed. Those landowners with an animal lot designated as critical for control are eligible for a complete barnyard system. If the site owner is unable to manage installation or management of a complete barnyard system, or if Marinette County staff determine that a complete system is not necessary to greatly reduce the phosphorus load from the site, the owner will be required to divert upland clean water and roof runoff away from the lot. State cost-sharing is available for these low cost, clean water diversions. Critical sites will also be eligible for full barnyard systems to achieve more phosphorous control.

Barnyard sites that contribute between 20.1 lbs. and 50 lbs. of phosphorus annually (table 2-12) will also be considered eligible for cost-sharing for either low cost, clean water diversions or full barnyard systems. The barnyard inventory identified one yard which meets this phosphorous loading criteria.

Barnyards contributing 20 lbs. of phosphorus or less are not eligible for cost-sharing unless a 50 percent reduction in phosphorus can be achieved with clean water practices such as diversions and roof gutters.

If any barnyards were omitted and not identified during the planning phase, and are subsequently located, a field investigation and associated revisions will be conducted by Marinette County project staff. Barnyards meeting these criteria will be eligible for cost sharing, provided they meet the proper management category.

Table 2-12 Barnyard Inventory Results and Eligibility Criteria Goal: 40% Reduction in Phosphorus Loading = 47 Pounds

	Inventory Results			Criteria	
Subwatershed	Number of Barnyards	Pounds of Phosphorus	% of Barnyard Phosphorus by Subshed	Critical Sites > 50 lbs. P	Eligible Sites 20.1 - 50 lbs. P
				# Barnyards	# Barnyards
Medicine Brook	2	53.0	45	1	0
Peshtigo River	7	65.7	55	0	1
Total	9	118.7	100	1	1

Table 2-13 Barnyard Runoff Pollution Objective: 40% (47 lbs. P)

Category	No. of Sites	Lbs. reduced	% Reduced (goal)	% Reduced (total)
Critical	1	38	80	32
Eligible	1	9	20	8
Ineligible	7	--	--	--
Total	9	47	100	40

Manure Storage

Surface and groundwater is at risk when manure storage facilities are improperly located, designed or constructed. Manure overflows and storage facility failures are a serious threat to aquatic life. Marinette County adopted a manure storage ordinance to prevent ground and surface water pollution by assuring proper design, construction location and management of permitted facilities. An ordinance must meet the guidelines adopted by DATCP and cite the applicable NRCS construction and management standards. Ordinances require permits for the installation and major repair of manure storage facilities. An operation is eligible for cost-sharing a manure storage facility if the storage facility is needed to manage manure during periods of snow-covered, frozen and saturated conditions in order to protect water quality. All landowners having a potential need for manure storage were evaluated using the Manure Storage Rating Guidelines (MSRG) as developed by USDA Natural Resources Conservation staff. Based on the MSRG, winter spreading of manure and the lack of nutrient management planning contributes 2100 pounds of phosphorous annually to the Middle Peshtigo-Thunder Rivers watershed. The inventory rating, phosphorous load, and acre deficit will be utilized as a preliminary nutrient management plan to determine storage needs and whether a landowner has enough land to utilize the manure.

MSRG Rating -

An indication of the amount of phosphorous draining to surface waters due to manure spreading practices. It is based primarily on two considerations:

1. The pounds of phosphorous that could be saved by proper nutrient management and no winter spreading.
2. The percentage of high hazard fields.

Phosphorous Load -

Determined from the amount of manure spread and the land spreading conditions.

Acres Deficit -

Number of acres needed for spreading the amount of manure produced in the winter, minus the acres that are suitable for winter spreading.

Based on these criteria, eleven of the sixteen operations in the watershed are eligible for cost sharing. All internally drained fields will be considered High Hazard for manure spreading during periods of snow-covered, frozen and saturated conditions.

The eligibility for storage facilities will be based on the least cost practical system that meets storage capacity needs and meets NRCS Std. 313 or 425. These options may include, but are not limited to, a properly sited unconfined manure stack (following Std. 312); the construction of a short term storage facility (capacity for 30 to 100 days manure production following Std. 313); the construction of a long term storage facility (capacity for up to 365 days production in accordance with Std. 313 or 425); or a reduction in the number of animals. The rental of additional lands or giving manure which cannot be spread to a neighboring farm that can use the manure in accordance with a nutrient management plan

are also options. This is allowed, provided the landowner enters a lease/rental/barter agreement for the maintenance period of the BMP installed.

Certain components of waste management systems (as specified in NRCS Std. 312), specifically those involving collection, handling and storage, require the preparation of a nutrient management plan (NRCS Std. 590) for the acreage that the waste may be spread. Roof Runoff Management (NRCS Std. 588), Livestock Exclusion (NRCS Std. 472), and Clean Water Diversions (NRCS Std. 362) are exempt from this requirement. Operations eligible for waste management systems are also eligible for cost-sharing of nutrient management practices, specifically the development of both nutrient management and pest management plans (NRCS Std. 590), soil testing and crop scouting. See "Nutrient and Pest Management" later in this chapter for additional detail.

Nutrient and Pest Management

Landowners receiving cost-sharing funds for manure storage practices are required to develop a nutrient management plan for those acres that will receive manure applications resulting from these practices. An NRCS Std. 590 nutrient management plan may be used besides the Manure Storage Rating for Surface Waters to indicate whether a storage facility is needed. Nutrient and Pest Management is recognized as one of only a few BMPs that can be applied for protection or improvement of groundwater and surface water. Farmers can benefit from nutrient and pest management plans by taking nutrient credits for legumes and land spread manure. Commercial fertilizer applications are then adjusted to meet crop needs and can generally be reduced. Manure spreading runoff and management of nutrients are addressed through NRCS Nutrient Management Standard 590.

Critical and Eligible livestock operations listed in table 2-13 will be encouraged to participate in an on-farm nutrient and pest management educational program to reduce over application of nutrients and pesticides. Because of the sandy nature of the soils in the Middle Peshtigo-Thunder Rivers Watershed and the extreme susceptibility to ground water contamination, all cropped fields will be eligible for cost shared nutrient and pesticide management.

These plans may be prepared by crop consultants, landowner/operators, or with assistance from Marinette LWCD staff. Plans must be consistent with NRCS Standards 590 and 595. Landowners will be eligible to participate for up to three years and will receive the cost share rate or per acre rate. Plans will be submitted to and approved by the Marinette County LWCD. Records will be kept showing progress toward reducing the use of fertilizer and pesticides.

Other practices that are singularly eligible for cost-sharing are soil and manure testing, crop scouting, and spill control basins for pesticide handling.

Rural Sediments

Upland Sediment

The Surface Water Resource Appraisal inventories revealed little evidence of upland erosion in the watershed. Most of the watershed is forested and currently has a low potential for erosion. Agricultural activities are limited to the Medicine Brook and Peshtigo River subwatersheds.

A 40 percent reduction in sediment from eroding fields is targeted for agricultural lands. To be classified as Critical, landowners' fields must be contributing greater than .6 tons/acre/year of sediment and have soil loss greater than "T". An estimated 428 acres of cropland in the watershed are classified as Critical, delivering 12.3 percent of the upland sediment load (96 tons) in the watershed. The average sediment delivery rate for all subwatersheds is 0.13 tons/acre/year.

An additional 27.7 percent of the sediment load delivered to surface waters (241 tons) will be controlled through Eligible sites, which include an estimated 2,455 acres. The Eligible classification includes those fields delivering sediment at a rate greater than 0.1 tons/acre/year (see table 2-14a & 2-14b).

Table 2-14a Upland Sediments - Cropland Inventory Results

Subwatershed	Cropland inventory results		
	Acres	Tons per year - Sediment delivered	% contributed by watershed
MB	933	47.8	6
PR	4,511	734.2	94
Total	5,444	782	100

Table 2-14b Upland Sediment - Reduction Goal

Subwatershed	Goal - 40% reduction in sediment delivered					
	Critical >T soil loss and >0.6 Tons/acre sediment delivered			Eligible >0.1 Tons/acre sediment delivered		
	# Acres	Target - tons	% reduced (of goal)	# Acres	Target - tons	% reduced (of goal)
MB	0	0	0	439	19	494
PR	428	96	31	2,016	195	2,067
Total	428	96	31	2,455	214	2,561

Gully Erosion

Gully erosion is not a significant problem in the watershed, overall, and a formal inventory of gullies in the watershed was not completed as a part of the planning process. There are, however, specific locations in the watershed where gully erosion is known to be a serious problem. Eligibility for cost sharing for gully erosion will be based on sites exhibiting bare soils and evidence of active erosion, that have a direct connection to surface water via channeled flow, and reasonable access to machinery necessary for the installation of BMPs.

Streambank Erosion

The vast majority of the stream corridors in the watershed are forested and in good condition. However, there is serious risk of erosion from future residential construction and development. Use of erosion control BMPs and construction site BMPs will be critical to protect stream shoreline.

The streambanks of the entire mainstream of the Peshtigo River (approximately 29 miles) were evaluated. Significant erosion has occurred and/or aquatic habitat were degraded along less than one mile of streambank. Most of the damage can be attributed to natural changes in water levels and to water level changes due to hydroelectric dam operations. On the Sandstone Flowage portion of the river, erosion is also being caused by boats and personal water craft.

Livestock Access

One agricultural site was found with evidence of trampling by cattle. This site and any others with cattle access will be eligible for cost sharing. Additional eligible sites on permanent or intermittent streams may be identified by Marinette County LWCD staff during implementation.

Shoreline Erosion

The severity of shoreline erosion is affected by water level fluctuations, human trampling, surface water traffic, and shoreline land use practices. A lake shoreline erosion inventory on lakes in Marinette and Oconto Counties was done during the summer of 1995. Of approximately 300 developed properties on Sandstone Flowage and Thunder, Eagle, Deer, Lost, Boundary, and McCaslin Lakes, 26 percent had at least moderate erosion.

An erosion inventory of the Peshtigo River, from the Sandstone Dam to the outlet from Lake Noquebay, was conducted in 1997. Several significantly eroded sites were noted. These may be caused by fluctuations in water levels due to hydroelectric operations rather than human activity in riparian areas.

While the inventory did not identify shoreline erosion as a major sediment problem, the loss of shoreline habitat caused by erosion is serious. On the developed riparian properties that have any natural vegetation at the waters edge, there is often only a narrow strip of non-turf plants. Any additional losses to erosion are of major significance and should be reduced.

Critical area sites for shoreline erosion are those with severe erosion. Severe sites have banks averaging at least six feet in height, with a lateral recession rate of 0.5 foot per year or greater. All bare and eroding shoreline/streambank reaches in the watershed will be eligible for best management practices. Priority for installation of BMPs will be given to owners of actively eroding sites and large areas of non-vegetated surface. Priority will also be given to urban style, manicured lawns where native vegetation has been removed, that are greater than 30 feet wide and are within 75 feet of the shoreline or streambank.

Riparian Nutrients and Sediment

The overall watershed goal is to protect water quality by reducing the amount of nutrients, pesticides, and sediment that are being delivered to surface and ground water. Improper siting of structures and impervious surfaces, along with excessive clearing and grading in the riparian zone, will be targeted with voluntary use of BMPs and improved enforcement of the Marinette County Shoreland Zoning Ordinance. Proper septic system siting and maintenance are administered under Marinette County Sanitary Codes.

Nutrients and Pesticides

Analysis of nutrient and/or pesticide needs will give the riparian landowner an opportunity to have an equal balance of enhancing water quality and properly maintaining their lawn. Soil testing, to prevent over fertilization, along with proper timing of fertilizer and pesticide applications are vital. Appropriate land use and adherence to shoreland zoning and sanitary codes protects property values, maximizes enjoyment of the land, protects water quality, enhances aesthetic values, and conserves fish and wildlife habitat.

Sediment

As riparian development has shifted from the 1940's paradigm to the current regime, sediment delivery to watershed lakes has increased by 450% (see table 2-15). Residential construction in the riparian zone, if improperly managed, can cause the transport of huge amounts of sediment to surface waters. Compaction of the soil by heavy equipment during construction can reduce infiltration rates for as long as fifty years. Completely clearing a 20,000 square foot lot can result in transport of up to 18 tons of sediment (Sorge and Panuska, 1997).

Improperly designed or maintained boat landings have the potential to cause erosion and impact water quality significantly. When roads leading to boat ramps, or the boat ramps themselves are made of gravel and not properly graded, sediment is deposited into surface waters. Paving certain roads or constructing sediment basins to collect runoff from existing gravel roads can reduce sediment loading. County staff will identify and evaluate problem boat landings to determine cost share eligibility. All landings that are determined to be a pollution source will be eligible for cost sharing. BMPs will be installed at eligible boat landings using NPS Program and/or Lake Protection Grant funds.

Runoff From Developed Shorelines

Research has shown that improper development within a watershed or around a lake (table 2-15), even at relatively low densities, can significantly increase the export of pollutants.

A direct correlation between the degree of riparian development and degraded water quality has been established in many studies. In 1995, a paleolimnological study of Thunder Lake was conducted by the WDNR. A sediment core was used to document water quality changes that have occurred in the last 150 years (Garrison, 1997). The report summary stated:

> "Thunder Lake has historically had excellent water quality with low nutrients and high water clarity. This water quality is beginning to decline, most likely because of shoreline

development in the last 10-15 years. Although logging in the late 1800's likely resulted in considerable disturbance in the watershed, it did not result in increases of inlake nutrient levels nearly as much as recent shoreline development. This recent development has also been more destructive than the initial cottage development in the 1950's and 60's."

Table 2-15 Impacts on Lakes Due to Varying Levels of Development

Undeveloped Condition	1940's Development	1990's Development
Maple beech forest 6% slope to lake sandy loam soil	Maple beech forest 6% slope to lake Grass corridor 20' wide Cottage 700 sq. Feet Gravel Drive 800 sq. Feet 35 ft. Buffer strip	Maintained lawn, soil graded 6% slope to lake Home 3,350 sq. Feet Paved drive 770 sq. Feet
Impacts on Lake (April - October)		
1000 ft^3 runoff to lake 0.03 lbs. P to lake 5 lbs. Sediment to lake	1000 ft^3 runoff to lake 0.03 lbs. P to lake 20 lbs. Sediment to lake	5000 ft^3 runoff to lake 0.20 lbs. P to lake 90 lbs. Sediment to lake

(Adapted from Sorge and Panuska, 1997.)

Funding of BMPs in developed and riparian areas is based on:

- Practices that restore shoreline habitat on developed riparian lots. At least 20% of the developed riparian lots in the watershed will be restored.
- Practices that reduce shoreline erosion. Shoreline erosion will be measurably reduced on at least 30% of the identified eroded properties.
- Practices that reduce nutrients and contaminants in riparian runoff. At least 20% of developed riparian lots (approximately 100) will adopt BMPs that limit nutrient and contaminant concentrations in runoff.

Forestry Activities on Public Land

Forested land makes up the largest percentage of land use in the watershed (71%) and most of the land is well managed. Marinette County and Wisconsin Public Service Commission are the 2 owners of the majority of forested land in the Marinette County portion of the watershed. The U.S. Forest Service manages 23,000 acres in the western part of the watershed, in Oconto County. Silviculture practices on these lands are performed in accordance with Wisconsin's Forestry Best Management Practices for Water Quality (DNR, Holaday, 1995). The Nicolet National Forest uses Wisconsin's forestry BMPs as a basis for their runoff management practices. If existing Forestry BMPs continue to be well implemented, forestry practices in the watershed shouldn't pose a threat to the degradation of water quality. There are no BMPs to specifically address forestry practices in the watershed that will be cost shared through the watershed project. There are several federal programs that cost share forestry BMPs. A sampling of these programs is found in Chapter 4.

Pollutant Reduction Goals and Project Objectives for Rural Runoff

Goals for water quality in the Middle Peshtigo-Thunder Rivers Watershed were identified earlier in the chapter as protection, enhancement, and restoration of water resources. In rural areas these will be achieved through project objectives for sediment, phosphorus, and groundwater.

The following is a summary of reductions to be targeted for the entire watershed.

Sediment Objectives

Reduce overall sediment delivered by 44 percent. To meet this goal, the following is needed:

- 40 percent reduction in sediment reaching streams from agricultural uplands in all subwatersheds.
- a general reduction in sediment erosion on gully and streambank sites.
- 55 percent reduction in shoreline sediment delivered to lakes.

Phosphorus Objective

Reduce overall phosphorus load by 30 percent. To meet this, the following is needed:

- 40 percent reduction in P from barnyards draining to surface waters in all subwatersheds.
- 40 percent reduction in P from land spread manure.
- the installation of shoreline buffers (or the Shoreline Habitat Interim BMP[2]) on at least 75 developed riparian lots.
- 30 percent reduction of urban style lawns in the 75-foot setback on developed riparian properties in the watershed.

Groundwater Objective

- Properly seal all abandoned and unused wells within the watershed.
- Encourage the Village of Crivitz to draft a Wellhead Protection Plan and create a Wellhead Protection Ordinance.
- Provide cost sharing for Nutrient and Pest Management for all watershed farmers.

Table 2-16 summarizes the phosphorus reduction goals for the Middle Peshtigo-Thunder Rivers Priority Watershed Project.

[2]The Shoreline Habitat Restoration BMP is being evaluated by the DNR's Bureau of Watershed management for its ability to protect water quality. Upon approval, it will be eligible for use in this watershed.

Table 2-16 Phosphorus Reduction Objectives

Phosphorous Delivered (lbs)	Phosphorous Reduction Objective(lbs)	Phosphorous Reduced (lbs)	Source	Percent of Total
118	45%	54	Barnyards[1]	9.2
1,175	40%	310	Cropland	53.1
590	45%	220	Riparian Development	37.7

Note: [1] The barnyards listed above do not reflect those that drain to closed depressions. Although the barnyards draining to closed depressions use nitrogen runoff as their eligibility criteria, they are a source of an additional 409 pounds of phosphorus.

Urban Runoff Pollutants

Description of Urban Runoff

The principal water quality and quantity problems derived from urban runoff result from many factors including:

- Loadings of sediment, nutrients, 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.

Urban runoff carries a variety of pollutants to surface water. Pollutants found in urban runoff include heavy metals (lead, copper, zinc, cadmium and chromium) and many toxic organic chemicals (polychlorinated biphenols, polycyclic aromatic hydrocarbons, pesticides and many others). Other substances in urban runoff include sediment, nutrients, bacteria, and protozoans.

The delivery of pollutants to streams from existing urban areas depends on the types of urban land uses, the types of storm water conveyance systems, and urban pollution prevention practices. Freeways, commercial and industrial areas have the highest unit/area/year pollutant loads, producing the most significant amounts of metals and other urban toxic pollutants. Medium density and multi-family residential areas also generate metals, sediment and phosphorus and include large impervious areas. Residential areas contain more lawn area than commercial areas, while commercial areas have more rooftops, street, and parking lot surfaces. Lawns can also contribute 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, etcetera.

The sole urban area in the watershed is the Village of Crivitz. Approximately 350 acres of Crivitz lies in the Middle Peshtigo-Thunder Rivers Watershed. Crivitz contains a mix of medium residential, commercial, light industrial, and institutional development. Runoff from new urban development such as single family homes, hotels and other tourism-related facilities, especially along the Peshtigo River,

has the potential to degrade water quality further unless stormwater management controls are incorporated during development.

Stormwater Conveyance

Description

Storm water is most commonly conveyed to streams through a combination of storm sewers, roadside ditches, grassed swales, and ponds. Storm sewers transport runoff rapidly with no pretreatment or filtering of the runoff before it enters streams. Properly designed grassed swales generally reduce runoff volume through infiltration. Sod vegetation serves to remove some pollutants from runoff before it flows into streams and storm sewer systems.

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 stream or lake.

Reducing pollutant transport to surface waters involves reducing urban storm water reaching streams, primarily from impervious surfaces. This is accomplished by increasing the infiltration of storm water into the soil. 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 can reduce bank erosion and the need for expensive, highly engineered drainage structures such as concrete lined channels. Infiltration practices can be used with wet detention ponds to supplement pollutant removal effectiveness or reduce pond size.

Practices that increase on-site infiltration include porous pavements, redirecting roof downspouts to grassed areas, and directing runoff water 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 runoff and erosion. Finally, infiltration basins can be at the end of drainage outlets serving larger drainage areas.

Analysis of storm water management techniques shows that 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.

Construction Site Erosion

Description

Construction sites are those areas in any phase of construction that involves disturbing the soil through grading or excavation. In the project area, they entail development and renovation or redevelopment. The renovation and redevelopment activities include utility replacement, street replacement, bridge reconstruction, or rehabilitation of commercial, industrial, or residential areas.

Uncontrolled construction site erosion can devastate aquatic communities in waters receiving sediment-laden runoff. The reduced capacity of stormwater conveyance systems resulting from sedimentation

can cause localized flooding. Importantly, water quality improvements occurring through implementation of nonpoint source control practices for existing developed areas can be negated by construction site erosion pollution sources. Predicting rates of construction site erosion is difficult. However, erosion rates exceeding 75 tons/acre/year can occur. This rate of erosion is greater than occurs on the most severely eroding croplands and 65 times the sediment loading rate from existing commercial and industrial areas. Often the proximity of construction sites to shorelines, storm sewers or other drainage ways results in nearly all of the sediment being delivered to surface waters.

Management Needs and Alternatives

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.

Developers are governed by state regulations (Ch. 281 Wis. Stats.) set forth by the Department of Commerce for erosion control on sites with one and two family dwellings; and the DNR Wisconsin Pollutant Discharge Elimination System (WPDES) permit regulations for sites greater than five acres.

Despite these regulations, several potential impediments to effective erosion control exist. For example, developers sometimes perceive erosion control as an add-on cost and not a built-in cost of construction. Enforcement is often done only in response to complaints. Maintenance of erosion control is often poor. Sedimentation basins can consume large areas where vacant land is scarce and unnecessary grading and excavation are commonplace. Soil is routinely tracked onto roads because preventive measures are not a high priority for builders. There is often confusion about who is responsible for installing erosion control practices.

Local 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) suggested changes to the model ordinance (set forth by Mr. James H. Schneider, League Legal Counsel, in the March 1989 issue of "The Municipality"). 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).

Developers and contractors need to know what is expected of them, and they need better access to technical information through seminars and other educational activities and materials. Erosion control inspectors need specific guidelines for documenting ordinance violations to provide for more consistent and effective legal action.

Because of the gaps in state agency regulations, construction site erosion control is best accomplished 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.

Pollution Prevention Practices

Description

Pollution prevention practices remove pollution at its source and prevent the need for the treatment that might be required if the pollutant entered the water. Practices include street sweeping, yard waste collection, recycling programs, and a variety of behavioral changes.

Street sweeping removes some 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, to remove winter accumulation of sand and street dirt, and in the fall, to remove leaves, provides the greatest benefit. The potential for lawn care chemicals to be carried by runoff to nearby streams and drainageways is also a concern. Fertilizer residues can enrich surface waters with nutrients and promote algae growth. Pesticides can add to toxic pollution.

Many benefits can be gained through small changes in the lifestyle of watershed residents. There are many actions individuals can take; the following is a partial list:

- Reduce or eliminate the use of galvanized roof materials and gutters, a primary source of zinc in urban runoff. Revise municipal building codes where possible.
- Remove pet wastes immediately from lawns, sidewalks, and streets to reduce bacterial contamination of urban runoff. Familiarize pet owners with good pollution prevention practices.
- Control the timing and the amounts and types of fertilizers and pesticides applied in all areas. Market phosphorus-free fertilizer. Test lawn soils and only apply nutrients that are deficient.
- Dispose of automobile waste fluids such as radiator water and engine oil appropriately, keeping them out of the storm sewer system. Set up municipal recycling programs for antifreeze and waste oil.
- Remove street dirt, leaves and debris from catch basins, streets and parking lot surfaces through municipal street maintenance and leaf collection programs.
- Control construction site erosion.
- Minimize use of street deicing compounds.
- Reduce the area and extent of parking lots.

Objective

Encourage the use of pollution prevention practices, such as those listed, through local programs. This goal ties together closely with the information and education component of the project.

Wetland Restoration and Easements

Wetland Inventory

A wetland inventory conducted by the WDNR identified 16,788 acres of wetlands, (about 13.5% of the land in the watershed, table 2-3) within the Middle Peshtigo-Thunder Rivers watershed. About 2,042

acres of wetlands have been drained. Loss of wetlands to agricultural practices and riparian development has not been identified as a serious threat to water quality in the Middle Peshtigo-Thunder Rivers Watershed. This situation may be changing as it relates to riparian wetlands. The demand for lake front property has led to the development of most of the prime building spots adjacent to lakes, and has placed a premium on all lake shore property. Consequently, an increasing number of wetland acres are being filled for residential dwellings.

Wetland Restoration

Wetland restoration is considered a best management practice for controlling nonpoint sources of pollution. Wetland restoration BMPs include, but are not limited to: the plugging or breaking up of existing tile drainage systems, the plugging of open channel drainage systems, other methods of restoring the pre development water levels of an altered wetland, and the fencing of wetlands to exclude livestock. Secondary benefits of wetland restoration may be enhancement of fish and wildlife habitat.

Wetland restoration is an available option to address any of the following:

1. Cultivated hydric soils with tile or open channel drainage systems discharging to a stream or tributary.

   Wetland restoration will reduce the amount of nutrients and pesticides draining from the altered wetland to a water resource by either establishing permanent vegetation or altering the drainage system.

2. Pastured wetlands riparian to streams, or tributaries.

   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 the livestock. Livestock exclusion by fencing will control the pollutants and restore the wetland.

3. Prior converted wetlands downslope or up slope from fields identified as eligible upland sediment sources.

   Restoration of wetlands in these situations will do one of two things: 1) create a wetland filter which reduces the pollutants from an up slope field(s) to a water resource; or 2) reduce the volume and/or velocity of water flowing from an up-slope wetland to a downslope critical field. Two eligibility conditions must be met to use wetland restoration in this situation:

   - All upland fields draining to the wetland must be controlled to a soil loss rate that is less than or equal to the soils "T" value.
   - Wetland restoration costs must be the **least-cost** practice to reach sediment reduction goals.

4. Wetlands filled, cleared or converted to building sites within 300 feet of shorelines or existing wetlands. Priority will be given to wetlands contiguous to surface waters.

Much of the wetland loss in the watershed is due to filling of riparian wetlands for dwelling sites. Reclamation of these areas will restore a key component of the riparian ecosystem. Only those properties not facing legal action due to violation of current Marinette County Shoreland Zoning Ordinances and WDNR Water Regulation and Zoning Codes will be eligible for cost-sharing of the restoration.

Land Easements

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

- Shoreline Buffers: vegetative areas which minimize nonpoint source impacts and other direct impacts to streams;
- Critical Area Stabilization: stabilization efforts needed on sites that either erode at an excessive rate, or have high sediment delivery rates to surface water;
- Wetland Restoration: areas where wetlands are intentionally restored or enhanced to improve their ecological values, such as natural filters of surface water.

Easements may also be considered for protecting municipal well heads if it can be established that vegetative cover will protect groundwater quality by correcting an existing threat.

Although easements are not considered a best management practice, they can help achieve desired levels of nonpoint source pollution control in specific conditions. Easements are used to support best management practices, enhance landowner cooperation and more accurately compensate landowners for loss or altered usage of property. The benefits of using easements in conjunction with a best management practice are many. Riparian easements can provide fish and wildlife habitat along with the pollutant reduction function. Easements are generally perpetual, so the protection is longer term than a management practice by itself. An easement may allow for limited public access (depending on the situation). However, the primary justification of an easement must be for water quality improvement.

Easements should be considered in the following situations:

1. To permanently provide critical or sensitive developed riparian areas with natural vegetated buffers. Easements are strongly recommended whenever:

    - The easement will reduce the intensity and impact of human activities in the near shore area.
    - Habitat functions for a broad range of vertebrate and invertebrate species, including fish, amphibians, reptiles, and aquatic insects are enhanced.
    - Seasonal or breeding habitat for aquatic fauna dependent upon near shore terrestrial areas is protected or improved.

2. To exclude livestock from grazed wetlands or along eroding streambanks within the watershed. Easements are strongly recommended whenever:

   - There is any grazing of wetlands.
   - Livestock density is so great that areas of unvegetated soil are within 60 feet of streams or intermittent streams.
   - More than 30 percent of streambank accessible to livestock is severely trampled and eroding.
   - Channel erosion is exacerbated by livestock grazing such that unvegetated streambanks are two feet or more in height.

3. When elimination of row cropping and the establishment of permanent vegetative cover will stabilize a critical area. Easements are strongly recommended whenever:

   - Row cropping is occurring within 60 feet or less of streams or intermittent streams.
   - Row cropping is being practiced on slopes greater than 9 percent.

4. To support eligible wetland restorations. Easements are strongly recommended whenever:

   - The eligible wetland restoration is greater than 1 acre in size.

5. When a barnyard or animal feedlot is located within the flood plain and: a) a permanent easement is the least-cost alternative to provide adequate pollution reduction or, b) a permanent easement provides a greater level of pollution reduction than on-site engineering options at a price that is cost-effective when compared with the pollution reduction and the price of the available engineering options. Easements are strongly recommended whenever:

   - Engineering options would require intensive management to continue to provide adequate pollution reduction.
   - Surrounding land use is largely agricultural and it is anticipated that it will remain so for two decades or more.

Whether purchased by the DNR or a local unit of government or project sponsor, easements are cost-shared at 100%. Easements purchased by the DNR. must be perpetual. If the county or other governmental unit chooses to enter into an easement agreement with a landowner, the easement must be for no less than 20 years, or perpetual.

Ordinances

Animal Waste Storage Ordinance

Marinette County enacted an animal waste storage ordinance in 1995. The ordinance requires that all manure storage facilities be permitted by Marinette County before construction begins and be built in accordance with NRCS standards. Oconto County has also enacted an animal waste ordinance. Oconto County's ordinance requires that earthen manure storage ponds (NRCS Std.-425) must have an

Oconto County permit. Concrete manure storage ponds (NRCS Std.-313) are not required to be permitted by the county.

Construction Site Erosion Ordinance

Many local governments recognize that the cost of *preventing* damage from erosion and sedimentation is often less than the cost of *correcting* damage from erosion. Also, many believe that the cost of preventing erosion damage should be borne by those benefiting from the development rather than by taxpayers paying to remove sediment from ditches, culverts, streets, harbors, lakes, and streams. These local governments are developing or amending subdivision ordinances, zoning ordinances, and other local ordinances to include runoff and erosion control requirements for developing land areas.

Chapter 236 of the Wisconsin Statutes gives cities, villages, towns, and counties authority to control erosion from developing subdivisions and smaller land divisions, such as individual building lots. This chapter establishes the minimum standards and procedures for subdividing land in Wisconsin. The chapter enables local governments that have an established planning agency to adopt subdivision ordinances that are more restrictive than the state standards. Several of these government units have included runoff and erosion control provisions in their ordinances. These ordinances typically require a developer to submit a detailed plan specifying control measure for reducing erosion and runoff during and after development. Typically, before a final plat is filed the person who reviewed the erosion and runoff control plan visits the development site and certifies that the measures have been installed following the plan.

The DNR suggests that the Wisconsin Construction Site Erosion Best Management Handbook (DNR Publication WR-222-93) be used as a reference for any development that occurs in the Middle Peshtigo-Thunder Rivers Priority Watershed Project. The Village of Crivitz, the Towns of Athelstane, Silver Cliff, and Stephenson (in Marinette County) and the Townships of Lakewood and Riverview (in Oconto County) are encouraged to adopt construction site erosion control ordinances.

Septic System Inspection and Maintenance Ordinance

Neither Marinette and Oconto Counties currently require septic system inspection and update when property is sold. Effluent discharges from nonconforming septic systems adjacent to watershed lakes and streams plus septic systems constructed in unsuitable soils has the potential to impact water quality and public health negatively.

County Land & Water Conservation Department staff and Middle Peshtigo-Thunder Rivers Priority Watershed Citizens Advisory Committee recommend that the Marinette County Department of Sanitarian and the Marinette County Board of Supervisors consider adoption of an ordinance requiring the inspection and update of all septic systems on any property in Marinette County when the property is sold. Oconto County is encouraged to do the same.

Other Pollution Sources

Many pollution sources contributing to surface water quality degradation in the watershed are typically not addressed by the priority watershed project. Control of these pollution sources occurs through other state and county regulatory programs, as described below.

Industrial Point Sources of Pollution

Discharges of wastewater from permitted municipal and industrial sources are important considerations for improving and protecting surface water resources. Chapter 283, Wis. Stats., requires any person discharging pollutants into the waters of the state to obtain a Wisconsin Discharge Elimination System (WPDES) Permit issued by the DNR.

Sewage Treatment Systems

Sanitary sewer service is only available in the Village of Crivitz, which has a municipal wastewater treatment facility. Approximately 500 persons, 17 percent of the watershed population, receive service. Wastewater generated by the remainder of the watershed residents is disposed of through private on-site systems.

Private Sewage Systems

Septic systems consist of a septic tank, a soil absorption field, or an outhouse. Septic systems fail due to soil type, location of system, poor design or poor maintenance. Pollutants from septic system discharges are nitrates, bacteria, viruses and hazardous materials from household products. Generally, in the Middle Peshtigo-Thunder Rivers Watershed, the soils are not suitable for conventional septic tank soil absorption systems. The glacial outwash associated with the Menahga, Pence-Padus, Mancelona-Emmet-Menahga Associations of the watershed do not have sufficient filtering capacity for an effective absorption system. As a result, throughout the watershed, many systems have a lack of absorption that present a surface and ground water quality problem. Land spreading of septic system waste during the winter months can also create surface water quality problems.

The Wisconsin Fund is a Private Sewage System Replacement Grant Program offering financial assistance designed to help eligible homeowners and small business operators offset the costs of replacing a failing septic system. The program is administered by the Marinette County Zoning Department, and has been used since 1981. The grant program applies to principal residences and small businesses built before July 1, 1978, and is subject to income and size restrictions. Seasonal homes are not eligible for participation in this program. Interested individuals should contact the Marinette or Oconto County zoning department for more information.

Land Application of Municipal and Industrial Wastes

Sludge is an organic, non sterile, by-product of treated wastewater, composed mostly of water (up to 99 percent). The reuse of sludge through land application is considered a beneficial recycling of nutrients and a valuable soil conditioner. Use of sludge in this manner is also considered one of the most cost-effective means for a treatment facility to dispose of the material.

Land application of municipal and industrial sludge is regulated under NR 204 and NR 214 and requires a WPDES permit. Minimum distances from wells, application rates, soil types, depth to groundwater, distance from surface water, and the type of crop to be grown on sludge amended fields are taken into consideration when the DNR approves sludge spreading permits.

Solid Waste Disposal Sites

The Mar-Oco Landfill is found in Marinette County in the town of Stephenson, T32N R19E, SEC 32. This is the only active landfill in the Middle Peshtigo-Thunder Rivers Watershed. Its a state-of-the-art facility, and poses no threat to water quality at this time. Six inactive landfill sites exist within the watershed, but none of these are known to be causing water pollution.

Leaking Underground Storage Tank (LUST) Sites

The Wisconsin Remedial Response Site Evaluation Report (DNR publication number SW-144-91) lists the sites identified through the LUST program. Seven sites within the watershed are listed in table 2-5.

Other Contaminated Sites

The Wisconsin Remedial Response Site Evaluation Report also has the Inventory of Sites or Facilities Which May Cause or Threaten to Cause Environmental Pollution and the Spills Program List. This includes sites or facilities identified under the Hazardous Substance Spill Law. See table 2-5 for a list of spill sites.

CHAPTER THREE
Implementation

This chapter identifies the means for implementing rural management actions for nonpoint source pollution control described in the previous chapter (see below). The success of this priority watershed project depends on the aggressive implementation of these nonpoint source pollution control strategies.

This chapter identifies:

- The best management practices (BMPs) needed to control nonpoint sources of pollution as described in Chapter Two;
- Cost containment policies;
- Cost-share agreement procedures;
- Schedules for project implementation;
- The cost share budget;
- The estimated project budget for staffing and other support.

Developed and Riparian Area Best Management Practices (BMPs)

Removal of natural shoreline vegetation along lakes and streams within the Middle Peshtigo-Thunder Rivers Watershed has resulted in increased runoff, higher erosion rates, and degraded fish and wildlife habitat. Landowners will be encouraged to adopt shoreline BMPs recommended by Marinette and Oconto Counties LWCD staff, but will not be required to do so to be eligible for cost sharing. Each participating landowner will be provided with a comprehensive site analysis which not only focuses on water quality, but also on wildlife habitat, improved fisheries, aesthetics, and landowner goals.

Implementation efforts will center on three areas:

A. Shoreline/Streambank Erosion
B. Natural Shoreline Vegetation Restoration
C. Runoff Management

Sites will be evaluated for cost effectiveness and practicality of implementation. The overall objective for these BMPs is to protect surface and ground water in the watershed and restore and maintain the biological integrity and diversity of riparian ecosystems.

Shoreline/Streambank Erosion and Runoff Management

All bare and eroding shoreline/streambank reaches in the watershed will be eligible for BMPs. Priority for installation of BMPs will be given to sites that are actively eroding, have a large non vegetated surface, or have urban style manicured lawns greater than 30 feet wide at the waters' edge. All lakes and rivers will be eligible.

Natural Shoreline Vegetation Restoration

The current Marinette County Shoreland Zoning Ordinance poses stronger restrictions than the Shoreland Ordinance imposed by the state. The ordinance requires that no more than 30 feet of trees and shrubbery in any 100 feet, as measured along the ordinary highwater mark, may be clear cut to a depth of 50 feet. No single clear-cut strip may exceed 10 feet in width. In areas that have not been clear cut, only selective cutting shall be permitted. Such cutting shall leave sufficient trees and shrubbery to: screen uses and structures to the landward side as seen from the water during the summer months; prevent erosion, retard the flow of pollutants; and preserve the natural beauty.

Forestry Best Management Practices (BMPs)

Logging activities that take place within the riparian management zone can have a major impact on surface water resources. Forest roads, landings, stream crossings must be properly designed, constructed, and maintained to minimize sediment delivery from active logging sites to lakes, streams, and wetlands. The WDNR requires the use of forestry BMPs on forested lands owned by the WDNR and encourages counties and private landowners to incorporate them in their forestry management plans. Cooperating consultant foresters are required to manage private lands in a way that is comparable to WDNR's standards for WDNR-owned land. Managed Forest Law and Forest Stewardship management plans must incorporate BMPs to control soil erosion that adversely affects water quality. Nicolet National Forest staff support the use of the forestry best management practices developed by WDNR.

All Marinette County Forestry staff have received forestry BMP training. Logging contractors are not required to receive training, however, contractors are required to follow forestry BMPs for all timber sales on county land. Timber sales are monitored by both county and WDNR staff for compliance. Advice on the proper application of forestry BMPs is available from WDNR forestry staff. the Marinette County forestry department, and the Marinette County Land & Water Conservation Department.

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 tables 3-1, 3-2, and 3-3.

Design and installation of all BMPs must meet the conditions listed in NR 120. Generally these practices use standard specifications included in the NRCS 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 also approve alternative best management practices and design criteria based on the provisions of NR 120.15 where necessary to meet the water resource objectives.

In some cases, farmers whose home farms are outside the watershed own cropland within the watershed which receives significant amounts of agricultural waste. To meet the goals of the watershed, these farmers will be eligible for BMPs.

If the installation of BMPs destroys significant wildlife habitat, NR 120 requires that habitat be recreated to replace the habitat lost. Every effort shall be made during the planning, design, and installation of BMPs to prevent or minimize the loss of existing wildlife habitat. The DNR District Private Lands Specialist or a designee will assist the Marinette County LWCD in determining the significance of a wildlife habitat and the methods that may be used to recreate the habitat. Wildlife habitat restoration components of the practice are cost-shared at 70 percent.

The practices eligible for cost-sharing and the cost share rates for each BMP are listed in tables 3-1 and 3-2 below; the BMPs listed in table 3-1 can be cost-shared either at 50% or at the flat rates listed.

Table 3-1. BMP Flat Rates

BEST MANAGEMENT PRACTICE	FLAT RATE
Contour Farming	$ 9.00/ac[1]
Field Stripcropping	$7.50/ac
Contour Stripcropping	$13.50/ac[1]
High Residue Management	$ 18.50/ac[2]
Cropland Protection Cover	$ 25.00/ac[2]

1. Wildlife habitat restoration components of this practice are cost-shared at 70%.
2. $18.50 per acre for up to three years. Maybe nonconsecutive depending on rotation.

Table 3-2. State Cost-Share Rates for Best Management Practices

Best Management Practice	Cost Share Rate
Field Diversions	70%
Terraces	70%
Grassed Waterways	70%
Nutrient Management	50%
Pesticide Management	50%
Intensive Grazing Management	50% [1]
Critical Area Stabilization	70% [3]
Grade Stabilization Structures	70%
Lake Sediment Treatment	70%
Agricultural Sediment Basins	70%
Shoreline and Streambank Protection	70% [3]
Shoreline Buffers	70% [3]
Wetland Restoration	70% [3]
Barnyard Runoff Management	70%
Animal Lot Abandonment or Relocation	70%
Roofs for Barnyard Runoff Management and Manure Storage Facilities	70%
Milking Center Waste Control	70%
Manure Storage Facilities	70%/50% [2]
Well Abandonment	70%
Livestock Fencing	50%
Animal Watering System	70%
Cattle Mounds	70%
Pesticide Spill Control Facilities	70%
Structural Urban BMPs	70% [4]
Land Acquisition	50% [4]

1. To a maximum of $2,000 per watering system.
2. 70% of the first $20,000 and 50% of the remaining cost with a maximum cost share amount of $35,000 for manure storage, including manure transfer equipment.
3. Easements may be entered into with landowners identified in the watershed plan in conjunction with these BMPs. See Chapter Two for an explanation of where easements may apply.
4. The maximum cost share rate for storm sewer rerouting and removal of structures necessary to install structural BMPs is 50%.

Following is a brief description of some commonly used BMPs listed above. 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 on the contour.

Contour Stripcropping. Growing crops in a systematic arrangement of strips or bands, on the contour, in alternate strips of close grown crops, such as grasses or legumes, and row-crops.

High Residue Management. A system which leaves at least 30 percent of the ground covered with crop residues (stalks and leaves) after crops are planted. Crop residue limits erosion by protecting and binding the soil.

Cropland Protection Cover. A crop of close-growing grasses, legumes, or small grains grown to control erosion during periods when the major crops do not furnish adequate protection. It is usually grown for one year or less.

Nutrient Management. The management and crediting of nutrients from all sources, including legumes, manure, and soil reserves for the application of manure and commercial fertilizers. 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. The management of the handling, disposal and application of pesticides including the rate, method and timing of application to minimize pesticides entering surface and groundwater. This practice includes integrated pest management scouting and planning.

Pesticide Handling Spill Control Basins. Structures designed to contain accidental spills or overflows from pesticide handling, loading, and unloading operations.

Intensive Grazing Management (Rotational Grazing). Intensive grazing management is the division of pastures into multiple cells that receive a short but intensive grazing period followed by a period of recovery of the vegetative cover. Rotational grazing systems can correct existing pasturing practices that result in degradation and should replace the practice of summer dry-lots when this practice results in water quality degradation.

Livestock Fencing. Enclosing or dividing an area of land with a suitable permanent structure that acts as barrier to livestock or big game. The fencing excludes livestock from areas that should not be grazed, subdivide land to permit use of grazing systems, and protect new seedings and plantings from grazing.

Manure Storage Facility. A structure for the storage of manure for the period of time 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.

High Residue Management. A system which leaves at least 30 percent of the ground covered with crop residue after crops are planrted.

Field Diversions. A shallow channel constructed across the slope of the land to divert water from areas where it may cause flooding or erosion. The water is diverted to where it can be stored or transported safely.

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.

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

Critical Area Stabilization. The planting of suitable vegetation on nonpoint source sites and other treatment necessary to stabilize eroding lands.

Agricultural Sediment Basins. A structure designed to reduce the transport of sediment, agricultural waste, and other pollutants transported from agricultural fields and barnyards to surface waters, closed depressions, and wetlands.

Shoreline and Streambank Protection. The stabilization and protection of stream and lake banks against erosion. Protection of fish habitat and water quality from livestock. Methods include fencing, shaping and seeding of vegetation, rock riprap, bioengineering, or structures to stabilize shorelines and/or provide fish habitat

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.

Remote Watering System. Development of a system of portable tanks, pumps, and pipes designed to bring water to livestock in all grazing cells.

Shoreline Buffers. A permanent 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.

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

Well Abandonment. Chapters NR 811 and NR 812, Wisconsin Administrative Codes, require proper abandonment, by permanent filling of unused wells.

Barnyard Runoff Management. Structural measures to redirect surface runoff around the barnyard, and collect, convey or temporarily store runoff from the barnyard. Management includes measures such as: sediment basins, roof gutters, and clean water diversions.

Animal Lot Abandonment/Relocation. Permanent Abandonment 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.

Roofs for Barnyard Runoff Management and Manure Storage Facilities. Roofs for barnyard runoff management and manure storage facilities are roofs and supporting structures constructed specifically to prevent rain and snow from contacting manure.

Structural Urban Best Management Practices. These practices are source area measures, transport systems and end-of-pipe measures designed to control storm water runoff rates, volumes and discharge quality. These practices will reduce the amount of pollutants carried in runoff and flows destructive to stream habitat. Included are such practices as infiltration trenches, porous pavement, oil water separators, sediment chambers, sand filtration units, grassed swales, infiltration basins and detention/retention basins.

Milking Center Waste Control Systems. A milking center waste control system is a piece of equipment, practice or combination of practices installed in, or in conjunction with, a milking center for purposes of reducing the quantity or pollution potential of the wastes.

Easements. Easements are legally binding restrictions on land titles purchased to provide permanent vegetative cover.

Cattle Mounds. Cattle mounds are earthen mounds used in conlunction with feeding and dry lot operations and are intended to provide a dry and stable surface area for cattle.

Land Acquisition

Any local unit of government within the watershed area is eligible for nonpoint source grants to supplement the purchase of land (in fee) that is contributing or will contribute nonpoint source pollution. The target objective for land acquisition within the watershed is approximately 10 acres. This may increase after additional inventories and land acquisition strategies are developed by the individual units of government within the watershed. Any land acquisition proposal must meet the applicable goals of the Middle Peshtigo-Thunder Rivers Watershed project to be eligible for acquisition.

Economic Hardship

A landowner or land operator may be eligible for a higher level of cost-sharing of certain BMPs if the landowner/operator has a debt-to-asset ratio of more than 60 percent. This must be verified to the appropriate unit of government and the WDNR with a signed statement from an accredited financial institution. The rate and maximum amount of cost-sharing under a cost share agreement may be exceeded only for manure storage facilities and/or animal lot runoff control systems with written approval from the WDNR. Under the provisions of economic hardship, the following percentage payment rates and maximum payments apply:

- Manure Storage Facilities- for the first $20,000 of cost - 85%
- Manure Storage Facilities- for the remaining costs- 75%
- Animal Lot Runoff Control Systems- 85%

The maximum grant for economic hardship cases for the construction of manure storage facilities and animal lot runoff control systems may not exceed $45,000. Landowners who meet the Economic Hardship definition may want to contact the Wisconsin Housing and Economic Development Authority's Nonpoint Source Pollution Loan Guarantee Program.

Interim Best Management Practices

Under some circumstances, practices may be recommended that are not included on the BMP list, such as the Shoreline Habitat Restoration Interim BMP. This BMP includes the reestablishment of appropriate native vegetation in an area of land along the shore of a lake or stream, replacing manicured lawn, non-native species, or non-conforming structures.

Administrative Rule NR 120.15 provides for alternative practices where necessary to meet the water resource objectives identified in the watershed plan. The Department may 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 interim best management practice. The Shoreline Habitat Restoration Interim BMP will not be available for cost sharing in the Middle Peshtigo-Thunder Rivers Watershed only after it is evaluated for its water quality protection abilities and approved by the DNR's Runoff Management Practices Section.

Practices Not Cost-Shared

Practices not cost-shared, but which shall be included on the cost share agreement if necessary to control the nonpoint sources, are listed below (as listed in NR 120.17):

- 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.
- Changes in location of unconfined manure stacks involving no capital cost.
- Non-stationary manure spreading equipment.
- Practices needed for land use changes during the cost-share agreement period.
- Other practices deemed necessary to achieve the objectives of the watershed project.

- Minimum levels of street sweeping and leaf collecting.
- Operation and maintenance of cost-shared BMPs.
- 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 283 of Wis. Stats. except urban nonpoint sources that must be controlled to obtain a WPDES permit if control of the sources is identified in the priority watershed plan.
- Septic system controls or maintenance.
- Dredging activities.
- Silviculture activities except as necessary for site stabilization.
- Activities and structures intended solely for flood control.
- Practices required to control sources which were adequately controlled at the time the cost-share agreement was signed, but which are producing an increased amount of pollutant loading to the surface or groundwater, counter to the water resource objectives of the watershed plan, due to the landowner's change in land management.
- Practices to control spills from commercial bulk storage of pesticides, fertilizers, petroleum and similar materials.
- Activities required as part of a license for a solid waste management site.
- Activities funded through state or federal grants for wastewater treatment plants.
- Active mining activities.
- Pollution control measures needed during building and utility construction and stormwater management practices for new developments.
- Pollution control measures needed during construction of highways and bridges.
- Livestock operations which: have applied for and are eligible for WPDES permits, have been issued WPDES permits, have greater than 1,000 animal units, or are greater than 1,000 animal units and have been issued a notice of discharge.
- Practices whose purpose is to accelerate or increase drainage of land or wetlands, except where drainage is required as a component of a BMP.
- Practices normally and routinely used in growing crops and required for growing crops or feeding livestock.
- Other practices or activities determined by DNR not to meet the objectives of the program.

Cost-Share Budget

Costs of Installing BMPs

The quantity and type of management practices required to meet the water quality objectives of this project are listed in table 3-3. The capital costs of installing the BMPs are estimated for a 100 percent landowner participation rate. Units of measurement and cost per unit for the various BMPs are also included.

The capital cost of installing the Best Management Practices is approximately $1 million, assuming 75 percent participation.

- State funds necessary to cost-share this level of control would be approximately $696,775
- The local share provided by landowners and other cost-share recipients would be approximately $313,819.

Easement Costs

Chapter Two identifies where nonpoint source program funds can be used to purchase easements. The estimated cost of purchasing easements on eligible lands is shown in table 3-3. At 75 percent participation, the estimated purchase price of easements on eligible lands would be $75,000. Easements are funded at 100 percent and will be purchased by the state.

Cost Containment

Cost Containment Procedures

Chapter NR 120 requires that cost containment procedures be identified in this plan to control the costs of installing BMPs. Cost-share payments will be based on actual installation costs. If actual costs exceed the amount of cost-sharing determined by the average method, the amount paid to the grantee may be increased with approval from the Marinette County Land & Water Conservation Committee. Appropriate documentation regarding the need for changes will be submitted to WDNR.

Table 3-3 Cost-Share Budget Needs for Management Practices in Marinette and Oconto Counties

Marinette County Costs

BMP	Number	Cost/Unit ($)	Total Cost	75% Participation			
				State Share	Local Share	Hrs/ Unit	Total Hours
Upland Control							
Change in Crop Rotation	100 ac	NA	0	0	(1)	.1	8
Contour Cropping [1]	100 ac	9	900	675	68	.3	23
High Residue Management [2]	600 ac	18.5	11,100	8,325	833	.04	18
Cropland Protection Cover (Green Manure) [3]	500 ac	25	12,500	9,375	938	.04	15
Intensive Grazing Management (Rotational Grazing) [4]	2 ea	4,000	8,000	3,000	3,000	15	23
Livestock Fencing	10,000 ft	2	20,000	10,500	4,500	.04	300
Critical Area Stabilization	10 ac	800	8,000	4,200	1,800	.5	4
Grassed Waterways	8 ac	3,000	24,000	12,600	5,400	22	132
Field Diversions and Terraces	300 ft	3	900	473	203	.04	9
Agricultural Sediment Basin	1 ea	11,000	11,000	5,775	2,475	90	68
Shoreline Buffers	30 ac	500	15,000	7,875	3,375	2	45
Nutrient Management[5]	9,000 ac	6	54,000	20,250	20,250	.1	675
Pest Management [5]	3,000 ac	10	30,000	11,250	11,250	.1	225
Pesticide Handling Spill Control Basin	3 ea	20,000	60,000	31,500	13,500	40	90
Wetland Restoration	3 ea	2,000	6,000	3,150	1,350	34	77
							1,712

Barnyard Runoff Control								
Barnyard Runoff Management	5	ea	20,000	100,000	52,500	22,500	100	375
Runoff Collection Basin [6]	1	ea	10,000	10,000	5,250	2,250	100	75
Roof Gutters	8	ea	1,500	12,000	6,300	2,700	3	18
Clean Water Diversion	3	ea	2,500	7,500	3,938	1,688	21	47
Roofs	4	ea	25,000	100,000	52,500	22,500	20	60
Manure Storage Facility [7]	5	ea	60,000	300,000	135,000	90,000	120	450
Animal Waste Storage Facility Abandonment	3	ea	15,000	45,000	20,250	13,500	120	270
Animal Lot Abandonment or Relocation	1	ea	16,500	16,500	8,663	3,713	100	75
Well Abandonment	110	ea	600	66,000	34,650	14,850	20	1,650
Milking Center Waste Control	6	ea	7,000	42,000	22,050	9,450	40	180
								3,200
Shoreline Erosion Control								
Shaping and Seeding	2,700	ft	10	27,000	14,175	6,075	.1	203
Fencing	1000	ft	1	1,000	525	225	.06	45
Shoreline Habitat Restoration for Developed Areas [6]	95	ea	1,500	142,500	74,813	32,063	30	2,138
Other Shoreline Protection	1	ea	2,000	2,000	1,050	450	30	23
Rock Riprap	500	ft	30	15,000	7,875	3,375	.2	75
Shoreline and Streambank Protection	2,700	ft	20	54,000	28,350	12,150	.5	1,013
Channel Crossing	1	ea	3,000	3,000	1,575	675	18	14
Remote Watering Systems	1	ea	2,000	2,000	1,050	150	15	11
								3,522

Miscellaneous								
Structural Urban BMP's	5	ea	4,000	20,000	10,500	1,500	80	300
Subtotal				1,226,900	604,451	312,431		
Easements	100	ac	1,000	100,000	75,000	0	10	750
Marinette County Total				1,326,900	679,451	312,431		9,484

Oconto County

Shaping & Seeding	300	ft.	10	3,000	1,575	675	0.1	30
Shoreline Habitat Restoration for Developed Areas [6]	5	ea.	1,500	7,500	3,938	1,688	30	150
Well abandonment	10	ea.	600	6,000	3,150	1,350	20	
Shoreline and Streambank Protection	300	ft.	20	6,000	3,150	1,350	0.5	150
Oconto County Totals				22,500	11,813	5,063		399
Totals for Entire Project				1,349,400	696,775	313,819		9,883

1. Local share consists of labor and equipment costs. This practice is cost-shared at a flat rate of $9/acre.
2. High Residue Mngt. is cost-shared at a per acre rate over a 6 year period. Number of acres shown represents 6 times the eligible acres. The annual per acre rate is $18.50.
3. This practice is cost-shared at a flat rate of $25/acre/year.
4. Cost-shared at 50%.
5. Cost-shared at a per acre rate over a 3 year period. Number of acres shown represents 3 times the number of acres eligible.
6. This is an interim BMP and is being evaluated by DNR's Watershed Management Bureau for its ability to protect water quality. It will be used in this watershed upon approval by DNR.

Cost-Share Agreement and Contact Strategy

Money for cost-share agreements will be distributed by the Marinette County LWCD from a Nonpoint Source Grant provided by the DNR. Marinette County will complete most of the cost share agreements with landowners, and implement the plan for the most part. Each County LCD receives additional grant money to support administrative responsibilities. Cost share agreements are binding contracts between landowners and Marinette County LWCD. Landowners must meet eligibility requirements defined in Chapter Two.

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 a mailing from the county explaining the project and how they can become involved.
- During the first year of implementation, county staff will make personal contacts with all landowners that have been identified as having Critical nonpoint sources of pollution.
- The county will continue to make contacts with eligible landowners and operators until they have made a definite decision regarding participation in the program.
- The county will contact all eligible landowners not signing cost-share agreements by personal letter six months before the end of the cost-share sign-up period.

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 and Costs

Table 3-4 lists the total estimated staff needed to carry out the project assuming a 75 percent level of participation by eligible landowners. Approximately 36,100 staff hours are required to implement this plan. This includes 11,800 staff hours to carry out the information and education program.

Currently, one staff position in Marinette County is being funded by the Middle Peshtigo-Thunder Rivers watershed project. Marinette County LWCD will determine the need for additional staff based on the annual workload analysis. Marinette County will provide the majority of staff time for the project. Therefore, staff hours for Oconto County were not calculated.

The estimated cost for staff at the 75 percent participation rate is approximately $ 985,000. These costs will be paid by the state through the Local Assistance Grant Agreement.

Table 3-4 Estimated Marinette County Staff Needs for Ten Years of Project Implementation

Activity	Staff Hours (based on 75% participation)
Project and Financial Management	5,000
Information and Education Program	11,800
Pre-Contact Office Inventory; Landowner Contracts and Progress Tracking	3,600
Conservation Planning and Cost-Share Agreement Development	4,000
Plan Revisions and Monitoring	1,500
Practice Design and Installation	
Upland Sediment Control	1,700
Animal Waste Management	3,200
Shoreline/Streambank Erosion Control	1,500
Shoreline Habitat Restoration	2,250
Easements	750
Training	800
Ten Year Total:	36,100
Estimated Staff Required per year	2
Hours per year	4,000

Source: DNR; DATCP and the Marinette County LWCD

Table 3-5 Total Project Costs at 75 Percent Landowner Participation Rate

Item	State share of Costs
Cost-Share Funds: Practices	$696,775
Cost-Share Funds: Easements	$75,000
Local Assistance Staff Support	$900,000
Information/Education Direct	$110,000
Other Direct (travel, supplies, etc.)	$80,000
Engineering Assistance	$5,000
Total	$1,866,775

Source: DNR; DATCP and the Marinette County Land & Water Conservation Department.

Implementation Schedule

Grant Disbursement and Project Management Schedule

Implementation of this Priority Watershed project shall begin upon both approval of this plan and receipt of the Nonpoint Source grant. The plan must be approved by the Department of Natural Resources (DNR), the Marinette County Board, the Oconto County Board and the Wisconsin Land and Water Conservation Board. Implementation cannot begin unless a nonpoint source grant has been awarded.

The project implementation period is ten years, during which cost-share agreements with eligible landowners may be signed. This sign-up period may be extended for one year if an evaluation, conducted by the DNR, shows that an extension is warranted. The sign-up period may be extended for an additional one years following further review by the DNR. Practices listed on any cost-sharing agreement must be installed before the end of the implementation phase. The implementation phase of this project is scheduled to conclude in 2008.

The initial Nonpoint Source grant will cover the cost of practices over the entire ten year implementation phase. The amount of the Nonpoint Source grant is calculated as 75 percent participation by eligible landowners; see Table 3-3 for a detailed explanation. This grant may be amended due to changes needed for time of performance, funding levels, or scope of work. Local Assistance grants will be disbursed annually to Marinette and Oconto Counties to cover the costs of personnel, operating expenses, and equipment. The eligible costs for Local Assistance Grants are in NR 120.2. The DNR will evaluate a workload analysis and grant application submitted by Marinette and Oconto Counties.

Project Cost

The total state funding required to meet the rural nonpoint source pollution control needs at 75 percent level of landowner participation is presented table 3-5. This figure includes the capital cost of practices, staff support, and easement costs presented above. The estimated cost to the state is $1,866,775. The estimated cost to landowners and others is $314,000 for a total project cost estimate of $ 2,181,000.

This cost estimate is based on projections developed by agency planners and local staff. Historically, the actual expenditures for projects are less than the estimated costs. The factors affecting expenditures for this watershed project might include: the participation rate, the amount of cost sharing that is actually expended, the number of staff working on the project, and the amount of support costs.

CHAPTER FOUR
Integrated Resource Management Program

Introduction

The purpose of this chapter is to identify existing state, federal and local resource management programs which provide benefits for water quality and/or fish and wildlife resources in the Middle Peshtigo-Thunder Rivers watershed. Watershed staff will work to coordinate the efforts of these programs to provide the best possible management of land and water resources in the watershed. This comprehensive approach will facilitate consideration of the various goals and objectives for all the programs in which the landowner participates. Each of these activities is described below.

Fisheries and Wildlife Management

Watershed best management practices (BMPs), such as streambank protection, shoreline buffer strips and easements, should be implemented in a manner that preserves and enhances the management goal of providing a quality fishery in the Middle Peshtigo-Thunder Rivers watershed. Specifically, all streambank protection BMPs should be installed using large diameter-sized rock below the water line. Rock riprap should be installed and sized so that the placement and size of rock will positively benefit fish habitat. Vegetative shoreline erosion control using emergent aquatic vegetation for habitat enhancement should be used where applicable. Wildlife habitat components should also be incorporated into vegetative filter strips along streams or in upland areas.

Where necessary to provide missing habitat and cover, county watershed staff will promote installation of streambank structures as allowed in NR 120.14(14)(b). Shoreline erosion control measures will be installed in a manner beneficial to fish and wildlife. WDNR fish management and wildlife management personnel will be consulted for input in the design of streambank and shoreline protection BMPs to maximize benefits to the fish and wildlife communities. In cooperation with counties, WDNR staff will also review placement of agricultural sediment basins, and provide 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. DNR staff will also help resolve questions concerning effects of agricultural nonpoint source BMPs on wetlands.

Natural shoreline is the best way to maximize resistance to erosion while providing the greatest diversity of wildlife habitat. A natural community includes submergent and emergent aquatic vegetation, woody debris (such as fallen trees), wetland plants, and upland plants. County staff will provide management alternatives, planting recommendations, and cost sharing to encourage landowners to replace their riparian lawn with natural vegetation.

The WDNR fisheries staff in Peshtigo has received funding to conduct a fisheries study within the Thunder River and North Fork Thunder River subwatersheds. In addition to standard survey methods and calculation of the Index of Biotic Indicators, a volunteer creel census program may be developed. County watershed staff will work with WDNR Fisheries staff to promote and implement a volunteer creel census in the Middle Peshtigo- Thunder Rivers Watershed.

Wetland Restoration

Significant restorable wetlands have not been identified in the Middle Peshtigo-Thunder Rivers watershed. The general guidelines for wetland restoration, easement acquisition and shoreline buffers to protect existing wetlands should be followed (see page 85). Wetlands that are important wildlife habitats will be identified in consultation with DNR Wildlife Management. Shoreline buffer easements may be acquired adjacent to these wetlands to offer better protection from sedimentation and other nonpoint source pollution.

Groundwater Management

Wells provide a direct conduit for pollutants to reach groundwater resources. Preventing well contamination and sealing abandoned wells are important steps for protecting these resources. If not properly sealed, abandoned wells can directly channel contaminated surface water or shallow groundwater into deeper drinking water aquifers, bypassing the normal purifying action that takes place as surface water slowly percolates downward. Abandoned wells are a significant threat to groundwater quality in the Middle Peshtigo-Thunder Rivers watershed.

The Marinette and Oconto County LCD's will encourage all landowners to seal abandoned wells properly. Information on the proper abandonment procedures and cost sharing will be provided to landowners when abandoned wells are located.

The Village of Crivitz will be encouraged to create a Well Head Protection Plan to protect municipal water supplies.

Wisconsin Well Compensation Grants

Wisconsin's Well Compensation grant program provides financial assistance to replace or treat private wells contaminated with heavy metals, pesticides, solvents or gasoline. Wells must exceed state or federal drinking water standards. Replacement of wells contaminated with bacteria or nitrate is not eligible for cost-sharing. The exceptions are livestock wells contaminated with more than 40 ppm of nitrate. WDNR district water supply personnel should be consulted for more information concerning income limits and other eligibility requirements. Eligible landowners will be encouraged to apply for well replacement funds through the Wisconsin Well Compensation Grant Program.

Private Sewage System Maintenance and Rehabilitation

Poorly sited or improperly functioning private sewage systems have the potential to contaminate groundwater and surface waters in the Middle Peshtigo-Thunder Rivers watershed. Pollutants from sewage system discharge includes bacteria, viruses, household chemicals, nitrates and phosphorus. Many sewage systems in riparian areas are outdated and installed in soils that do not adequately filter pollutants due to the poor filtering ability of the soil and/or a high water table. Failing sewage systems in riparian areas are a special concern since pollutants can enter the surface waters with minimal filtering. Sewage system failure is often due to poor maintenance, primarily a failure to pump septic tanks when needed.

Marinette and Oconto Counties staff will provide educational materials to promote the proper maintenance of private sewage systems. Sewage system maintenance and household tips to reduce groundwater contamination will also be stressed during field visits and "home environmental audits."

It is also recommended that Marinette and Oconto Counties adopt an "update at date of sale" ordinance to require the proper inspection, update and/or replacement of septic systems when a home is sold.

Wisconsin Fund

The Private Sewage System Replacement & Rehabilitation Grant Program (Wisconsin Fund) provides financial incentives to protect and improve groundwater quality in Wisconsin. The Wisconsin Fund provides funds to update private sewage systems installed before 1978. To be eligible the septic system must have been inspected by the Marinette County Sanitarian and determined to be failing by discharging waste to the groundwater or surface water. Only permanent residences qualify, and there are income restrictions. Applications for Wisconsin Fund assistance are made through the Marinette County Zoning and Solid Waste Department.

Marinette and Oconto County staff will inform watershed residents about the benefits of the Wisconsin Fund grant program and encourage eligible landowners to apply.

Shoreland Zoning

Wisconsin's Shoreland Management Program (NR 115) is a partnership between state and local governments that requires development near navigable lakes and streams to meet minimum standards. NR 115.01 Purpose (2) states that shoreland subdivision and zoning regulations shall:

> "further the maintenance of safe and healthful conditions; prevent and control water pollution; protect spawning grounds, fish and aquatic life; control building sites; placement of structure and land uses and reserve shore cover and natural beauty."

Chapter NR 115, Wisconsin Administrative Code, contains minimum state standards for shoreland protection:

- setbacks for structures from waterways and property lines
- minimum lot sizes and land division review
- controls on cutting shoreline vegetation
- standards for earth-moving activities
- protection for wetlands
- regulation of septic systems and wells
- restrictions on improvements to older structures that do not meet shoreland standards

(Adapted from Bernthal and Jones, 1997)

Each Wisconsin county has zoning ordinance provisions that protect water resources values: water quality, recreation and navigation, fish and wildlife habitat, and natural scenic beauty. County ordinances must have standards that meet or exceed the minimum state standards contained in Chapter NR 115, Wisconsin Administrative Code (See Appendix A).

A sampling of Marinette County Shoreland Zoning codes is listed below.

- All land divisions must be created by submitting a certified survey map to the County Zoning Office.
- New lots must be a minimum of 100 feet wide at the Ordinary High Water Mark (OHWM) and building line, and a total of 30,000 square feet.
- Seventy-five foot setbacks from the OHWM for all structures except piers, boat hoists and boat houses. Decks, screen porches and other accessory structures must be set back. Boat houses must be 20 feet back from the OHWM.
- No more than 30 feet of trees or shrubbery in any 100 feet, as measured along the OHWM, may be clear cut to a depth of 50 feet. No single clear-cut strip may exceed 10 feet in width.
- In areas that have not been clear-cut, selective cutting only shall be permitted. Such cutting shall leave sufficient trees and shrubbery to screen uses and structures to the landward side as seen from the water during the summer months, prevent erosion, retard the flow of pollutants and preserve natural beauty.
- Filling, dredging, and grading activities require permits.

Riparian development in the Middle Peshtigo-Thunder Rivers Watershed has increased by 139 percent since 1976 and is becoming a serious problem. Removing natural vegetation and replacing it with impervious surfaces and manicured lawns can have a profound impact on water quality. Many lakes within the watershed are developed or face development within the future.

In the 1990's waterfront property values have increased up to 400% in some northern Wisconsin counties, as much of the prime shoreline has been developed. In addition to increases in land prices, otherwise unattractive wet, rocky, or steep parcels face development. It is more difficult to alter these landscapes without harming nearby water resources, especially as many land owners fail to make the connection of land use and water quality (Bernthal & Jones, 1997).

County watershed staff will help the Marinette County Zoning Administrator and the WDNR Water Regulation and Zoning Specialist enforce County and State shoreline zoning and septic system ordinances by proving information and education to landowners and by reporting zoning violations. In

addition, county staff support increased fiscal penalties for landowners and contractors involved in violations of shoreland zoning ordinances. These individuals should be required, at their cost, to remedy nonconforming conditions and bring the property back into compliance with local Zoning Ordinances.

Riparian Wildlife Habitat

A study conducted by WDNR and the Sigurd Olsen Environmental Institute in 1996 and 1997 (Meyer et al., 1997) looked at the effectiveness of the current ordinances and statutes in protection of wildlife habitat around lakes in northern Wisconsin. Although the study area did not include Marinette County, its findings are applicable. Several areas were investigated and are discussed below.

Vegetative Structure

Tree canopy cover was reduced from 57% at undeveloped sites to 38% at developed sites. Subcanopy cover was reduced from 18% to 8% and the shrub layer from 34% to 7%. There was significantly less coarse woody debris. The relative proportion of shoreline covered by trees and shrubs was also significantly impacted by development. Tree canopy was reduced from 35% to 22% and shrub coverage was reduced from 64% to 16% at undeveloped versus developed sites.

Aquatic vegetation loss associated with development was especially disturbing. The average proportion of shallow water covered with aquatic vegetation decreased from an average of 15% to less than 1%. Consequently the proportion of unvegetated lake bottom increased from 69% at undeveloped sites to 95% at developed sites.

Analysis of these numbers predicted that on lakes that are developed at densities consistent with modern development practices (100 ft. wide lots), the tree canopy will be reduced 93%, and the shoreline shrub layer will be eliminated, as will woody debris in the terrestrial buffer, the water/land interface, and the shallow water zone.

Green Frog Distribution and Abundance

Green Frogs (*Rana clamitans*) were chosen as a riparian habitat quality indicator species. Green frogs are shoreline dependent and territorial during the breeding season. Their consistent and relatively stationary calling makes them easy to count and map. Researchers tested whether a relationship existed between the proportion of shoreline classified as green frog habitat, the number of green frogs present, and the density of development along the shorelines in the study lakes.

Undeveloped lakes had an average of 2.6 calling green frogs per 100 meters of suitable habitat, developed lakes had 1.5 frogs, and hyper-developed lakes held 0.7 frogs per hundred meters of suitable habitat. These figures by themselves are significant, but we must also factor in the declines in suitable habitat. An average of 82% an undeveloped lake's total shoreline was suitable green frog habitat. For developed lakes the percentage drops to 67%. Hyper-developed lakes had only 15% of their shoreline suitable for green frogs.

Analysis of the data showed that if a lake were developed to the maximum allowed by current shoreland zoning regulations (3.3 homes/100 meters), there would be no suitable green frog habitat. For this study, the green frog was used as an "indicator species", the theory being that what is good (or bad) for green frogs will be good (or bad) for frogs and other amphibians as well. The same habitat destruction and fragmentation that impacted green frogs would impact other amphibians. This was born out during the study in dramatic fashion. In one instance the researcher reported going "from the din of a full chorus of frogs and toads on an undeveloped lake (it can actually be painful to listen to!) to a developed lake that was absolutely silent - and only 2 miles apart!" (Meyer, et al., 1997)

Breeding Bird Populations in Northern Wisconsin

Researchers tested whether habitat alteration due to development impacted the bird species composition and abundance on 34 lakes in northern Wisconsin. They found that species richness (number of species) and abundance (number of individuals) were very similar at undeveloped versus developed lakes. What differed was what species were present.

On developed lakes the birds sighted were those expected at backyard or urban bird feeders, such as American robin, American goldfinch, common grackle, brown-headed cowbird, mourning dove, etc. Classic northern forest birds such as Swainson's and hermit thrushes, northern parula warbler, black-throated green warbler, pine warbler, yellow-throated vireo, etc. greatly preferred undeveloped lakeshore. The incidence of ground nesting birds and insect eating birds greatly declined with increasing development. Many of the species displaced by development are edge sensitive or have special habitat needs. This strongly suggests that habitat alteration is a primary factor influencing the shift in bird community structure on the study lakes.

County Watershed staff will support Wisconsin's Shoreland Management Program (NR 115) to meet its stated purpose. Strong evidence exists that current protections are inadequate.

Surveys of riparian landowners from across northern Wisconsin have demonstrated a lack of knowledge of Shoreland Zoning Ordinances. For example, a survey of 315 Oneida County riparian landowners conducted in 1995 states:

> "Survey respondents answered correctly only 17% of the time, on the average, to a series of questions which tested the level of knowledge of specific requirements of the ordinance." (Czarnezki, 1995).

The "Water Watch" program is being facilitated by the WDNR Shoreland Management Program to address this lack of knowledge. The Water Watch program trains volunteers to greet new riparian property owners (as identified by the County Zoning and Property Listing departments), and inform them about state and county codes and ordinances that affect shoreland land management.

County watershed staff support and promote this program. It provides landowners with an informal opportunity to learn the rules that govern shoreland activities and lets them know that they have neighbors who are concerned about environmental quality.

The Marinette County Land & Water Conservation Committee should, following Chapter 92.07 (9), establish by policy and codification, a "Plant & Erosion Control Materials Program." The program will provide site design and planting recommendations to promote natural alternatives to manicured

lawns. County watershed staff, with the help of the Northern Lights Master Gardeners and the University of Wisconsin- Extension, will obtain or propagate native trees, shrubs, forbs and grasses for transplant to shoreline properties. WDNR Fisheries and Wildlife Management programs will be consulted to maximize the environmental and ecological benefits of planting native vegetation. The Marinette County LWCD will apply for a Lake Protection Grant to address the changing nature of shoreland development and its impact on water quality within Marinette County and the entire watershed project.

Wisconsin developed an antidegradation policy in 1989 in response to Federal Clean Water Act requirements, and a petition, filed by the National Wildlife Federation, to revoke the state waste water permitting authority. Many of the state's high quality waters classified as "Outstanding Resource Waters" (ORW) or "Exceptional Resource Waters" (ERW) receive special protection under this antidegradation policy. There are 52 streams or stream reaches classified as ORW and 109 classified as ERW in Marinette County. No lakes in the county are currently classified as outstanding resource waters, although Caldron Falls flowage is currently under consideration for this designation. County Watershed staff advocate the designation of Caldron Falls Flowage as an outstanding resource water, and will work toward the designation of additional lakes and streams within the watershed as Exceptional and Outstanding Resource waters.

As the availability of lake front property decreases within the watershed, river front land will become more attractive for development. A natural shoreline is even more important to rivers and streams than to lakes for maintaining a healthy ecosystem. County watershed staff will work with the Marinette County Zoning Administrator and the WDNR to ascertain the adequacy of Marinette County Shoreland Zoning Ordinances for protecting rivers and streams. If county ordinances are not adequate, they should be revised to provide the necessary level of protection to watershed streams and rivers.

Cattle access to streams and lakes has not been identified as a serious problem in the watershed. Any sites impacted by cattle identified during the implementation phase of the project should be protected with BMPs. Sensitive riparian areas can be acquired through easements.

County watershed staff will seek to participate in Wisconsin's Department of Agriculture, Trade & Consumer Protection's Shoreland Management Program. County staff will consider developing a shoreland ordinance which makes landowners within the watershed eligible for state funding available from DATCP to install Best Management Practices.

County watershed staff will promote a tax incentive program to reward riparian landowners that practice water quality friendly stewardship on their property. Efforts in this area are underway. In one suggested scenario, riparian landowners will adopt a long term riparian zone preservation plan which is certified by watershed staff. The landowner would then receive a tax credit.

Lakes

The intensity of use of the lakes and flowages in the Middle Peshtigo-Thunder Rivers Priority Watershed has increased dramatically in recent years. This has led to greater conflicts between boaters, users of personal watercraft, canoeists, anglers, swimmers, and property owners. Increasing the size, speed and numbers of boats and personal watercraft has also increased shoreline erosion. However, WDNR Lake Management Planning Grant and Protection Grant Programs are available to local governments, qualified lake associations, and qualified nonprofit conservation organizations. These grants provide funding for the lake management planning process and for implementation of the associated recommendations, so that watershed residents can participate in creating solutions to current lake-related problems.

The planning process can include investigation of lake and watershed conditions, evaluation and development of zoning ordinances, development of management plans, or certain educational activities. The products of most lake management planning grants are comprehensive lake management plans which address specific local concerns and provide alternatives for lake and watershed management. The WDNR may pay up to 75 percent of the cost of a planning project, which must not exceed $10,000 during each biennial state budget. The remaining 25 percent of the project cost is paid by the grant recipient.

Implementation of protection projects includes land acquisition, wetland restoration, and development of protective ordinances. The state pays 75 percent of the project implementation costs, and the grant recipient responsible for the remainder. Funding is limited to $200,000 per grant. Expansion of the program to support local efforts to classify lakes and to provide appropriate management for different types of lakes, has been proposed in the legislature. Local governments and lake associations would be eligible for these grants. The Wisconsin Department of Natural Resources also administers the lakes "Self Help Program", which trains volunteers to monitor water quality trends in the lake of their choice. Watershed staff encourage interested watershed residents to become involved in this program to assist in cost effectively tracking water quality trends in the watershed.

The Marinette County LWCD staff will help the Thunder Lake Association to strengthen their existing lake management plan. The following components should be incorporated into a new plan:

- Old data (the past management plan)
- New data (from sediment core and self help monitoring activities)
- A nominal group process to identify needs and problems
- A selection of management alternatives

Marinette County Land & Water Conservation Department will work to help additional Lake Associations get organized in the watershed. Qualified Lake Associations, in cooperation with county watershed staff, can apply for grant dollars to monitor their lakes, acquire sensitive land, or develop ordinances to protect their lake. The Marinette County LWCD will also strive to create a county wide lake association to address issues of general concern to riparian landowners throughout the watershed. Marinette County will apply for Lake Classification Initiative grant money to classify lakes and determine proper management for each of them.

The University of Wisconsin-Extension administers the Adopt-A-Lake Program, with support from the Wisconsin Department of Natural Resources. Specifically, the Adopt-A-Lake program has four main objectives:

- Increase youth awareness of the value of Wisconsin's inland lakes.
- Empower youth to participate in hands-on lake protection activities.
- Develop an understanding of lake management and the social dynamics of lake issues in the next generation of lake leaders and citizen volunteers
- Build linkages between youth and adults regarding lake issues, and stimulate adults to take action on lake management issues.

The Adopt-A-Lake program can provide direction and resources to teachers and youth leaders interested in adopting a lake. County watershed staff will promote and support this program in the Village of Crivitz Schools, the Marinette County 4-H Club, scout groups, and other youth organizations within the watershed.

Streams

Development of riparian areas along rivers and streams for houses and cottages can have a significant impact on water quality. Water quality is impacted when as little as ten percent of the watershed is covered with impervious surfaces. Loss of natural shoreline vegetation is even more critical to streams than lakes. Streams are susceptible to natural and manmade blockages due to dams or other structures.

Zoning and septic system ordinances should be enforced on all streams. County watershed staff will help the enforcement efforts by providing information and education materials to riparian landowners and by reporting zoning violations. County staff will work with WDNR and Army Corp of Engineers staff to promote the removal of dams and structures that impede water flow or cause erosion on watershed streams.

The Stewardship Program

The Stewardship program enables the purchase of land or easements to protect sensitive environmental areas. The Streambank Protection Program under stewardship is an important means of protecting water quality, in addition to the Nonpoint Source program. Under this program, the WDNR can obtain easements on watershed streams previously selected for the Stewardship program. Streambank easements are generally 66 feet wide on each side of the stream. If needed, the DNR may financially support the fencing of the stream to limit livestock access.

Marinette and Oconto Counties support the nomination of watershed streams for stewardship eligibility. County staff and WDNR Fisheries personnel will participate in the selection process for the Stewardship Program and will recommend watershed streams for the program.

Forestry Programs

Private forest lands, which account for more than 36,000 acres within the Middle Peshtigo-Thunder Rivers watershed, are important producers of forest products in Marinette County. Private forest lands also contribute to the quality of water resources and fish and wildlife resources in the watershed. Financial assistance is available for forest management and soil and water resource protection through the Stewardship Incentive Program (SIP), the Managed Forest Law Program (MFL) and other forest stewardship programs. Additional information can be found in WDNR publication FR-093-95, Wisconsin Forestry Best Management Practices For Water Quality, developed by WDNR Bureau of Forestry.

Stewardship Incentive Program

The Stewardship Incentive Program (SIP) was developed to stimulate enhanced management of forest lands by cost-sharing approved management practices. SIP provides cost share funding of up to 75% for practices that provide soil and water protection. The SIP program applies to nonindustrial private forest land of 10 acres or more on forested or forest related (i.e., prairie, wetlands) lands. Development of a landowner forest stewardship plan, site preparation and tree planting, timber stand improvement; windbreak and hedgerow establishment, soil and water protection and improvement, riparian and wetland protection and improvement, fisheries habitat enhancement, wildlife habitat enhancement, and forest recreation enhancement are cost shared by SIP.

Managed Forest Law

The goal of the Managed Forest Law (MFL) program is to encourage long-term sound forest management. MFL is a tax incentive program for industrial and nonindustrial private woodland owners who manage their woodlands for forest products while also managing for water quality protection, wildlife habitat and public recreation. In return for following an approved management plan, property taxes are set at a lower rate than normal. Later when the landowner receives an income from a timber harvest, some deferred tax is collected as a yield tax. Management plans are based on the landowners objectives. These plans may mandate harvesting, planting, thinning, release and soil erosion while addressing other practices such as wildlife and aesthetic activities on a voluntary basis.

Other Stewardship Programs

Other forest stewardship programs available to watershed landowners include the Forest Improvement Program (FIP) and ACP. These programs provide funding for the establishment of timber stands.

Watershed staff and WDNR Foresters will encourage eligible state forest landowners in the Middle Peshtigo-Thunder Rivers watershed to participate in Wisconsin's Forest Stewardship Programs to benefit water resources and forest habitat. Protection of soil and water resources should be addressed in all SIP and MFL plans where applicable.

Coordinating Regulations, Permits, and Zoning

Best management practices that address shoreline erosion such as riprap or vegetative shoreline stabilization will require permits from the WDNR. Any BMP that affects wetland form or function may require permits form the WDNR, Marinette County Zoning office and the US Army Corps of Engineers.

Marinette County will work closely with the WDNR Water Regulation and Zoning staff, the Marinette County Zoning Department and the US Army Corps of Engineers to assure that necessary permits are received prior to the installation of shoreline stabilization practices. Bioengineered erosion controls will be promoted as an effective and environmentally friendly alternative to rip-rap and sea walls.

In an attempt to protect the use, enjoyment and water quality of our lakes and streams across the state, federal and local government regulates some activities on riparian properties. Activities that disturb or remove the natural vegetation surrounding our lakes and streams reduces the buffering capacity of the area and often drastically increases erosion, sedimentation and nutrient runoff. Many lakefront property owners, particularly those who are purchasing waterfront property for the first time, are not aware of these regulations or the need for them.

County watershed staff will work in cooperation with the Property Listing Department, Zoning Department and the WDNR to provide information packets to new waterfront property owners throughout the watershed to educate residents about the existence of zoning regulations and the proper contacts to make within each agency. Educational materials will be distributed to lakefront residents explaining the steps they can take to become responsible lake stewards.

Marinette County has recently formed an Ad Hoc Land Use Committee representing local government entities, agencies, and citizens. The committee was created with the expectation of educating decision makers within the county about land use planning. The Middle Peshtigo- Thunder River Priority Watershed Project's Citizens Advisory Committee will be represented on this committee. Project staff will play an active role in educating the public about land use planning. The watershed project can serve as a mechanism to introduce land use planning to Marinette, Oconto and Forest Counties.

Watershed staff will serve as a catalyst to bring in organizations and groups to educate county landowners and officials about the relationship of land use to water quality. Example groups might be Thousand Friends of Wisconsin, UW- Extension lake staff, etc. County staff will develop their own informational presentation targeting land use issues specific to the Middle Peshtigo Priority Watershed.

Coordination With State and Federal Conservation Compliance Programs

The Middle Peshtigo-Thunder Rivers 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 Natural Resource Conservation Service. DATCP will assist watershed staff and the NRCS to identify landowners within the watershed that are subject to the compliance provisions of FPP and FSA. Conservation Farm Plans were completed for all landowners by FSA in December 31, 1989. There are currently no Farmland Preservation Plans within the watershed project.

Implementation and amendment of these conservation plans may be necessary during the implementation phase of the watershed project. Watershed project staff will inform DATCP Farmland Preservation staff and NRCS of changes in plans resulting from management decisions and the installation of needed BMPs for nonpoint source pollution abatement.

The Middle Peshtigo-Thunder Rivers Priority Watershed drains part of the Upper Green Bay Basin of the North East Region. The reorganization underway at the Department of Natural Resources stresses partnerships with stake holders in the basin and formation of a basin team. Efficient resource use, consensus, communication, and coordination between partners are possible results of these efforts. Watershed staff will participate as active partners and Upper Green Bay Basin team members, and will work to achieve mutual goals.

Archaeological Sites: Coordination with Historic Preservation Laws

Projects using state and federal funding, assistance, licenses and permits are required by law to consider the effects of their actions on archaeological and historical sites and historical structures. The watershed project is a joint cooperative effort between federal, state, and county agencies plus the private landowners who volunteer to participate in the program. As a result, the federal Historic Preservation Act of 1966, as amended, and the state historic preservation statute, s. 44.40, Wis. Stats., have been blended to produce a cultural resource management program which is both compatible to preserving cultural sites and implementing the watershed project.

Seventy-three recorded archaeological sites lie within the Middle Peshtigo-Thunder Rivers Watershed. Of these sites, 34 date to the post-contact or Historic period. These sites include logging camps, historic cabins or homesteads from Euro-American settlers, a school house, and a trading post. A historic Ojibwa camp and a historic Menominee plant collecting location are also on record. Most of the recorded historic sites lie within the Nicolet National Forest, where there is a program to identify and list these historic sites. It is likely that unrecorded sites exist outside the forest. Historic sites are more visible in wooded areas than pre-contact (prehistoric) archeological sites. Usually there are visible foundations and berms, or metal debris scattered over the surface. Often historic sites, both homesteads and logging camps, are revealed by the presence of apple trees and clearings. Such sites may be attractive to souvenir hunters and bottle collectors who may dig the garbage dumps. These sites, though recent compared to pre-contact sites, are important to our understanding of the history of northern Wisconsin.

There are 33 recorded pre-contact Native American sites. As mentioned above, these sites are difficult to detect in forests. There have been very few large-scale surveys designed to detect pre-contact archeological sites in the watershed. Many surveys in the Nicolet National Forest have been walkover

surveys. While these surveys may find lumber camps and homesteads, they are less satisfactory for locating buried sites. Occasionally quartz fragments from stone tool-making are observed in ground disturbed by logging. Burial mounds are more conspicuous in the landscape and are more likely to be recorded than a village or campsite.

Pre-contact sites range from a spear point from the Early Archaic period (7000-5000 BC) made from Hixton silicified sandstone, through copper artifacts and "turkey-tail" points from the late Archaic period (3000-1000 BC) to garden beds, village sites and mound groups from later periods (1000 BC-1600 CE). Very little professional excavation has occurred in the watershed, and very little is known about the pre-contact archeology within the watershed. Since so little is known, preservation of pre-contact sites should be a priority.

Six sites within the watershed have evidence of occupation by both pre-contact Native American groups and historic Euro-Americans. One burial site could not be assigned a date. Three or four logging camps have been reported along the Peshtigo River by avocational archaeologists but their exact location has not been recorded yet. Rock art may be present on exposed rock outcrops within the watershed. No rock art sites are so far reported, but no systematic surveys to locate rock art have been undertaken.

These areas will need special consideration when structural best management practices are being considered. Settling basins, manure storage structures, and streambank or shoreline shaping and riprapping are likely practices that may impact archaeological sites. As discussed above, state and federal laws require preservation of archaeological resources within the framework of the NPS Program.

Before finalizing the cost-share agreement with the landowner, project staff should review the maps showing known archaeological and historic sites. If a known site occurs near a proposed BMP, this does not necessarily mean the BMP needs to be moved or altered. Sometimes, the specific location of the BMP will not be near enough to the location of the known site to warrant further review. Project staff should visit the area and conduct a "pre review" to ensure that the *specific* location of the proposed BMP will not disturb the known archaeological or historic site. Instructions and Cultural Resource Site Review Documentation forms are available in the Implementation Manual.

If it is too difficult to determine through a pre review, or if it appears that the known site would be disturbed, contact the State Historical Society to set up a formal Archaeological or Historic Site Review of the area. Any costs incurred as part of a site review *will not be passed on to the landowner*. The WDNR's Nonpoint Source Pollution Abatement Program will reimburse the costs of professional historic and/or archaeological site reviews. Sometimes, a representative from the U.S. NRCS may conduct the review.

Practices of concern	Practices that will not Impact Cultural Sites
Archeological Sites	Contour Farming
Field Diversions	Contour Strip-cropping
Terraces	Field strip-cropping
Grade Stabilization Structures	Reduced Tillage
Agricultural Sediment basins	No-till systems
Streambank & Shoreline Stabilization	Permanent Vegetative Cover
Sediment Retention, Erosion or Water Control Structures	Cropland Protection Cover
	Critical Area Stabilization
Structural Urban Practices	Nutrient Management
Wetland Restoration	Pesticide Management
Buildings	Shoreline Buffers
Barnyard Runoff Management Systems	Livestock Exclusion from Woodlots
Animal Lot Relocation	Grass Waterways
Manure Storage Facilities	
Roofs for barnyard/Manure Storage Facilities	

Endangered and Threatened Resources

Information on threatened and endangered resources was obtained from the Bureau of Endangered Resources of the DNR. Endangered resources include rare species and natural communities. It should be noted that comprehensive endangered resource surveys have not been completed for the entire Middle Peshtigo Thunder River Priority Watershed. The lack of additional occurrence records does not preclude the possibility that other endangered resources are present in the watershed. In addition, the Bureau's endangered resource files are continuously updated from ongoing field work. There may be other records of rare species and natural communities which are in the process of being added to the database and so are not listed in this document.

Habitat

Protection of habitat is the key to preserving species. A common theme in the listing of species below is that most are dependent on wetlands. Drainage of riparian wetlands for homes and cottages is a major threat. Much of the prime riparian property in the watershed has been developed. This is placing pressure on marginal areas, including wetlands. The Middle Peshtigo-Thunder Rivers Priority Watershed Project will emphasize protection of endangered and threatened species.

Rare Species

Rare species are tracked by Wisconsin's Natural Heritage Inventory of the Bureau of Endangered Resources. Species tracked by the inventory include those that are listed by the U.S. Fish and Wildlife Service or by the state of Wisconsin.

Wisconsin Endangered Species

An endangered species is one whose continued existence as a viable component of this state's wild animals or wild plants is determined by the DNR to be in jeopardy on the basis of scientific evidence. Wisconsin endangered species within the watershed are:

Lycaeides Idas Nabokovi, northern blue butterfly;

This small, bright blue butterfly depends on the presense of its only larval host plant, wild blue lupine. Lupine are found in sandy barrens and oak savannahs. Fire suppression has lead to loss of habitat.

Vaccinium Cespitosum, dwarf huckleberry;

This member of the blueberry family grows on fairly dry soils and in openings among aspen.

Wisconsin Threatened Species

A threatened species is one which, if not protected, has a strong probability of becoming endangered. Wisconsin threatened species within the watershed are:

Dendroica Derulea, cerulean warbler;

This small blue and gray warbler lives in open hardwood uplands along streams.

Calypso Bulbosa, fairy slipper;

One of our most beautiful wild flowers. It is found mostly in coniferous woods, especially characteristic of old beach ridges under conifers.

Ophiogomphus Howei, pygmy snaketail;

This 1.25 inch, green and yellow, river dwelling drangonfly is sensitive to water pollution. It needs sand/silt substrate during its nymphal stage. Dams and deteriorating water quality have been cited as causes for population decline.

Wisconsin Special Concern Species

A special concern species is one for which some problem of abundance or distribution is suspected in Wisconsin, but not yet proven. The purpose of this category is to focus attention on certain species **before** they become endangered or threatened. Wisconsin special concern species within the watershed are:

Rana Catesbeiana, bull frog;

Our largest frog. Its found in lakes, ponds, slow moving waters. Needs heavily vegetated wetlands. Tadpoles require almost two years to transform.

Gomphus Quadricolor; rapids clubtail

This 1.75 inch, slender black, green, and yellow river dwelling dragon fly is found only in the northern 2/3 of the state. Nymphs live in sand/silt substrates.

Neurocordulia Yamaskanesis, stygian shadowfly;

This dragonfly inhabits bogs with flowing water.

Carex Gynocrates, northern bog sedge;

A sedge found in bogs, along boggy shores and openings in boggy woods, often in sphagnum.

Arethusa Bulbosa, swamp pink;

A native orchid becoming rare due to habitat loss. Found in bog mats, generally sphagnum, in coniferous swamps and in similar peat conditions.

Cypripedium Reginae, showy lady's slipper;

A native orchid found in open clearings in boggy ground. Often associated with cedar and tamarack.

Malaxis Brachypoda, white adder's mouth;

This native orchid is found in mixed woods and swamp forests, and coniferous swamps and thickets near shorelines.

Strix Nebulosa, great gray owl;

Large owl nesting in spruce or pine forests usually near swamps or clearings; usually in old hawk or eagle nests.

Phyciodes batesii, tawny cresent spot;

This 1.5 inch orange and brown butterfly is dependent on asters for larval food sources. It is found in moist meadows and pastures. Reasons for its decline are unknown.

Arabis Missouriensis, Deam's rock cress;

A species of rock cress found in sandy open woodlands and fields.

Adlumia Fungosa, climbing fumitory;

A vine found in woods, rocky chores and thickets. Does well on islands.

Clematis Occidentalis, purple clematis;

This species of clematis dwells in rocky woods and thickets, on stream banks, and in burned or cleared areas.

Medeola Virginiana, indian cucumber root;

Usually found in moist or swampy woods, maple forests (especially at margins of pools), hemlock knolls and cedar bogs.

Platanthera Hookeri, Hooker orchis;

An orchid of coniferous or mixed woods, thickets and borders, especially on wooded dunes and sandy soils.

Platanthera Orbiculata, large roundleaf orchid;

Found in rich deciduous or mixed woods, coniferoous forests to swamps (or bogs) of cedar, hemlock, etc.

Gomphurus Lineatifrons, splendid clubtail;

A 2.65 inch, dull colored dragonfly or streams and lakes. Larvae live in silt/sand substrate.

Gomphus Viririfrons, green-faced clubtail.

This dark, greenish-yellow faced, river-dwelling dragon fly is found only in the northern 2/3 of the state. Nymphs live in sand/silt substrates.

Haliaeetus Leucocephalus, bald eagle;

This large, fish eating member of the hawk family is at risk due to disturbance at nest sites, loss of nest trees and loss of waterside habitat.

Natural Areas

Natural areas are sites that contain high quality examples of natural communities. There are no formally designated state natural areas in the MPTR watershed. However, the following natural communities have been identified in the watershed, some of them rare or uncommon in Wisconsin.

Frying Pan Lake Spruce Bog - lake (deep, hard, seepage), northern wet forest
Peshtigo River - stream (fast, hard, cold)
Thunder Swamp - stream (fast, hard, cold), northern wet-mesic forest, northern wet forest
Forbes Springs - northern wet-mesic forest, spring pond
McCaslin Mountain - northern wet forest, northern wet-mesic forest
North Fork Springs - spring pond
Marinette County Beech Forest - northern mesic forest

If specific locational or other information is needed about these species or natural communities, contact the Bureau of Endangered Resources, DNR. **Please note** that the specific location of endangered resources is sensitive information. Exact locations **should not** be released or reproduced in any publicly disseminated documents.

CHAPTER FIVE
Information and Education Activities

Goal

Residents of the watershed will make decisions and take actions that protect surface and ground water quality in the Middle Peshtigo/Thunder Rivers watershed.

The Middle Peshitgo - Thunder Rivers Watershed project is protection oriented. Water quality is generally good and the local environment is healthy. However, there are serious threats on the horizon to ground and surface water. Ground water in the watershed is among the most susceptible in the state to contamination. The proximity to population centers and high quality water resources make the watershed very attractive to tourists, retirees, and seasonal residents. Development pressure is heightening. Crucial riparian habitats may be lost and water quality degraded.

A strong information and education (I&E) plan is the most important component of a protection oriented watershed project. The Middle Peshtigo - Thunder Rivers Priority Watershed Project will maintain strong I&E efforts for the life of the project. Implementation of the watershed plan will focus strongly on putting educational strategies into action. A sign of the success of the Information & Education component of the Watershed plan will be the creation of a public and private partnership, formed in an effort to bring citizens together to work for the protection of water quality. Ideally, these groups will be actively working to protect the watershed far beyond the life of the project. New concepts about prior stewardship of our land and water, and the intrinsic connection between each individual's actions on the land, and the effects of those actions on water quality, will be forged.

Objectives

1. Assist rural and village residents, especially riparian landowners, in minimizing the impact of nutrients, sediment, and other pollutants from their properties and septic systems on water quality. Help these residents understand the connection between their actions on the land and water quality.

2. Create a sense of stewardship and appreciation for local water resources while providing the skills and knowledge to preserve them.

3. Assist local government officials and citizens to better understand the benefits of land use planning, shoreland zoning, and septic system ordinances.

4. Help contractors minimize the impact of nutrients, sediment and other pollutants on water quality. Help loggers minimize the impact of forestry activities on water quality.

5. Help farmers minimize the impact of nutrients, manure, sediment and other pollutants on water quality.

6. Develop strategies and resources to increase environmental awareness in local schools.

7. Create a recognition program for landowners that install best management practices and for those whose property was already managed in an environmentally friendly manner.

8. Form partnerships with local stakeholders interested in protecting water and environmental quality.

See pages 131-138 for a more detailed explanation of the messages and activitites that will be utilized to reach each objective.

Audience

The primary audience of the I&E program will be watershed commercial and governmental decision makers, watershed landowners eligible for project participation, and consumers of watershed land and water resources, including seasonal residents. Secondary audiences are priority watershed landowners not eligible for project participation, businesses and suppliers of services to the priority watershed, interest groups, local government and interested citizens.

1. **Riparian Audience:** Landowners that live or conduct an enterprise adjacent to a lake, river or stream. Seasonal and short term visitors that come to recreate on watershed lakes and streams.

2. **Agricultural Audience**: Agricultural and horticultural producers, cooperatives, agricultural consultants and cooperating agencies.

3. **Forestry Audience:** Loggers, consulting and industrial foresters, forest landowners, users and consumers of watershed forests.

4. **Institutional Audience:** Lake Associations, local government, sporting and environmental groups, business associations, chamber of commerce, schools, news media, service clubs and churches.

5. **Commercial Audience:** Contractors, developers, realtors, well drillers, resort owners, stores and shops and guides.

6. **Urban Audience:** Permanent and seasonal residents of the Village of Crivitz or in concentrated rural areas (subdivisions).

7. **Educational Audience:** Teachers, students, school administrators.

Design

The Middle Peshtigo - Thunder Rivers Priority Watershed Project is a voluntary, rather than a regulatory program. People have to want to participate in the watershed project for it to be successful. A protection oriented priority watershed such as this one is even more dependent on changes in the attitudes of watershed residents. Unlike a more traditional, agriculturally focused watershed project, fewer opportunities for significant cost-sharing of agricultural BMPs exist in this watershed. Fiscal incentives cannot be the prime motivator for participation in the program. Each participant must truly believe in the project.

The I&E strategy is designed to create a positive attitude and active participation in the watershed project. The education plan focused on four main elements:

Knowledge: People must be aware of and understand watershed issues. They need to know what is expected of them and why.

Skills: People need skills to correct runoff pollution problems. They must be supported with tools, resources, equipment and expertise.

Motivation: Some individuals need moral or financial incentives to change their actions. They need to know what is in it for them.

Feedback: To stay excited about the watershed project, people need positive, on-going feedback. Positive feedback will maintain momentum and increase participation. Recognition is a key component of feedback.

Implementation Team

The education strategy was developed by Marinette County watershed staff, with assistance from the Middle Peshtigo - Thunder Rivers Watershed Citizens Advisory Committee, University of Wisconsin Cooperative Extension, (UWEX), Wisconsin Department of Natural Resources (DNR), USDA Natural Resource Conservation Service (NRCS) and Marinette County Zoning.

Marinette County LWCD will take lead responsibility for the implementation of the information and education strategy. The University of Wisconsin Cooperative Extension (UWEX), the Department of Natural Resources, (WDNR), and the Department of Agriculture (DATCP) will provide supporting assistance. The LWCD will seek support from local units of government and organizations such as lake rehabilitation districts, villages, lake associations, and other community groups and businesses, to implement the I&E strategy.

Strategy

Most priority watershed projects have several components that are common to their I&E programs. These general activities are listed below:

Watershed Newsletter: "Land & Water Connections" will be published five times per year. Its purpose is to update project activities, solicit support from watershed and county residents, and educate readers about water quality issues.

News Releases: Approximately thirty (30) press releases per year will be submitted to local print media. Press releases will highlight watershed project activities, recognize project participants, educate the general populous and stimulate involvement in watershed issues.

Water Quality Fair: A water quality fair is a way to deliver several educational messages in a casual atmosphere, combining entertainment, hands-on experience, and demonstrations. Watershed residents can meet agency staff and ask questions of landowners that have installed BMPS on their property.

On-Site Landowner Contacts: One-to-one communication is recognized as the best way to deliver the conservation stewardship message. LWCD staff will seek out opportunities to meet with landowners individually or at scheduled gatherings.

Several specific objectives can be found on the following pages. These include example messages and activities that relate to the objectives.

Objective 1: Assist rural and village residents, especially riparian landowners, in minimizing the impact of nutrients, sediment, and other pollutants from their properties and septic systems on water quality.

Runoff pollution is the # 1 threat to water quality in the Middle Peshtigo-Thunder Rivers Watershed. Watershed residents need to understand the connection between their actions on the land and water quality.

Messages

- Water quality problems begin at home.
- There can be serious environmental consequences from lawn and garden chemicals and excessive nutrients from failing or improperly placed septic systems.
- Using natural processes in yard and home care is better for water quality.
- Rules of thumb for protecting water quality around the home.
- Erosion from construction sites and landscaping is a major source of sediment and nutrients.
- The principles of erosion and sedimentation control.

Activities

- Workshops on lawn care, minimizing runoff, and natural landscaping
- Demonstration sites: natural landscaping in riparian areas, erosion control.
- Soil test riparian lawns and publish the results.
- Posters in restaurants, bait shops, gas stations, and boat landings.
- Door to door information distribution.
- Displays and videos.
- Demonstration tours (buffers on lakes, proper lawn care, aquatic vegetation management).
- Distribute informational handouts on specific best management practices.
- Construction site erosion control workshops.

Objective 2: Create a sense of stewardship and appreciation for local water resources while providing the skills and knowledge to preserve them.

Public participation is critical to the success of the priority watershed project. Local citizens must recognize the need for watershed protection and believe in the watershed project. Only they can provide momentum and foster political support for the difficult decisions that might be needed.

Messages

- Good water quality is our responsibility and should not be taken for granted.
- Stress the value of wetlands, streams, lakes, and ground water.
- Most BMPs are cost shared through the watershed project.
- Environmental quality is important to our physical health, economic prosperity, and quality of life.
- We can often protect water quality with simple techniques and minor changes in our life style.
- County watershed staff can provide technical expertise to help you to protect water quality.
- Funds are available to help defray the cost of restoring wetlands on your property.

Activities

- One-on-one contacts.
- Fact sheets - direct mail.
- Activities and presentations for school and volunteer groups such as: birding trips, wetland visits, BMP demonstrations, new styles of land stewardship, etc.
- Signs at stream crossings and boat landings.
- Tour "Lake Friendly" homes.
- "A Tale of Two Lakes" display which shows good and bad riparian land use practices and explains their effects.

Objective 3: Assist local government officials and citizens in understanding the benefits of land use planning, shoreland zoning, and septic system ordinances.

Local officials, administrators, and citizens must believe in and support the laws and ordinances that protect our local environment. Political will and social pressure will ensure that proper steps are taken and decisions adhered to. Before people will make and support decisions that may affect their lives and livelihoods, they must recognize the need for those decisions. The watershed project will research, analyze, and publicize the actions that people are making that harm water quality.

Messages

- Clean water resources are community assets.
- There is a strong connection between land use and water quality.
- Growth and development decisions should reflect the need for clean water.
- We all have a role in keeping the water clean and protecting wildlife habitat.
- Acknowledge contributions of cost share participants toward improved water quality.
- Clean water (especially groundwater) is important to health.
- Quality water resources greatly contribute to the county economy.
- Laws and ordinances prevent surprises, protect property values, and hold down the cost of services.

Activities/delivery

- Meetings/presentations for elected officials and staff.
- Tours of riparian properties that show appropriate land use.

Objective 4: Help contractors minimize the impact of nutrients, sediment, and other pollutants on water quality. Help loggers minimize the impact of forestry activities on water quality.

It is crucial that decision makers in these industries be involved in the watershed project. Development of riparian areas and logging of private and county forests are activities that if properly done, will have minimal effects on water and environmental quality. If improperly implemented, these actions will seriously degrade our surface waters and wildlife habitat.

Messages

- Why sustainable development is important.
- Good neighbors protect water quality.
- BMPs can help keep soil and nutrients on your land.
- Removing too many trees from along small streams can cause peak summer water temperatures to rise and kill cold water fish such as trout.
- Forestry and construction BMPs help preserve ground and surface water quality while maintaining soil fertility and land values.
- Descriptions of construction site and forestry BMPs
- The role trees play in protecting water quality.
- Too much organic debris deposited in a stream in a short time can harm water quality.

Activities

- One-on-one contacts.
- Informational meetings, workshops, and demonstration tours.
- Presentations at meetings of farmers or loggers groups.

Objective 5: Help farmers minimize the impact of nutrients, manure, sediment, and other pollutants on water quality.

Farms contribute significant loads of nutrients to surface water and ground water. Farmers need to understand that installing Best Management Practices can save them money, and improve efficiency in many ways. Most agricultural operations in the watershed are near the watershed population center of Crivitz. Improper agricultural operations can place village drinking water sources at risk.

Messages

- How BMPs help preserve ground and surface water quality while increasing farm efficiency and reducing costs.
- Cost sharing is available to implement agricultural BMPs.
- BMPs may require regular maintenance.
- Groundwater quality can be affected by improper agricultural practices and can affect drinking water supplies.
- Ground water quality problems can affect herd health and are difficult to correct.
- Abandoned wells are a potential source of groundwater contamination.
- Preserving stream corridors and wetlands is important for flood protection, wildlife, groundwater recharge, and erosion control.

Activities

- One-on-one contacts with farmers.
- Informational meetings and demonstration tours on farms.
- Presentations at meetings and gatherings of farmers.
- Articles for other newsletters (CFSA, UWEX, cooperatives).
- Displays (e.g., County Fair, etc.) such as nutrient management, impacts of runoff pollution.
- Nutrient Management Field Days.

Objective 6: Develop strategies and resources to increase environmental awareness in local schools.

Long term protection of the watershed depends on educating the next generation of decision makers. Children can also affect the attitudes of their parents in a positive way. Young people are among the most active users of recreational resources and the watershed environment. Their support for the project is important.

Messages

- General knowledge about the science and ecology of water and the strong connection between land use and water quality.
- Individuals can make a difference. There are many ways to protect water quality.
- County watershed staff can provide many of the tools and training needed to protect water quality.
- There are many interesting environmental careers and volunteer opportunities.
- Human activities near lakes, streams, and wetlands affect on water quality.
- Improper land use can result in contaminated ground water.

Activities/Delivery

- Teacher training in water science and ecology, quality issues, etc.
- Create a library of I&E materials such as pamphlets, maps, videos, books, etc. for use in classrooms.
- Seek or create opportunities to address students on water quality and related topics.
- Obtain the Enviroscape and other display models which demonstrate land use impacts on water quality or proper management techniques.
- Participate in Marinette County environmental activities at Camp Bird and state programs such as Adopt-A-Lake and the Water Action Volunteers.
- Include students in research, monitoring, survey work, and volunteer activities.
- Generate environmental interest and awareness through competitions such as the Environmental Poster Contest or science projects.

Objective 7: Create a recognition program for landowners that install best management practices and for those whose property was already managed in an environmentally friendly manner.

Recognition of environmentally friendly landowners is an important feedback mechanism to maintain momentum of the watershed project. It is also a way to generate word-of-mouth advertising for the watershed project.

Activities

- Create appropriate award categories for individuals, riparian landowners, farmers, loggers, contractors, developers, schools, organizations, and local government.
- Create a series of Public Service Announcements to promote the award program.
- Set up a tour of award winners for local public officials.
- Design informational signs for placement on the property of award winners.
- Give award winners exposure in the local media through press releases.
- Cover award winners extensively in watershed newsletters.

Objective 8: Form partnerships with local stakeholders interested in protecting water and environmental quality.

Many groups have a stake in water quality within the watershed. There is a great deal of overlap between watershed project goals and those of the stake holder groups. The watershed project will work with stakeholders and bring groups with compatible goals together.

Messages

- Working together is critical for protecting watershed water quality.
- Good water quality is important to business.
- It is much easier and less expensive to prevent problems than to fix them.
- Working together will increase our political clout.
- County watershed staff can provide tools and expertise to groups that wish to protect and promote water quality.

Activities

- County watershed staff will give presentations at meetings to explain and promote the Middle Peshtigo-Thunder Rivers Priority Watershed Project.
- Advertisements from partnership groups will be sought to help sponsor the Middle Peshtigo-Thunder Rivers Priority Watershed newsletter.
- Watershed staff will set up displays at fairs, gatherings, fund raisers, etc., highlighting issues and runoff pollution threats facing the watershed.
- Training will be provided to aid riparian landowners that wish to form Lake Associations. These lake associations will be encouraged and helped to form a county wide lake association.
- Partners will be encouraged to take leadership roles in specific aspects of the watershed project or in protection of specific bodies of water.
- Develop a partnership with local realtors emphasizing environmentally friendly development.

Evaluation

An evaluation report of information and education activities will be prepared annually. Evaluation will be built into program activities where feasible. Activities may be evaluated by recording the number of attendees at a function, the number of target audience members reached, event surveys, or other methods. A survey will be used every two years to assess how watershed residents are getting information about the program, how effective the activities are a delivering messages, and if behavioral changes have occurred.

Table 5-1 Information and Education Budget and Staff Needs

Activity	Total Number	Total Direct Costs	Required Staff Hours		
			Years 1-3	Years 4-8	Years 9-10
Newsletters	40[1]	$20,000.00	480	800	320
News Releases	240[2]	$1,000.00	450	750	300
Landowner Surveys	4[3]	$2,000.00	160	160	80
Public Meetings/Presentations	144[4]	$2,000.00	500	800	350
Demonstration Tours	7	$7,000.00	72	120	48
Direct Mailing	8[5]	$4,000.00	96	240	96
Training			96	120	32
Water Quality Education in Schools			900	1,000	200
On-site landowner Contacts			750	900	150
Well Water Testing			200	0	0
Awards/Recognition	7	$1,000.00	60	125	70
Project Display	8	$2,000.00	240	400	0
Video	3	$1,000.00	320	640	0
Signs	As Needed	$2,000.00	100	150	0
Water Quality Fair	1	$2,000.00	200	0	0
Lake Friendly Home Campaign	1	$200.00	100	80	0
Slide Presentations	4	$1,000.00	160	160	0
Totals		$45,200.00	4,884	6,445	1,646

Note: Estimates of frequency
1- Five newsletters per year.
2- Thirty press releases per year.
3- One survey every other year.
4- Eighteen meetings/presentations per year.
5- One direct mailing per year

CHAPTER SIX
Project Evaluation

This chapter briefly summarizes the plan for monitoring the progress and evaluating the effectiveness of the Middle Peshtigo-Thunder Rivers Priority Watershed Project. The evaluation strategy includes these components:

Administrative review
- Pollution reduction evaluation
- Watershed Resource Evaluation Monitoring

Information on the first two components will be collected by the Marinette County LWCD and reported regularly to the WDNR and the DATCP. The project team will meet early in the year throughout the implementation phase to review and evaluate the accomplishments of the preceding year. 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 WDNR's Bureau of Community Assistance. The Watershed Resource Evaluation Monitoring follows guidance established by WDNR's Bureau of Water Resources Management to select and monitor specific sites in the watershed to monitor resource quality changes.

A final report will be prepared for the Middle Peshtigo-Thunder Rivers Priority Watershed Project within 18 months of the end of the grant period. This report will include information on landowner participation, project management, grant management, technical assistance, and any Signs of Success sites completed within the watershed among other topics. It is developed to evaluate progress, provide documentation on attainment of water quality and pollutant load reduction objectives, evaluate BMP effectiveness, and provide recommendations on which target key areas needing improvement in the NPS program. WDNR, with the assistance of DATCP and the Marinette County LWCD, will prepare the final report.

Administrative Review

The first component, the administrative review, will focus on the progress of Marinette 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 Marinette County Land & Water Conservation Department will provide the following data to the DNR and the DATCP annually:

- Planned and completed BMPs
- Planned and completed conservation systems
- Major information and education activities undertaken

Accomplishment data are summarized in the Annual accomplishment Report prepared by DATCP and WDNR, and are also discussed at watershed review meetings held annually for projects in implementation. Additional evaluation data provided by Marinette County LWCD for the annual watershed review include the following items:

- Pollutant load reductions (described below)
- Status of grants and related financial activities
- Evaluation of landowner participation
- Status of project administration including data management, staff training, and BMP monitoring
- Status of nutrient management planning, and easement acquisition and development
- Effectiveness of construction site erosion control activities

Details of the reporting requirements are contained in DNR Publication WR-223-94, which is reviewed every two years by DATCP and DNR and revised as necessary.

The Field Offices Computing System (FOCS) is a computer data management system developed by the U.S. Natural Resources Conservation Service (NRCS). The NRCS, the WDNR and the DATCP use FOCS to meet the accomplishment reporting requirements of all three agencies. FOCS is used to collect data for administrative accomplishments, and will provide the information to the WDNR and the DATCP for program evaluation.

Financial Expenditures

Marinette County LWCD and other participating units of government will provide the following financial data to the WDNR and the DATCP quarterly:

- 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 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 Marinette County staff
- Amount of money paid for installation of BMPs, and money encumbered in cost-share agreements

The Marinette County LWCD and other participating units of government will also provide the WDNR the following financial data annually:

- Staff training expenditures

- Interest money earned and expended
- Total budget and expenditures on the project

Time Spent on Project Activities

The Marinette County LWCD and other participating governmental units with local assistance grants will provide time summaries to both departments for the following activities annually:

- 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 Middle Peshtigo-Thunder Rivers Watershed. Data collected for evaluation include sediment load reduction from uplands; streambanks and gullies; reduced winter spreading of manure; and shoreline (habitat) protection. Chapter Two of this plan describes target pollutant reductions for the subwatersheds.

Cropland Sources

Marinette County LWCD staff will use a modified version of the USLE model to estimate sediment reductions due to changes in cropping practices.

Shoreline Sources

LWCD staff will estimate changes in shoreline sediment erosion and the footage of developed riparian frontage re vegetated with natural buffer. A tally will be kept of landowners contacted, shoreline sediment (in tons) being generated at the time of contact, changes in erosion levels estimated after installing BMPs, and reduction in urban style lawn.

Barnyard Runoff

The Marinette County LWCD will use the BARNY model to estimate phosphorus reductions due to the installation of barnyard control practices and will report the information to the WDNR through FOCS. If FOCS is replaced, the replacement system will be used for all project tracking.

Forest Management Practices

Progress in increasing the use of forestry BMPs and the enrollment of landowners in various forestry management programs will be discussed annually. The needs for future information and training will be evaluated.

Road Construction and Runoff

Progress made toward improving road construction and maintenance practices in the watershed will be discussed annually. The needs for future information and training will be evaluated.

Water Resource Evaluation Monitoring

Limited funds and the intensive staffing needed to properly evaluate water quality changes prohibit monitoring each watershed individually. Instead, two types of evaluation monitoring are being conducted statewide: Whole Stream Monitoring and Signs of Success.

The goal of the evaluation monitoring activities is to determine the progress the Nonpoint Source Program is making toward improving the quality of Wisconsin's water resources.

Evaluation monitoring activities were developed to answer five questions about the water resource objectives and the pollution reduction goals:

1) Do the levels and types of best management practices recommended in the watershed plans achieve the water resource objectives?

2) Do the types and levels of best management practices, recommended in the watershed plan, achieve the pollutant reduction goals?

3) Does any level of practice installation below 100 percent achieve the water resource objectives or the pollutant reduction goals?

4) Do we need to adjust the pollutant load reduction goals to achieve the water resource objectives?

5) Can we use simple environmental indicators in many watershed projects to provide some early evidence that the practices might achieve the water resource objectives and pollutant reduction goals?

A team of experts from state and federal agencies, and the University of Wisconsin was formed to develop and direct the evaluation monitoring activities at the Whole Stream Monitoring and Signs of Success sites.

Whole Stream Monitoring Sites

Criteria were developed to select and monitor twelve streams around the state. The stream sites represent the five major types of fisheries found in agricultural and urban parts of priority watersheds, and they also represent three of the five ecoregions in the state. We have five fishery types: high gradient cold water sport fisheries, high gradient warm water sport fisheries, high gradient warm water forage fisheries, low gradient warm water forage fisheries, and low gradient cold water sport fisheries. A storm sewer outfall is also being monitored. The three ecoregion types represented are the Southeastern Wisconsin till plains, the Driftless area, and the North Central Hardwood Forest.

All but one stream site drains a small area (about ten square miles or less). The schedule involves two years of monitoring before any best management practices are installed. Five years of monitoring are needed during the practice installation phase, two years during the response period, and two years during the post practice installation phase, for a total of eleven years of monitoring.

State-of-the-art chemical and physical monitoring is being done at all the stream sites. State-of-the-art biological monitoring will be done at eight of the twelve streams. Results of the monitoring will be used to determine how well the best management practices achieve the pollution reduction goals and objectives. Improving the fish community is the most important water resource objective for all the streams.

A total of about $8,360,000 would be needed for the stream monitoring, if the work is carried out over a period of eleven years. The success of the evaluation monitoring activities depends on the installation of all the best management practices at the Whole Stream Monitoring Sites.

Signs of Success

Signs of Success (SOS) monitoring is short-term and designed to provide some early evidence that better land management does make a difference. One site is being sought for each watershed project. Signs of Success will focus on one practice such as barnyard runoff controls, manure storage, or streambank fencing that is expected to affect the adjacent stream.

Monitoring will take place over a two-year period--the year before and the year after a practice is installed. Expected improvements will be on those sites where habitat degradation has occurred. Habitat sampling and photographs will be used to show the benefit of the practice. Limited chemical monitoring and fish sampling will be done at some sites.

The cost of the Signs of Success program is $74,000 (1994) per year. The results of the Signs of Success monitoring will be featured in educational materials such as local newsletters and newspapers and the statewide newsletter "Fields and Streets."

SOS sites for Middle Peshtigo-Thunder Rivers are still being identified and will be established shortly after the implementation stage begins.

Appendix A
NR 115 - Shoreline Management

Wetlands. Counties, cities, and villages must regulate wetlands within shorelands. The county requirements are found in NR 115, and city and village requirements are governed by NR 117. Wetlands in the shoreland zone shown on the Wisconsin Wetland Inventory maps (usually wetlands, or portions of wetlands, 5 acres or larger) are regulated. Generally, the shoreland-wetland district is an overlay onto existing zoning classifications and supersedes any other less restrictive zoning requirement. Permitted uses in county-zoned wetlands are limited to:

- hiking, fishing, trapping, hunting, swimming, and boating
- harvesting wild crops
- silviculture
- pasturing of livestock
- cultivation of agricultural crops
- construction and maintenance of duck blinds
- construction and maintenance of certain nonresidential buildings
- construction and maintenance of piers, docks, and walkways, provided that no filling, flooding, dredging, draining, ditching, or excavating is done
- establishment and development of public and private parks, recreation areas, and boat access sites
- construction of electric, gas, or other utility lines
- construction and maintenance of railroad lines

All other uses are prohibited. Similar limitations apply to shoreland-wetlands in cities and villages, although there are a few additional permitted uses, and cities and villages are not required to allow all of the uses in the list above.

Shoreland-wetland areas can be rezoned to allow otherwise prohibited uses by amendment of the shoreland-wetland map (rezoning). Rezoning is prohibited if it results is significant adverse impact on any of the following wetland functions and values:

- storm and flood storage capacity
- maintenance of dry season stream flow
- discharge of groundwater to wetland
- filtering or storage of sediments, nutrients, or contaminant
- shoreline protection against soil erosion
- fish spawning, breeding, nursery, or feeding grounds
- wildlife habitat
- areas of special recreational, scenic, or scientific interest

Any amendment must go through a zoning ordinance amendment procedure including notice, public hearing, and development of written supporting the need for a zoning change. Any such rezoning proposal must be reviewed by DNR for consistency with NR 115 or NR 117.

Minimum lot sizes. Minimum lot sizes are established for the shoreland zone to protect health, safety, and welfare and to guard against pollution of the adjacent body of water. Lots served by a public sanitary sewer must have a minimum average width of 65 feet and a minimum area of 10,000 square feet. Lots not served by a public sanitary sewer must have a minimum average width of 100 feet and a minimum area of 20,000 square feet.

Structure setbacks. Building and structure setbacks are established in order to conform to health, safety, and welfare requirements; preserve natural beauty; reduce flood hazards; and avoid water pollution. All buildings and structures, except piers, boat hoists, and boathouses, must be set back 75 feet from the OHWM. If an existing pattern of development is present, counties may allow lesser setbacks calculated by setback averaging. Not all counties allow this.

Vegetative cutting. Vegetative cutting standards are required to protect natural beauty; control erosion and reduce the flow of effluents, sediments, and nutrients; and protect fish and aquatic life. In the strip of land extending 35 feet inland from the OHWM, clear-cutting of trees and shrubbery is limited to less than 30 feet in any 100 feet along the shoreline. Farther inland of the OHWM, vegetative cutting is governed by the potential effect on water quality and by sound forestry and soil conservation practices.

Filling, grading, lagooning, ditching, and excavating. These activities are permitted only in accordance with the appropriate state permits under ch. 30, Stats., county shoreland-wetland zoning requirements, and local approvals to ensure that such activities have a minimal impact on erosion, sedimentation, and fish and wildlife habitat.

Other Shoreland Zoning Provisions. NR 115 specifically allows for the continued **lawful** use of an existing building, structure, or property that predates the shoreland ordinance or amendment, even if it does not conform to the new ordinance. Such uses are legal nonconforming uses. Nonconforming uses in the shoreland zone are treated similarly to those under general zoning [s.59.69(10) Wis. Stats.1.]. The county may prohibit altering, repairing, or adding to such a building or structure, if the cost over its life exceeds 50 percent of its equalized assessed value. Discontinuing a nonconforming use for 12 months results in losing the property's legal nonconforming use status.

In addition to these restrictions on shoreland development, counties are required to adopt two other programs for shorelands. First, each county must review any land divisions in shoreland areas which create three or more parcels or building sites of 5 acres or less each within a five- year period (NR 115.05(4)). County review is pursuant to s.236.45, Stats., and among other things, subdivisions abutting navigable waters must meet statutory requirements for providing public access to those waters. Second, each county must adopt sanitary regulations to protect health and to preserve and enhance water quality. Where a public sewer is not available, the private sewage disposal must conform to a county private sewage system ordinance. Where public water is not available, private wells must conform to state private well construction standards

Shoreline zoning is administered locally, usually by the county (except annexed areas where administration may be by city or village government), with technical assistance and support from the DNR. The department has legislatively mandated oversight duties, including the authority to object to

and overturn any zoning ordinance amendment that does not comply with NR 115 (or NR 117) standards. In addition, the DNR has the authority to review decisions granting special exceptions (conditional use permits), variances, and appeals. The DNR may appeal these local zoning decisions to the county Board of Adjustment or to Circuit Court.

One important way the DNR has assisted local governments is through providing model ordinances that incorporate the minimum standards of NR 115. Initially, the DNR developed the Wisconsin Shoreland Protection Ordinance in 1967, which most counties adopted as their original shoreland ordinance. The latest revision of the model ordinance incorporates shoreland-wetland zoning requirements of NR 115 and deletes sections that are no longer required in counties with comprehensive zoning. Many counties adopted this model ordinance to assure compliance with NR 115. Some counties have developed more restrictive shoreland zoning ordinances. However, this is not the case for shoreland-wetland standards, which counties cannot make either more or less restrictive than NR 115. Under NR 117, cities and villages may adopt more restrictive use standards for shoreland-wetlands.

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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."

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 are 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 DHFS 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 coliform, 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.

DHFS:

Wisconsin Department of Health and Family Services.

DIOXIN (2,3,7,8-tetrachlorodibenso-p-dioxin):

A chlorinated organic chemical which is highly toxic.

DISINFECTION:

A chemical or physical process that kills organisms 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 surroundings.

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 QUALITY INCENTIVE PROGRAM (EQIP):

A federal cost-sharing program to help landowners install measures to conserve soil and water resources. Funds are targeted to priority areas to achieve the maximum environmental benefit per dollar spent. EQIP is administered by NRCS.

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 (PAH) 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:

Underground water-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.

HAZARDOUS WASTE:

Waste that has been found to be fatal to humans or animals in low doses, or is otherwise capable of causing or significantly contributing to an increase in serious irreversible, or incapacitating reversible, illness.

HEAVY METALS:

Metals present in municipal and industrial wastes that pose long-term 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 past 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 "where solid waste is disposed on land by utilizing the principles of engineering to confine the solid waste to the smallest practical area, to reduce it to the smallest practical volume, and to cover it with a layer of earth or other approved material as required." Hazardous wastes frequently require various types of pretreatment before they are disposed of, i.e., neutralization, chemical fixation, or 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 "Oligotrophic.")

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 (NPS):

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.

NRCS:

Natural Resource Conservation Service.

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 (TMDLs):

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. (See also "Oligotrophic," "Mesotrophic," "Eutrophic..")

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 and 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: 1998

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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 Basin)	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
94-1	Duck Creek	Outagamie, Brown
94-2	Apple/Ashwaubenon Creeks	Outagamie, Brown
94-3	Dell Creek	Sauk, Juneau
94-4	Pensaukee River	Shawano, Oconto
94-5	Spring Brook	Langlade, Marathon
94-6	Sugar/Honey Creeks	Walworth, Racine
95-1	Pigeon River	Manitowoc, Sheboygan
95-2	Middle Peshtigo/Thunder Rivers	Marinette, Oconto
95-3	Fond du Lac River	Fond du Lac, Winnebago
95-4	Lower Rib River	Marathon
95-5	Kinnickinnic River (St. Croix Basin)	St. Croix, Pierce
95-6	Lower Little Wolf	Waupaca
95-7	Pine & Willow Rivers	Waushara, Winnebago

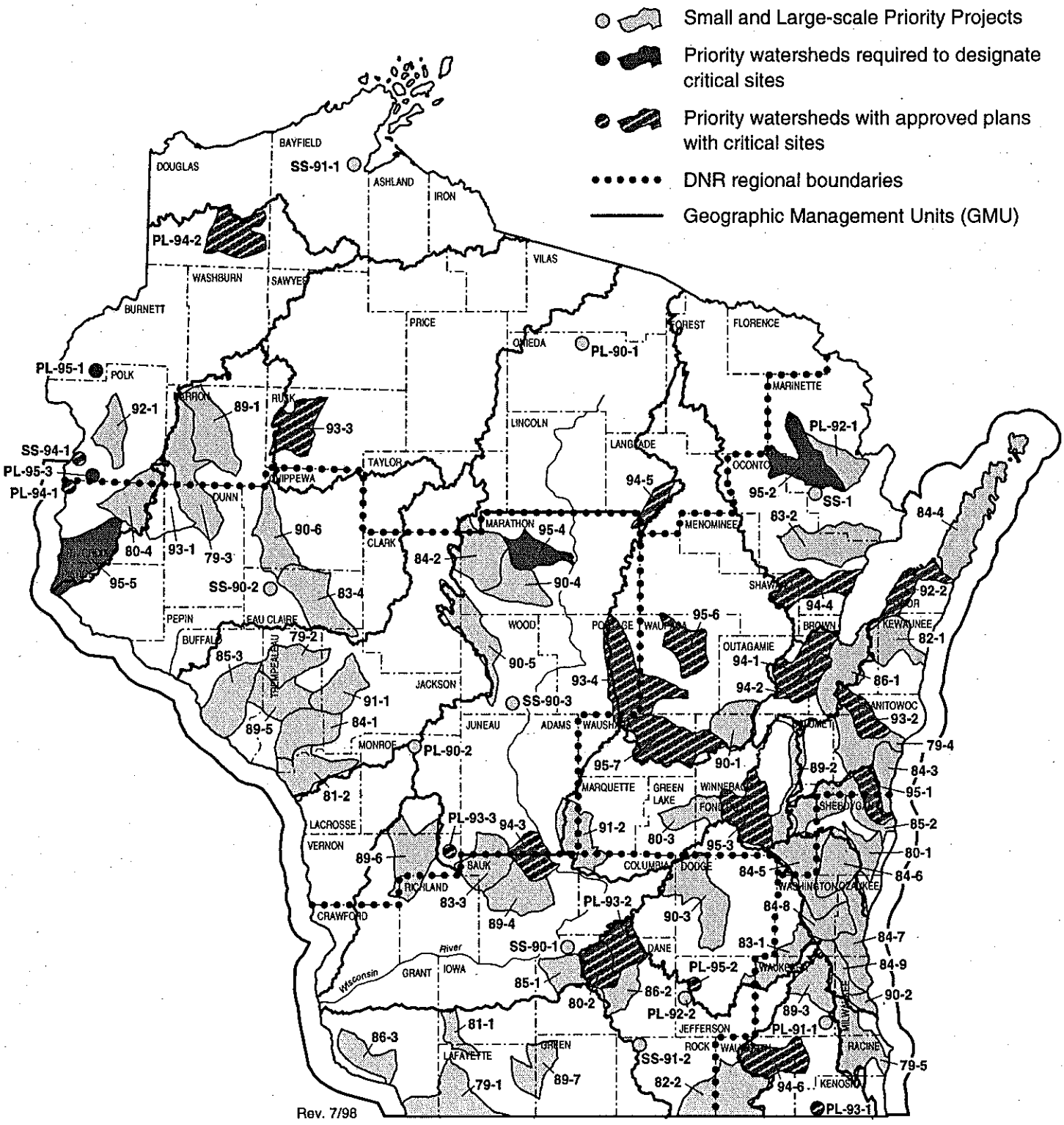
Year Selected-Map Number	Small-scale Priority Watershed Project	County(ies)
SS-1	Bass Lake ♦	Marinette
SS-90-1	Dunlap Creek	Dane
SS-90-2	Lowes Creek	Eau Claire
SS-90-3	Port Edwards - Groundwater Prototype ♦	Wood
SS-91-1	Whittlesey Creek	Bayfield
SS-91-2	Spring Creek	Rock
SS-94-1	Osceola Creek	Polk

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	Vernon
PL-94-1	St. Croix County Lakes Cluster	St. Croix
PL-94-2	Upper St. Croix/Eau Claire River	Douglas
PL-95-1	Big Wood Lake	Burnett, Polk
PL-95-2	Rock Lake	Jefferson
PL-95-3	Horse Creek	Polk, St. Croix

♦ Project completed

† Sixmile-Pheasant Branch is being redone as part of the Lake Mendota project (PL-93-2).

Priority Watershed Projects in Wisconsin



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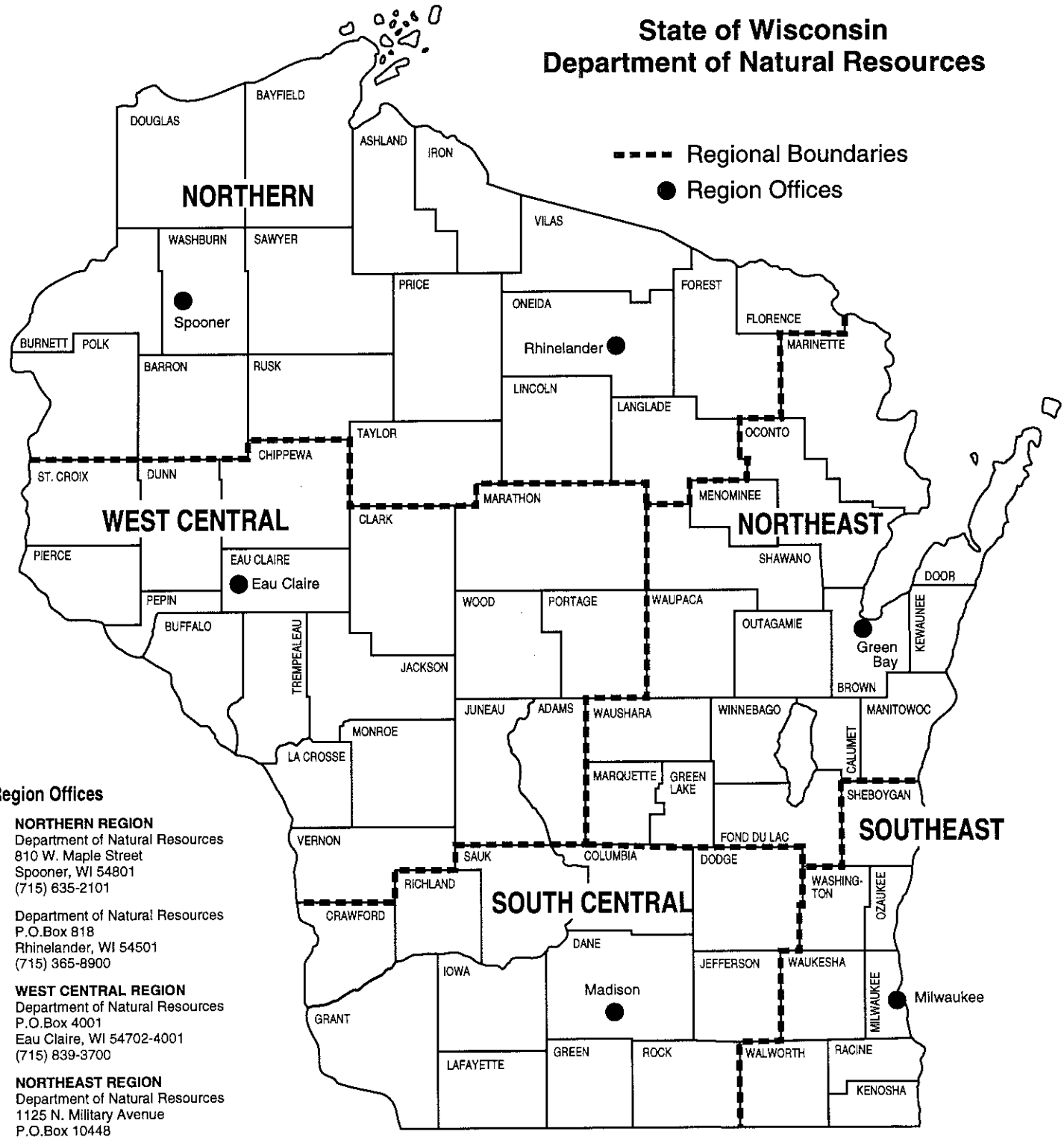
State of Wisconsin
Department of Natural Resources



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REV 7-97

Our Mission

To protect and enhance our natural resources:
our air, land and water;
our wildlife, fish and forests
and the ecosystems that sustain all life.

To provide a healthy, sustainable environment
and a full range of outdoor opportunities.

To ensure the right of all people
to use and enjoy these resources
in their work and leisure.

To work with people
to understand each other's views
and to carry out the public will.

And in this partnership
consider the future
and generations to follow.

WISCONSIN
DEPT. OF NATURAL RESOURCES