



Lake McCarrons Management Plan

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The Board of Managers
CAPITOL REGION WATERSHED DISTRICT

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EXECUTIVE SUMMARY

The Capitol Region Watershed District retained THE OSGOOD GROUP with assistance from BARR ENGINEERING to develop a management plan for Lake McCarrons. Lake McCarrons has received intensive management attention for over two decades. Yet, despite this attention, there remain problems and concerns. This plan addresses those concerns.

This plan was developed by an Advisory Group consisting of residents and concerned citizens. The Advisory Group was assisted by a Technical Group who served to keep the planning process on a sound technical footing. The Advisory Group conducted its deliberations over a six-month period, from January through June 2002. This plan represents their recommendation to the Capitol Region Watershed District.

Problems & Concerns

This Advisory Group did not limit their attention to only water quality concerns and included any concern relative to the quality, condition and aesthetic appeal of Lake McCarrons. Multiple lake management concerns for Lake McCarrons were identified. These concerns include water quality improvement, nuisance aquatic plant control, Eurasian watermilfoil, fisheries, recreational use, winterkill, wetland system operation and coordination among jurisdictions. In this vein, they identified these problems and concerns:

Lake Quality / Lake Health

1. Excessive Algae
2. Fish
3. Nuisance Aquatic Plants
4. Exotic Species
5. Diversity

Recreational Use

1. Surface Use
2. Lakeshore Use

Other Concerns

1. Ramsey County Park
2. Education and Enforcement

Vision

To address these problems and concerns, the Advisory Group developed a vision, goals and objectives.

Vision: Lake McCarrons is an invaluable community and regional asset. Investments will be made to improve and insure sound environmental, aesthetic and recreational practices. Education and enforcement will sustain needed lake improvement.

Management Goals & Objectives

GOAL #1 **Control or minimize summer algae blooms**

Objective 1a – Manage phosphorus so summer average lake concentration is 33 ppb or less.

GOAL #2 **Improve the fishery by a) eliminating winter fish kills and b) maintaining a diversity of gamefish.**

Objective 2a – Keep winter dissolved oxygen concentrations above 3 mg/L in the top four feet of the lake during the winter.

Objective 2b – Implement the DNR's fisheries management plan.

GOAL # 3 **Maintain and improve healthy native aquatic plants that a) provide minimal distraction from recreational activities, b) provide quality fish and wildlife habitat, c) minimize the ecological impacts and recreational nuisances of non-native plants and d) provide for coordination of management and control activities.**

Objective 3a – Develop and implement a comprehensive aquatic plant management plan that protects and restores beneficial native plants and minimizes the nuisances and ecological impacts of non-native plants.

GOAL #4 **Keep new exotic species out of the lake.**

Objective 4a – Use every reasonable means to prevent new invasive, exotic species from entering Lake McCarrons.

Objective 4b – Monitor Lake McCarrons for new invasive, exotic species infestations.

Objective 4c – Develop contingency plans for the introduction of new exotic species into Lake McCarrons.

GOAL #5 Assure that boating activities are safe, courteous and do not add to shoreline erosion.

Objective 5b – Manage watercraft in such a way so their wakes do not add to or increase the natural shoreline erosion from wind generated waves.

Objective 5b – Evaluate and enforce surface regulations to promote safe and courteous boating.

GOAL #6 Improve the lakeshore by a) removing unsightly debris, b) adding native plants to provide wildlife habitat and minimize the use of artificial erosion control structures and c) keep geese and nuisance waterfowl away.

Objective 6a – Remove debris and abandoned docks from the lakeshore. Once removed, assure unwanted debris is not dumped on the lake or on the lakeshore in accordance with Roseville's nuisance ordinance (Chapter 407).

Objective 6b – Implement lakeshore protection, restoration and erosion control projects around 50% of the suitable lakeshore using lakescaping or other non-structural methods.

Objective 6c – Prevent geese and other waterfowl from becoming pests.

GOAL #7 Address concerns with maintenance of the a) public boat ramp on the northeast end and b) fishing access on the southwest end of the lake.

Objective 7a – Develop and implement a plan to improve and maintain the appearance of the public boat ramp.

Objective 7b – Develop the South McCarrons Blvd. parcel as a model for educating lakeshore stakeholders about methods for improving aesthetic appearance and providing fish and wildlife habitat, goose control and erosion control for Lake McCarrons.

Management Actions

Following the development of goals and objectives, the Advisory Group reviewed management alternatives, then recommended 25 specific management actions. The management actions are listed below. These statements are 'action-oriented,' therefore contain words like 'will' instead of 'should' in reference to the implementation of the action. In many cases, the entity identified to implement many of these actions has agreed they will indeed do what is indicated. However, the final coordination and implementation of this plan is subject to review by the CRWD and other partners.

GOAL #1 Control or minimize summer algae blooms

Management Action 1 - Maintenance of Villa Park Ponds.

Management Action 2 - Implement sediment best management practices (BMPs) in subwatershed nos. 3, 7 and 8.

Management Action 3 - Implement watershed BMPs to remove phosphorus in subwatershed nos. 2, 4, 5 and 6.

Management Action 4 - Implement watershed-wide BMPs on a voluntary basis.

Management Action 5 - Alum application.

Management Action 6 - Evaluation of algae control actions.

Management Action 7 - Develop subwatershed target pollution standards.

GOAL #2 Improve the fishery by a) eliminating winter fish kills and b) maintaining a diversity of gamefish.

Management Action 8 - In five years, re-evaluate the need for artificially aerating Lake McCarrons during the winter.

Management Action 9 - The DNR will continue implementing its fisheries management plan for Lake McCarrons.

GOAL # 3 Maintain and improve healthy native aquatic plants that a) provide minimal distraction from recreational activities, b) provide quality fish and wildlife habitat, c) minimize the ecological impacts and recreational nuisances of non-native plants and d) provide for coordination of management and control activities.

Management Action 10 - Develop an aquatic plant management plan in 2003 with actual implementation to occur later.

GOAL #4 Keep new exotic species out of the lake.

Management Action 11 - Implement an exotic species prevention program.

Management Action 12 - Monitor Lake McCarrons for new invasive, exotic species infestations.

Management Action 13 - Contingency plan(s) will be developed for possible new exotic species.

GOAL #5 Assure that boating activities are safe, courteous and do not add to shoreline erosion.

Management Action 14 - Design and install signs at the public boat launch that clearly indicate applicable surface use regulations for Lake McCarrons.

Management Action 15 - Design and distribute an informational flyer to lakeshore owners.

Management Action 16 - Implement a lake use study to evaluate the environmental and aesthetic impacts of boating.

Management Action 17 - Clear the lake's outlet of debris on a daily basis.

GOAL #6 **Improve the lakeshore by a) removing unsightly debris, b) adding native plants to provide wildlife habitat and minimize the use of artificial erosion control structures and c) keep geese and nuisance waterfowl away.**

Management Action 18 - The Lake McCarrons Neighborhood Association will organize an annual lakeshore cleanup event in May.

Management Action 19 - The Ramsey SWCD will conduct a shoreline inventory to determine the amount of shoreline suitable for lakescaping as well as the shoreline subject to erosion.

Management Action 20 - The Ramsey SWCD will provide technical assistance and the CRWD will provide educational materials and cost sharing for lakescaping to lakeshore owners on Lake McCarrons.

Management Action 21 - Ramsey County Parks, the city of Roseville and other local units of government, in cooperation with the University of Minnesota will continue the goose control program.

GOAL #7 **Address concerns with maintenance of the a) public boat ramp on the northeast end and b) fishing access on the southwest end of the lake.**

Management Action 22 - Ramsey County Parks will develop a plan and implement landscaping improvements around the boat ramp.

Management Action 23 - Ramsey County Parks, in cooperation with Ramsey SWCD and the CRWD, will develop and implement a lakescaping plan compatible with fishing activities to provide a model for lakeshore stakeholders.

Administration, Coordination & Oversight of the Management Plan

Management Action 24 - Plan administration.

Management Action 25 - Monitoring, Education and Report.

Implementation Plan

The Implementation Plan summarizes the management actions, the agency responsible for taking the lead in implementing each action, partners and cooperators, and a budget estimate. The implementation plan consists of CRWD capital improvements, CRWD programs, CRWD operations and maintenance (O & M) and program costs of other agencies.

A Capitol Region Watershed District five-year implementation budget summary is presented in the table below.

CRWD 5-Year Implementation Plan Summary

Management Action	CRWD Capital Cost *	5-Year Program Costs				
		Year 1	Year 2	Year 3	Year 4	Year 5
1. Maintenance of Villa Park Ponds	\$443,900	\$5,000	\$5,000	\$5,000	\$5,000	\$15,000
2. Implement sediment BMPs.		\$6,000	\$6,000	\$6,000	\$6,000	\$6,000
3. Implement watershed BMPs						
4. Implement watershed-wide BMPs	\$13,000	\$37,200	\$37,200	\$37,200	\$37,200	\$37,200
5. Alum application	\$111,500					
6. Evaluation of algae control actions						\$15,000
7. Subwatershed pollution standards	\$50,000					
8. Evaluate need for winter aeration						\$2,000
9. DNR fisheries management						
10. Aquatic plant management plan		\$3,000	\$3,000			
11. Exotic species prevention program		\$2,000	\$2,000	\$2,000	\$2,000	\$2,000
12. Monitor for new exotic species		\$2,000	\$2,000	\$2,000	\$2,000	\$2,000
13. Exotic species contingency plans			\$4,000		\$4,000	
14. Boat launch signs						
15. Informational flyers						
16. Lake use study	\$12,000					
17. Keep lake outlet clear						
18. Annual lakeshore cleanup event						
19. Shoreline inventory						
20. Lakescaping assistance	tbd					
21. Goose control program						
22. Boat ramp landscaping						
23. South McCarrons lakescaping						
24. Plan administration		\$8,000	\$8,000	\$8,000	\$8,000	\$8,000
25. Monitoring, education and report		\$5,000	\$5,000	\$5,000	\$5,000	\$5,000
TOTALS	\$630,400	\$78,200	\$82,200	\$75,200	\$79,200	\$102,200

* Capital costs will be integrated into the annual program costs according to scheduling and funding priorities of the CRWD.

ACKNOWLEDGEMENTS

This management plan is product of the Advisory and Technical Groups. The City of Roseville recognized the value of Lake McCarrons in the 1970s and initiated the first studies of the lake and its watershed. These studies were made possible by funding and support from the U.S. Environmental Protection Agency and the MN Pollution Control Agency. As the implementation phase began in the mid-1980s, the Metropolitan Council provided monitoring and technical assistance. More recently, the University of MN St. Anthony Falls Lab conducted studies of Lake McCarrons.

Throughout this entire period, ongoing management has occurred. Many agencies have played important roles. They include the City of Roseville, the MN Department of Natural Resources, Ramsey County, the Ramsey Soil and Water Conservation District.

More recently, the Lake McCarrons Neighborhood Association participated in the development of a Strategic Management Plan for Lake McCarrons. An outcome of this effort called for the identification or creation of an 'entity' to coordinate the management of Lake McCarrons. That entity emerged with the creation of the Capitol Region Watershed District.

The past, present and future management of Lake McCarrons has been, is and will continue to be a highly coordinated and cooperative effort. This management plan will facilitate the total efforts of an inclusive array of individuals, agencies and organizations to fully realize the value of Lake McCarrons for our community.

The Board of Managers expresses our thanks and appreciation to all who have participated in the development of this plan and now will take up the challenge to improve Lake McCarrons.

CONTENTS

	<u>Page</u>
I Introduction	1
II Context for this Plan	2
Capitol Region Watershed District	2
Other Jurisdictions and Authorities	4
Lake McCarrons Neighborhood Association	7
Past Planning and Management Efforts	7
III State-of-the-Lake	11
The Lake	11
The Watershed	17
IV Development of the Lake McCarrons Management Plan	23
V Problems and Concerns	26
VI Management Goals & Objectives	30
Background - Vision, goals & Objectives	30
A Vision for the Management of Lake McCarrons	31
Management Goals & Objectives	31
VII Management Actions	37
Management Actions	37
Administration, Coordination & Oversight of the Management Plan	46
VIII Implementation Plan	47
Management Actions	47
Implementation Budget	52
IX References	53
X Glossary	55

Appendices

II-1	Goals & Policies of the Capitol Region Watershed District	57
II-2	City of Roseville - Shoreland, Wetland, and Storm Management Ordinance	66
II-3	City of Roseville - Surface Water Management Plan (1990)	68
II-4	City of Roseville - Nuisance Ordinance (Chapter 407)	70
II-5	Contact Information	76
IV-1	Advisory & Technical Group Rosters	79
VI-1	Background, explanation & justification for management actions to control or minimize summer algae blooms in Lake McCarrons	81
VI-2	MN DNR Fisheries - Lake Management Plan (June 21, 1999)	91
VII-1	Details of Barr (1999) Improvements to the Villa Park Ponds	92
VII-2	Summary of Urban Best Management Practices (Barr 2001)	95
VII-3	Outputs and Assumptions from the Watershed Treatment Model Applied to Lake McCarrons Subwatershed Nos. 2, 4 and 6	96
VII-4	Estimated Costs of Implementing Watershed-Wide BMPs	97
VII-5	Details of the Alum Application	98

Figures

II-1	Capitol Region Watershed District	3
III-1	Lake McCarrons Watershed, 1996	18
IV-1	Advisory Group	23
V-1	Nuisance Aquatic Plants in Lake McCarrons, May 1995	27
VI-1	Water Table Contours - Groundwater Flow to Lake McCarrons	83
VI-2	Lake McCarrons Watershed, Present Condition	89
VI-3	A Depiction of the 300-Foot Slow, No Wake Buffer on Lake McCarrons	35

Tables

III-1	Lake Quality Indicators and Lake Grades	12
III-2	Lake McCarrons TP, CLA, and SD from 1984 through 2001	13
III-3	Comparison of Water Quality Indices Before and After Implementation of the Villa Park Wetland Treatment System	13
III-4	Aquatic Plants in Lake McCarrons	15
III-5	Fish in Lake McCarrons	16
III-6	Fish Stocking in Lake McCarrons (1997 - 2000)	17
III-7	Land Use in Lake McCarrons Watershed, 1997	19
III-8	Timeline of Lake McCarrons Management Activities	20
III-9	Pollution Treatment Efficiency of the Villa Park Ponds	21
III-10	Annual Phosphorus Inputs to Lake McCarrons	22
VI-1	Historic and Contemporary Phosphorus Loads to Lake McCarrons	82
VI-2	Water and Phosphorus budgets for Lake McCarrons	84
VI-3	Estimated Lake Phosphorus Concentrations With and Without Internal Phosphorus	85
VI-4	Estimated Lake Phosphorus Concentrations Without Internal or External Phosphorus	86
VI-5	Estimated Lake Phosphorus Concentrations with Various Reductions in External Phosphorus and Without Internal Phosphorus.	87
VI-6	Reconciling Phosphorus Loads to Lake McCarrons	88

I. INTRODUCTION

Lake McCarrons is a small urban lake located in the southeast corner of Roseville. Those who visit the park and beach as well as lake area residents and neighbors enjoy the pleasant setting surrounding Lake McCarrons. However, like many other urban lakes, there are problems. While these problems are not unusual, atypical or severe, they do require attention.

The residents and neighbors around Lake McCarrons have been frustrated by the lack of results following intensive management efforts. The Villa Park Ponds were constructed in the mid-1980s for the purpose of cleaning the lake. This highly visible project has been touted as a model for urban stormwater management. Indeed, in its early phases, it removed pollution in impressive quantities. It has been discovered the system requires more maintenance than anticipated.

We also know now that the Villa Park Ponds alone - even at their optimal performance - will not solve Lake McCarrons' algae problems. Internal phosphorus sources must also be mitigated to reduce algae growth in the lake.

So, after almost two decades of intensive efforts, the condition of Lake McCarrons is unchanged.

There are other concerns too. Eurasian watermilfoil was discovered in 2000. Winterkill occurs about once every ten years. There are questions regarding whether the health of the lake will support a diverse fishery and wildlife. Is the use of the lake's surface appropriate for its size? Who is in charge of coordinating the management of this lake?

An earlier planning effort identified the need for an 'entity' to coordinate the management of Lake McCarrons. It was clear then, that until such an 'entity' could be identified, meaningful and comprehensive management efforts would be stalled. At that time, no one agency or organization could be identified. However, with the formation of the Capitol Region Watershed District, this 'entity' has stepped up.

The Capitol Region Watershed District is responsible for the development of this plan in recognition of the concerns and frustrations noted above. The District also has the motivation and resources to carry out meaningful planning and management actions in cooperation with other agencies and interest groups. The District has impaneled Advisory and Technical Groups and charged them with developing a management plan for Lake McCarrons for review by the public and the CRWD Board of Managers.

The Advisory and Technical Groups have taken on this challenge. Not only did numerous individuals and agency staff invest their time in this effort, they seized this opportunity to make this plan a model of cooperation. Thus, the results of their efforts will mean Lake McCarrons will have improved water quality and enhanced aesthetics for the public and land owners that enjoy the lake.

II. CONTEXT FOR THIS PLAN

Capitol Region Watershed District

The Capitol Region Watershed District (CRWD) was formed in 1998 to ‘protect, manage and improve the water resources’ in the District (see Figure II-1). Minnesota statutes and rules authorize the CRWD to manage land and water resources to develop and implement a comprehensive watershed plan (see CRWD 2000). The CRWD’s mission is: “To protect, manage and improve water resources of the Capitol Region Watershed District.” The vision of the District is to:

- Be a protector of our water resources
- Be stewards of the Mississippi River community to which we are a part
- Remember the Watershed District’s diverse population and economic status
- Develop cost-effective solutions to our water quality problems
- Protect and enhance our water resources for the enjoyment of all its users

The CRWD Plan contains goals and policies (Appendix II-1) to guide the planning and management of the District’s water resources. Two of the plan’s policies are particularly relevant to the development of a management plan for Lake McCarrons:

Action Policy WQUAL1a. Establish water quality standards for lakes and wetlands within the District that achieve desired levels of use. Evaluate information from previous work, including the Como Lake Restoration Project Diagnostic Feasibility Report (1982), the Lake McCarrons Strategic Management Plan (May 1996), and the District function and value assessment (1999), in a strategic planning process to identify the water quality standards.

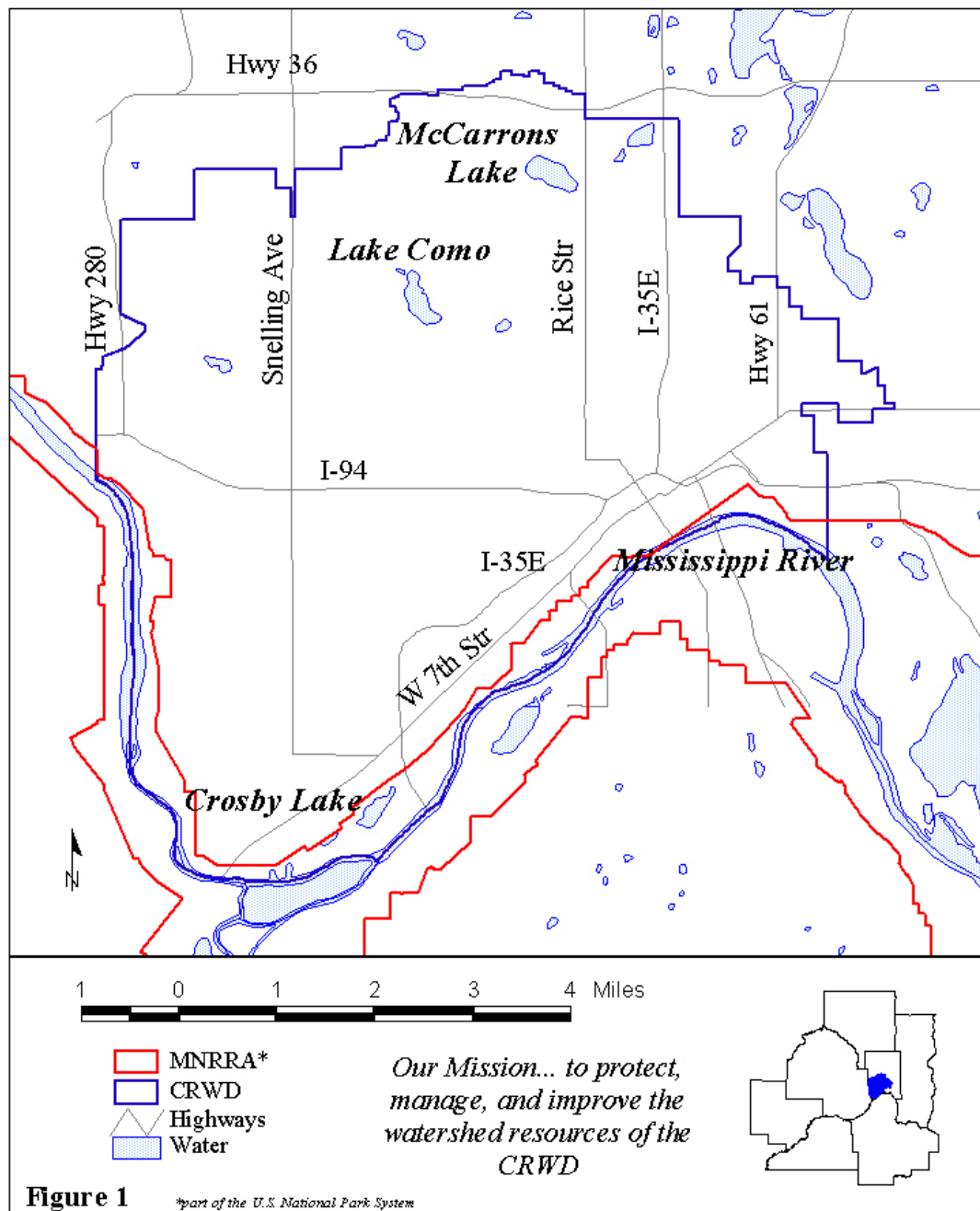
The ‘standards’ referred to in the above-stated action policy are not meant to imply regulatory standards, but rather refer to benchmarks or guidelines.

Action Policy WQUAL1b. Establish target pollutant loads for subwatersheds throughout the District which would achieve water quality standards and that can be adopted by member communities.

The CRWD has adopted an implementation plan that provides funding for the development of the Lake McCarrons Management Plan as well as future management actions recommended in the Lake McCarrons Management Plan.

Figure II-1
Capitol Region Watershed District.

Capitol Region Watershed District



Other Jurisdictions and Authorities

City of Roseville

Lake McCarrons and its tributary watershed are located wholly within the City of Roseville. Roseville regulates lands and waters through their Shoreland, Wetland, and Storm Management Ordinance, chapter 1016 (see Appendix II-2).

Roseville manages surface waters according to its Surface Water Management Plan (Appendix II-3). This plan was prepared in accordance with the Metropolitan Surface Water Management Act (M.S. 473.875 - 473.883) which directed local units of government to amend their local comprehensive plan in accordance with applicable watershed plans. Roseville's plan is now over ten years old and is to be updated in the near future, scheduled to be completed in February 2003. Nothing in the plan appears to conflict with the Lake McCarrons Management Plan (this plan). Of interest to Lake McCarrons, the five-year (1990 - 1994) capital improvement program provided for \$1,027,000 in projects specific to Lake McCarrons.

Roseville's Nuisance Ordinance (chapter 407) has relevance for Lake McCarrons because clutter and debris have been cited as problem areas requiring attention around the lake shore (Appendix II-4).

The Villa Park Ponds, the wetlands constructed to manage stormwater quality entering Lake McCarrons, are located in Villa Park. Roseville owns, operates and manages the park and ponds. The City prepared a natural resource inventory and management plan in 2002 for its park system, including Villa Park.

Roseville has an easement for the ponds at the Ramsey County Beach, located between the lake's outlet and Rice Street. Because these ponds are downstream from the lake, their operation is not critical for lake issues, except for making sure the outlet from the lake to the ponds remains free flowing. As a matter of practice, Ramsey County Park staff has been cleaning this structure on a daily basis during beach season.

Finally, Roseville regulates lake surface activities that are applicable to Lake McCarrons. In addition to applicable state-wide boating regulations, Roseville ordinance provisions (Chapter 702) that are applicable to Lake McCarrons include:

- Speed Limit: Motorboats are not to be operated at a speed greater than is reasonable and proper having due regard to safety of other boats and persons.
- Water-Skiing or Surfboarding: No motorboat shall be used for the purpose of water-skiing, surfboarding or other similar device, unless such operation is performed in a manner so that neither the boat nor the skier or surfboard rider come within 300 feet of the shoreline, docks, swimmers or other boats.
- No Wake Zone: No person shall operate a motorboat or be towed on water skis or similar device at greater than slow-no wake speed within 300 of shore. Launching or landing a skier by the most direct route to open water shall be exempt from this provision.

Ramsey County

Public Works

The Ramsey County Public Works (RCPW) Lake Management Program includes several activities related to Lake McCarrons. Each year, water transparency as measured by Secchi Depth and water quality sampling are completed from 6 to 8 times during the period May through September. Laboratory analyses include a variety of chemical and biological parameters including phosphorus and chlorophyll concentrations. Beach water quality is assessed from total and fecal coliform bacteria concentrations at monthly intervals in the period June through August. Aquatic plant populations are also surveyed periodically. Public Works staff installs a lake elevation staff gauge throughout the open-water period and take weekly lake level readings. Winter water level is measured by survey at least monthly. Public Works staff inspects and maintains the boat ramp. Public Works staff also administers a consultant contract for the annual chemical treatment of aquatic plants along the County park beach and shoreline.

Parks

Lake McCarrons County Park is a 15-acre park located on the east shore of Lake McCarrons. The park consists of approximately 900 feet of shoreline. In 1998, Ramsey County redeveloped the park to better accommodate traditional uses of swimming, boating and picnicking. A significant improvement was development of a stormwater ponding/wetland complex in the southeast portion of the park. This urban wetland was established in cooperation with the City of Roseville to accommodate stormwater within the park, as well as portions of South McCarrons Boulevard.

Recreational amenities within the park include a beach building (restrooms, changing rooms, lifeguard office), picnic shelter, handicapped-accessible play area, beach-front play area, fishing pier, sidewalks and a boat access with car/trailer parking.

Lake McCarrons County Park serves as a trailhead for the Trout Brook County Trail, which extends southeast from Lake McCarrons to the gateway segment of the Willard Munger State Trail. It also functions as a trailhead for the trails around Lake McCarrons and through Reservoir Woods.

Ramsey County also provides a shore fishing access located on South McCarrons Boulevard. A pedestrian stairway access is provided off the South McCarrons Boulevard trail. Street parking is available on adjacent roadways.

Ramsey County Parks has coordinated the annual goose roundup on Lake McCarrons. Increasing costs have raised the possibility this program may be curtailed in the future.

Sheriff

The Ramsey County Sheriff is responsible for enforcing the lake's surface use regulations and monitoring safety on Lake McCarrons.

Ramsey Soil and Water Conservation District

The Ramsey Soil and Water Conservation District (RSWCD) is a special purpose unit of local government established by State statute to assist private citizens and public agencies conserve natural resources. The RSWCD receives funding from the State, Ramsey County Board of Commissioners, and self generated funds. The RSWCD provides technical assistance, cost-share funding, and public policy development and direction for the conservation of Ramsey County's natural resources.

As it relates to the management of Lake McCarrons, the RSWCD can (at a minimum):

- Provide shoreline restoration technical assistance
- Provide technical assistance with "bio-infiltration" storm water management technologies
- Assist Roseville and CRWD with erosion and sediment control inspection and enforcement
- Assist the CRWD with BMP design and project management
- Provide groundwater protection assistance and technologies

Minnesota Department of Natural Resources

Several divisions within the DNR have various water management authorities. The division of fisheries and wildlife oversee the fisheries population assessments, stocking, any special fishing regulations and the aquatic nuisance control program. The ecological services division oversees the exotic species program, which includes the management and control of Eurasian watermilfoil and other exotic species not now in Lake McCarrons. The division of trails and waterways coordinates the state's public access program. The public boat launch on Lake McCarrons is owned and operated by Ramsey County Parks. Finally the waters division regulates the shoreland protection program. For Lake McCarrons, the City of Roseville has adopted a local shoreland ordinance that conforms to the states' criteria.

Minnesota Pollution Control Agency

The MPCA administers the federal Clean Water Act for the state. The phase I diagnostic-feasibility study, the phase II implementation grant and the phase III monitoring program - all section 314 of the Clean Water Act - have been administered by the MPCA. These monies were matched with various portions of local monies.

Metropolitan Council

The Metropolitan Council coordinates land use planning in the seven-county Twin Cities Metropolitan Area. The Council also operates the wastewater treatment, parks and open spaces, sports facilities and transit systems. The Metropolitan Council Environmental Services (MCES) division has conducted regional lake and watershed studies since 1980. MCES has also worked cooperatively with the City of Roseville and the Capitol Region Watershed District conducting intensive monitoring studies of Lake McCarrons and the Villa Park Ponds.

Who to Call for Further information and Assistance

There are many authorities and jurisdictions that have a role in the management of Lake McCarrons and its watershed. To help facilitate timely and effective communication among those agencies as well as by concerned citizens, contact information is provided (Appendix II-5)

Lake McCarrons Neighborhood Association

The Lake McCarrons Neighborhood Association (LMNA) is a non-profit corporation established about 10 years ago. The Association includes over 650 households and several business in a geographical area bordered by Highway 36, Dale Street, Larpenteur Avenue and Rice Street within the City of Roseville. Membership in the Association is not limited to Lake McCarrons lakeshore residents. The mission of the Association is "to promote a safe and healthy environment for the greater Lake McCarrons Community." Association objectives include, but are not limited to: Promoting Ecology, Neighborhood Safety, a Strong Sense of Community, Environmental Education and Awareness and Coordinating Efforts to Solve Neighborhood Issues. An 8-member Board of Directors provides leadership for the organization. Each year, four directors are elected by the membership for two year terms. Each Director represents one of four areas within the larger service area. Meetings are held four times each year. The fall meeting for the last two years has been a highly successful barbeque sponsored and funded by the Association for our entire service area.

Over the last ten years the Association has engaged the services of a wide variety of speakers on community and environmental issues and has been a cohesive and respected advocate voice to the City of Roseville and Ramsey County. The Association has a) learned about critters of many varieties, including pet control policies, b) provided input on water quality and recreational issues, and c) reviewed a wide variety of civic issues. The Association has mediated conflicts, consulted on the City of Roseville pathway around Lake McCarrons and been a prime advocate of the City of Roseville's acquisition of the Reservoir Woods site. The Association has painted street sewers with pollution warnings, conducted neighborhood clean-ups and negotiated sound environmental and safety practices for the St Paul Winter Carnival annual softball tournament. Most importantly, the Association has planted seeds of friendship within our community, encouraging the making of new friends and the re-connecting of some of the vintage variety.

Past Planning and Management Efforts

Several planning and implementation projects involving Lake McCarrons and its watershed have occurred over the past two or three decades. The more significant projects, in terms of scope and scale, are described below. Other smaller scale management activities have occurred over the same period; and these are listed in bullet form at the end of this section.

Diagnostic-Feasibility Study - Phase I (Roseville)

The City of Roseville was awarded a '314' grant to conduct a diagnostic-feasibility study (phase I) of Lake McCarrons. This study was conducted in late-1980 through 1981 and the final report was completed in

late-1982 (Donohue & Associates 1983). The report made these recommendations for the management of Lake McCarrons:

- Rehabilitate a filled wetland adjacent to the lake and construct a detention basin followed by six small wetland chambers (now known as the Villa Park Wetland Treatment System).
- Install two stormwater sumps for sediment removal in steep residential areas.
- A whole-lake alum treatment to remove phosphorus from the lake water and provide a bottom seal.
- Encourage public participation and education, especially regarding housekeeping measures throughout the watershed.

Lake McCarrons Wetland Treatment System - Phase II

(Roseville & Metropolitan Council)

The City of Roseville was awarded a '314' grant (phase II) in 1984 to implement the recommendations from the phase I study. Construction began on this project in April 1985 and was completed in November 1986. The recommended alum application was not implemented. The Metropolitan Council performed the monitoring associated with this project and prepared the final report (Oberts and Osgood 1988).

Lake McCarrons Strategic Management Plan

(Lake McCarrons Neighborhood Association, Ramsey County & ECOSYSTEM STRATEGIES)

The Lake McCarrons Strategic Management Plan (Osgood 1996) was a short-term effort to develop management goals for Lake McCarrons. It was envisioned that the plan would be a 'first step' in the ongoing management of Lake McCarrons. A stakeholder group involving citizens, businesses and governmental agencies found the condition of Lake McCarrons to be unacceptable in these ways:

- The level of phosphorus in the lake is too high
- The amount of aquatic plant growth is excessive
- The occurrence of 'green blobs' is a nuisance
- Occasional winterkills were affecting the fish and DNR's stocking program

The stakeholders also recognized there was no one entity or authority responsible for coordinating the management of Lake McCarrons and its watershed.

To address these concerns, these strategies were identified:

1. Reduce lake phosphorus concentrations to levels no greater than 35 ppb
2. Develop an aquatic plant management plan
3. Mitigate winterkills by artificially oxygenating the lake water
4. Identify or create an entity to coordinate the management of the lake and its watershed

No formal actions were taken in response to these strategies.

Lake McCarrons Wetland Treatment System - Phase III

(Roseville and Metropolitan Council)

The City of Roseville was awarded a '314' grant (phase III) in 1994 to perform follow-up monitoring of the implementation activities (MCES 1997). This study noted degradation of the Villa Park Wetland Treatment System and a reduction in its treatment efficiencies. These recommendations were included in the report:

- Re-establish the original configuration of the wetland chambers and remove the phosphorus-saturated soils.
- Install permanent floatable skimmers or baffle weirs at the pond outlet.
- Replace the lattice material under the footbridge and stabilize the channel that enters the sedimentation basin from the west.
- Consider lake treatments that include alum application to the lake or its inflow, rerouting the inflow to below the thermocline, and whole- or partial-lake mixing.

The Phase III monitoring also included an extensive system of thermal (temperature) monitoring to evaluate whether the inflow from the Villa Park Wetland actually plunged below the thermocline in the lake, as had been supposed in the earlier study (Oberts and Osgood 1988). The results demonstrated that this phenomenon actually occurred. This thermal effect is different than the concerns discussed by the Technical Group during the development of this plan. The technical Group's concerns related to the possibility that the increases in impervious surfaces disrupted subsurface flows to Lake McCarrons, which because groundwater is cooler, may have resulted in the warming of the lake.

Studies of Soil Phosphorus Saturation and Vegetation Harvesting Feasibility for the Lake McCarrons Wetland Treatment System

(Barr Engineering Company for Roseville and Metropolitan Council)

This study was undertaken to examine the possibility that saturation of phosphorus sorption sites had occurred on wetland soils and to assess what remedial measures could be undertaken to improve the treatment system's pollutant removal effectiveness, including the feasibility of improving pollutant removal through an annual program of aquatic plant harvesting. The following conclusions and recommendations were included in the report:

- Results of controlled laboratory experimentation on intact sediment cores collected from the Lake McCarrons wetland treatment system showed phosphorus adsorption sites on wetland soils were not saturated
- The decline in runoff pollutant removal efficiencies was the result of reduced contact time between runoff and wetland soils due to short-circuiting of flows through the wetlands
- Vegetation harvesting in the wetlands was determined to be infeasible and unlikely to improve overall runoff pollutant removal by the wetlands

- Pipes connecting wetland treatment cells should be removed, and the berms separating the cells should be reworked and augmented with permeable timber weirs whose overflow elevations are fixed and stabilized to reduce channelization and increase hydraulic residence time
- Construct energy-dissipating baffles in front of the pipes inletting flows to wetland Cells 3 and 4
- Examine the possibility that recently-noted export of dissolved phosphorus from the treatment system may be related to biochemical release from occasionally anoxic sediments in the outlet wetland cell and consider bypassing this cell or alum treatment of anoxic sediments

Other Management Activities

Other management activities involving Lake McCarrons and its watershed are listed here:

- Ongoing water quality monitoring, 1984 to present (Ramsey County, Metropolitan Council)
- Fisheries assessments, stocking and other projects (MN DNR)
- Simulation water quality and primary productivity strategies (UM Hydraulic Lab)
- Inflow dynamics and potential water quality improvement (UM Hydraulic Lab)
- Dredging of the Villa Park Sedimentation Basin, 1993 (Roseville)

III. STATE-OF-THE-LAKE

The assessment of the state-of-the-lake is intended to provide a point of departure for further evaluation of management goals, objectives and action alternatives. This analysis provided to the Advisory Group has been amended and updated here to reflect their concerns, provide clarification or additional technical details.

The Lake

Lake McCarrons is a small, urban lake located in Roseville, Minnesota. Lake McCarrons is surrounded by single-family residences and a County Park on the east end. The lake has one main inlet and one outlet.

The Basin

Lake McCarrons has a surface area of 81 acres and a maximum depth of 57 feet - small and deep by metro norms. The lake has a distinct thermocline at 10 to 12 feet, which separates an upper, mixing layer of water from a cold, stagnant layer. Sometimes Lake McCarrons does not turn over in the fall.

Water Quality

Lake McCarrons is eutrophic. Eutrophication is a process by which lakes become enriched with nutrients – usually phosphorus – that causes increased amounts of algae, more frequent algae blooms, depleted oxygen in the lake's bottom waters and often an increase in rooted plants. Eutrophication is often a concern, especially when a lake becomes enriched over a short time or when a lake's condition is markedly poorer than that of surrounding lakes.

In the extreme, highly eutrophic lakes become filled and are plagued by persistent algae blooms, abundant aquatic plants and unhealthy fish communities – all of which diminish the recreational use and environmental health of a lake. The condition of Lake McCarrons is not at this extreme end of the eutrophication spectrum.

Several indicators are normally used to assess eutrophication and its unpleasant manifestations. They are:

<u>Indicator</u>	<u>Significance</u>
Phosphorus	Phosphorus is considered the limiting nutrient in lakes. This means it is the element (in the lake water) in shortest supply relative to the growth needs of algae. Phosphorus is measured from lake water collected at the middle of the lake.
Algae	Algae are microscopic plants that float in lake water. Algae become nuisances when they become abundant. A particular kind of algae – blue-green algae – are a particular nuisance because they form scums. All algae become more abundant as the level of phosphorus in the water increases. The abundance of algae is determined by measuring <i>chlorophyll</i> – a green pigment – in lake water.

Clarity The transparency of lake water is easily observable. As the amount of algae increases, the water clarity decreases. Clarity is measured using a *Secchi disk*, an 8-inch white or black-and-white disk lowered over the side of a boat until it disappears.

Lakes are affected by other factors too. Many kinds of chemicals and sediments may enter lakes through runoff, seepage, rainfall or air deposition. Other activities and events, such as artificial alterations, manipulation of plants and animals, exotic species introductions, may lead to undesirable results, at which point they may be referred to as *pollution*.

As phosphorus in lake water increases, so does:

- The abundance of algae and the frequency of algae blooms
- The predominance of blue-green algae
- A reduction in water clarity
- The depletion of oxygen below the thermocline

The three water quality indicators – phosphorus, chlorophyll and Secchi disk – are related to perceptions of lake condition. Lakes may be classified, or graded, accordingly. For metro lakes, a grading system has been developed (Osgood 1989) based on the three water quality indicators (Table III-1):

Table III-1
Lake Quality Indicators and Lake Grades (from Osgood 1989).

TP	CLA	SD	Percentile	Grade	Perceived Condition
<23	<10	>10	<10	A	Crystal clear, beautiful
23-32	10-20	7-10	10-30	B	Little algae, minor problems
32-68	20-48	4-7	30-70	C	Definite algae, impaired use
68-152	48-77	2-4	70-90	D	High algae, un-enjoyable
>152	>77	<2	>90	F	Severe algae, enjoyment impossible

TP = total phosphorus (parts per billion or ppb); CLA = chlorophyll (ppb); SD = Secchi disk transparency (feet).

Percentile is a ranking of metro lakes, like a grading curve.

Grade is a letter assignment (not meant to indicate 'passing' or 'failing').

Perceived condition is based on user perceptions.

Lake McCarrons water quality indicators (TP, CLA and SD), based on data collected since 1984, are as follows (Table III-2):

Table III-2
Lake McCarrons TP, CLA and SD from 1984 through 2001.

	'84	'85	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01
TP	38	34	28	46	61	34	--	47	--	35	36	69	85	--	--	47	45	33
	--	--	--	--	81	32	49	47	25	44	37	50	37	49	29	37	38	31
CLA	20	16	14	26	30	17	18	30	--	15	13	28	16	--	--	19	29	19
	--	--	--	--	16	12	15	15	7	9	10	23	11	13	16	9	17	14
SD	7.5	6.9	9.2	5.9	4.6	5.9	10.2	4.9	--	6.9	7.5	5.9	5.6	--	--	5.9	7.2	10.2
	--	--	--	--	3.6	5.9	8.6	6.2	8.9	9.2	10.2	7.5	8.9	7.5	6.9	8.2	7.2	10.8

Data from Metropolitan Council studies (upper numbers) and Ramsey County studies (lower numbers)

For reference, the Villa Park wetland treatment system became operational in 1987. Thus, we can compare the lake's quality before and after the Villa Park wetland treatment system (Table III-3):

Table III-3
Comparison of Water Quality Indicators Before and After
Implementation of the Villa Park Wetland Treatment System.

<u>Indicator</u>	<u>1984-1986 Average (Range)</u>	<u>1987-2001 Average (Range)</u>
TP (ppb)	33 (28 – 38) No data	49 (33 – 85) 42 (25 – 81)
CLA (ppb)	17 (14 – 20) No data	22 (13 – 30) 13 (7 – 23)
SD (feet)	7.9 (6.9 – 9.2) No data	6.7 (4.6 – 10.2) 7.9 (3.6 – 10.8)

Data from Metropolitan Council studies (upper numbers) and Ramsey County studies (lower numbers)

Because the number of samples per summer, the timing of sample collection, and the field and lab methods used by the Metropolitan Council and Ramsey County do not correspond exactly, it is normal to see variability in these water quality indicators.

Lake McCarrons quality appears to be slightly poorer after the implementation of the Villa Pond wetland treatment system, graded B-C (before) compared to C (after), however, this is not a significant difference.

The MN Pollution Control Agency and the Science Museum of MN have analyzed sediment cores from Lake McCarrons to evaluate long-term changes or trends in certain water quality indicators (Heiskary and Swain 2002). Their preliminary evaluation has indicated that Lake McCarrons was probably much cleaner in pre-settlement times. Specifically, their data indicate that the lake's phosphorus concentration has doubled sometime between the years 1800 and 1970. Their data also show a higher and increasing level of chlorides. The phosphorus increase noted for Lake McCarrons is not unusual for metro lakes, however, the chloride concentrations in Lake McCarrons are high.

Dissolved Oxygen & Fish Kills

Because Lake McCarrons surface area is small and the lake is deep, it stratifies very early in the season. This means the thermocline, which separates a warm upper layer from a cold lower layer, develops very early in the season. The warmer upper layer actually floats on the lower cooler layer and the two do not mix throughout the season. As algae and other organic materials settle from the surface through the thermocline, it is decomposed by microbes, thereby using dissolved oxygen. As a result of this decomposition, the oxygen is depleted below the thermocline very early in the season.

The oxygen-poor lower waters prevent fish, which require oxygen, from inhabiting these areas. This is not problematic in the summer as the fish can live in the upper, oxygen-rich waters. However, during some winters, the oxygen in Lake McCarrons becomes totally depleted and the fish die. This is referred to as a *fish kill* or when only some of the fish die, a *partial fish kill*.

Fish kills occur when certain conditions occur, including an incomplete autumn lake mixing, an early freeze and heavy snow cover. In these conditions, Lake McCarrons begins the winter without having its oxygen replenished by the autumn turnover and loses the remaining oxygen quickly because snow cover prevents sunlight from getting into the water. Fish kills occur about once per decade in Lake McCarrons.

Aquatic Plants

Aquatic plant inventories for Lake McCarrons have been conducted only a few times in the past. Most recently, a 'broad-brush' inventory was conducted shortly after the discovery of Eurasian watermilfoil. A summary of historic submerged aquatic plant inventories follows (July 1993 from DNR fish survey; June & August 1996 from Metro Council; Sept. 2000 from DNR Exotic Species Crew):

Table III-4
Aquatic Plants in Lake McCarrons.

Species	1993	1996	2000
Coontail (<i>Ceratophyllum demersum</i>)	A	P	O
Northern watermilfoil (<i>Myriophyllum sibiricum</i>)	C	P	A
Eurasian watermilfoil (<i>Myriophyllum spicatum</i>)	--	--	C
Flatstem pondweed (<i>Potamogeton zosteriformis</i>)	C	P	--
Curlyleaf pondweed* (<i>Potamogeton crispus</i>)	R	P	R
Narrowleaf pondweed (<i>Potamogeton</i> spp.)	R	--	--
Sago pondweed (<i>Potamogeton pectinatus</i>)	--	P	R
Claspingleaf pondweed (<i>Potamogeton richardsonii</i>)	--	P	C
Robbin's pondweed (<i>Potamogeton robbinsii</i>)	--	P	--
Canadian waterweed (<i>Elodea canadensis</i>)	R	P	--
Wild celery (<i>Vallisneria americana</i>)	--	--	O
Chara (Muskgrass) (<i>Chara</i> spp.)	--	P	--

A=Abundant, C=Common, O=Occasional, R=Rare, P=Present

* Curly-leaf pondweed senesces (dies back) by early-July

Fish

The most recent fisheries survey was conducted in June 1998. The DNR assessments evaluate the fishes' numbers and weight compared to norms for similar lakes. The results of the June 1998 survey are summarized below (gamefish):

Table III-5
Fish in Lake McCarrons.

Species	Number*	Weight*
Black crappie	average	below average
Bluegill	average	average
Green sunfish	above average	below average
Hybrid sunfish	n/a	n/a
Northern pike	below average	above average
Pumpkinseed sunfish	above average	below average
Walleye	average	above average
White sucker	average	below average
Yellow bullhead	below average	average/above
Yellow perch	well above average	below average

* The numbers and weights are comparisons to the numbers and weights of fish found in similar lakes in the region.

Common carp are known to be present in Lake McCarrons. Their omission from Table III-5 means carp were not captured in the test nets and their population is low, despite the fact carp are commonly observed in the lake, especially during their spawning activity.

The DNR also stocks fish into Lake McCarrons. The stocking record for the years 1997 – 2000 is as follows (Table III-6):

Table III-6
Fish Stocking in Lake McCarrons, 1997 - 2000.

Year	Species	Number stocked
1997	Walleye	75,000
1998	Walleye	75,000
1999	Walleye	75,000
2000	Walleye	175,000

According to the DNR's report, the status of the fishery (as of June 1998) is:

Yellow perch were the most abundant species captured – well above average for this lake class. However, very few were over 6.5 inches long, and the average length was only 6.2 inches. Black crappie are also abundant but small. Lengths ranged from 5.1 to 9.3 inches, with a 5.9 inch average. Bluegill are moderately abundant with a respectable size structure. Lengths ranged from 3.7 to 7.6 inches with 6.0 inch average. Three walleye were captured, which is a little below average for this lake class. These were large – 21 to 25 inches. One 27 inch pike was captured. Electrofishing was not conducted so largemouth bass were (not) sampled, but are present in the lake. No tiger muskies were captured either, but may still be present from stocking conducted in the 1980's. Other species captured were pumpkinseed, hybrid sunfish, green sunfish, golden shiner, white sucker, and yellow bullhead.

The Watershed

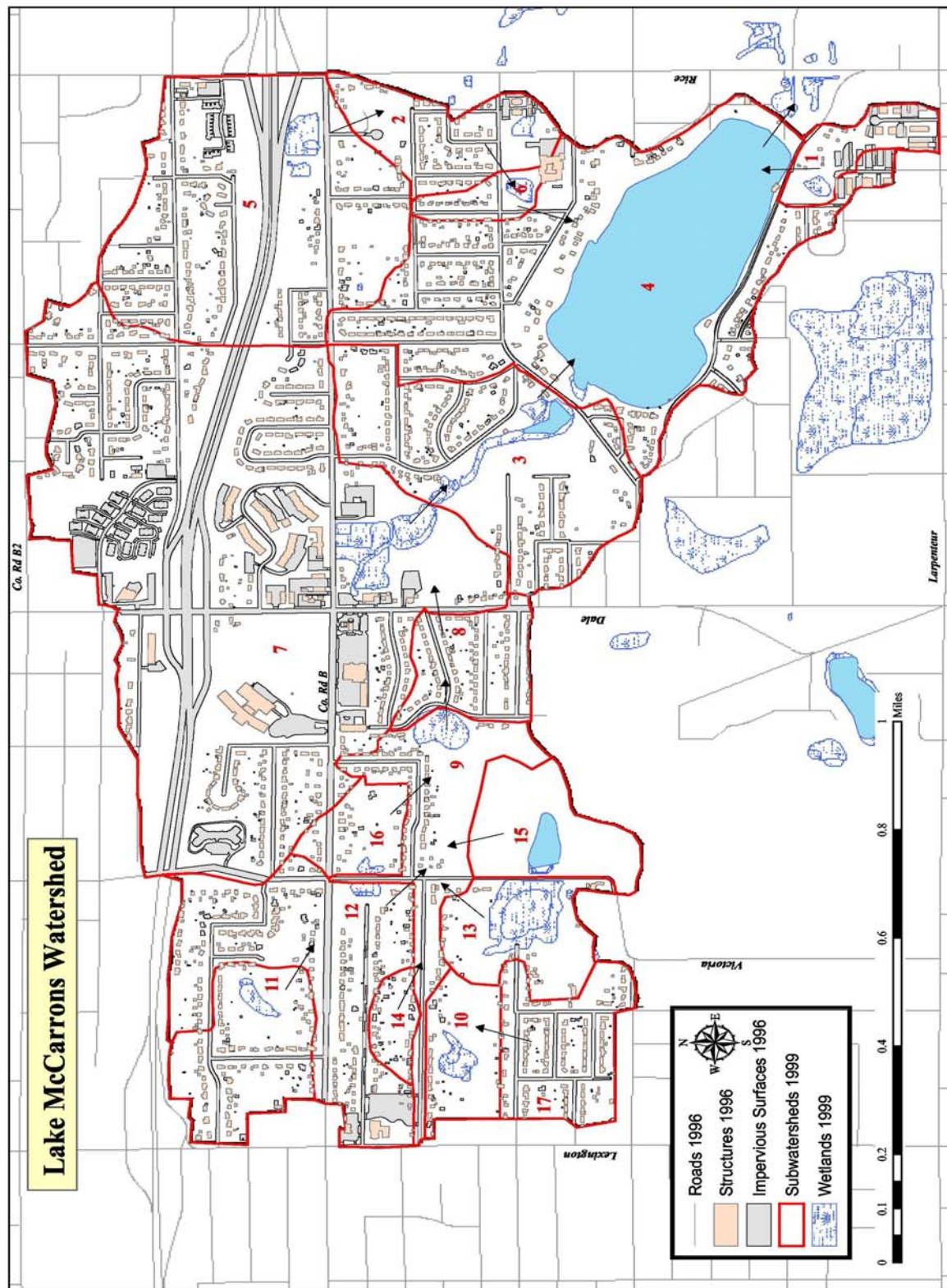
Lake McCarrons' watershed refers to the area that collects and contributes runoff to the lake. It is normal that as lands around a lake become urbanized, water runoff systems are altered in ways that increase the amount of runoff, the amount of pollution carried in the runoff and the land area contributing runoff. As well, the increase in hard surface usually results in robbing water that infiltrates to the groundwater.

No historical analysis has been conducted for the Lake McCarrons watershed. A good deal of contemporary analysis, on the other hand, has been conducted. The map below depicts Lake McCarrons watershed.

Figure III-1

Lake McCarrons Watershed, 1996 (Next page).

Subwatersheds are indicated. Subwatershed #4 refers to the area immediately adjacent to the lake.



Watershed and Land Use

The watershed area for Lake McCarrons was 736 acres in 1997. The land use is broken down accordingly (Table III-7):

Table III-7
Land Use in Lake McCarrons Watershed, 1997.

Land Use	Acres	Percent
Low density residential	83	11
Medium density residential	326	44
Multi-family residential	35	5
Commercial	27	4
Public	16	2
Open water	5	1
Wetland	16	2
Grassland	109	15
Woodland	82	11
Highway	37	5
TOTAL	736	100

Villa Park Wetland Treatment System

The Villa Park Wetland Treatment System is a series of ponds and wetlands constructed in the mid-1980s to treat runoff before it enters Lake McCarrons. Prior to construction of this system, runoff was routed directly through this area through a channel and no ponding or wetland contact occurred. A timeline (from MCES 1997) of activities leading to this project, its construction and modification is in Table III-8.

The Villa Park Wetland Treatment System is a series of constructed ponds and wetlands separated by berms (small dams) that finally empty into a terminal wetland with an outlet control that keeps water levels in the terminal wetland high to facilitate water contact with the wetland. The first pond in the series was dredged to an area of about 2.4 acres and has three inlets. This pond empties into a series of five wetland cells, which then empty into the terminal wetland. The terminal wetland also received input from the 'hockey rink detention pond,' which was constructed after the Phase II monitoring and before the Phase III monitoring.

Several intentional modifications to the ponds and a 100-acre addition to the tributary area have occurred since its original construction. In addition, much of the baseflow runoff is has become 'channelized,' meaning some of the flow through the ponds may be short-circuited. These factors may have accounted for the decreased phosphorus removal efficiencies (MCES 1997).

Table III-8
Timeline of Lake McCarrons Management Activities.

Date	Activity/Event
June 1977	Roseville applies for federal funds to improve Lake McCarrons
July 1980	EPA awards grant to conduct a diagnostic-feasibility study (Phase I)
Late-1982	Diagnostic-feasibility study completed
June 1984	EPA implementation grant (Phase II) received
Feb. 1985	Construction grant awarded
April 1985	Construction begins
Nov. 1985	Wetland/pond system construction completed
April 1986	Heavy rains and snowmelt damages system – not functional
Sept. 1986	System nearly restored, monitoring begins
Nov. 1986	Construction repair completed
June 1988	Phase II monitoring completed
Jan. 1993	Detention pond dredged to original configuration
Sept. 1994	Phase III monitoring grant awarded
March 1995	Water sampling begins
Nov. 1996	Water sampling (Phase III) ends

The Villa Park pond system was originally considered experimental because detention pond(s) and a constructed wetland were used in combination. For this reason, intensive monitoring was conducted before the construction of the ponds (Phase II, Oberts and Osgood 1988) and after (Phase III, MCES 1997).

The efficiency of this system in removing different kinds of pollution is important. The Phase III monitoring found that the overall treatment efficiency¹ had diminished between the Phase II monitoring (9/86 – 5/88) and Phase III monitoring (3/95 – 11/96):

¹ Treatment efficiency refers to the percentage of pollution removed as water passes through the pond/wetland system. Efficiency is calculated as the difference between the amount of pollution that enters the system and the amount that leaves, expressed as a percentage.

Table III-9
Pollution Treatment Efficiency of the Villa Park Ponds.

Pollutant	Phase II Efficiency	Phase III Efficiency
Suspended solids (sediments)	96%	66%
Total phosphorus	70%	4%
Dissolved phosphorus	45%	23%
Total nitrogen	58%	33%
Total lead	93%	--
Total zinc	--	38%

Based on their study (MCES 1997), Metropolitan Council Environmental Services staff made these recommendations:

- Continued dredging of the detention ponds
- Berms should be repaired or replaced
- Various inlet culverts should be restructured
- Re-establishing the original configuration of the wetland chambers and removing enriched soils
- Install permanent floatable skimmers
- Replacement of lattice material under footbridge
- Implement a public education program focusing on yard habits and household wastes
- Consider possible in-lake remediation measures

Sources of Phosphorus

Phosphorus enters lakes from several sources: rainfall and windblown, from internal recycling, from surface runoff, and from groundwater seepage. The measurement of phosphorus in runoff has been the subject of several intensive studies and accounts for the majority of all phosphorus entering Lake McCarrons.

The water quality studies have measured phosphorus in runoff, but have not specifically identified the exact source of phosphorus. Typically, phosphorus occurs naturally as part of living matter. As this material cycles and decomposes, phosphorus is released in mineral form or as attached to particles. In addition to the natural forms, phosphorus is intentionally added, most commonly in the form of lawn fertilizers. The water cycle facilitates the movement of phosphorus in all forms from all sources.

The phosphorus that has been measured in stormwater runoff enters the lake in two forms: total phosphorus (TP) and dissolved phosphorus (DP). Total phosphorus is a measure of phosphorus in all forms and dissolved phosphorus is a measure of that fraction that is dissolved in the runoff water as opposed to the fraction that is attached to particles. It is considered that the dissolved phosphorus is more readily available for use by algae.

Based on the previous studies, the annual amounts of phosphorus entering Lake McCarrons from surface runoff (all sources) are (Table III-10):

Table III-10
Annual Phosphorus Inputs to Lake McCarrons.

Year	TP	DP
Pre wetland/pond system		
1984	1,100 lbs.	218 lbs.
1985	803 lbs.	180 lbs.
1986	933 lbs.	209 lbs.
Post wetland/pond system		
1987	381 lbs.	108 lbs.
1995	458 lbs.	132 lbs.
1996	299 lbs.	106 lbs.

By comparing the phosphorus inputs to Lake McCarrons pre- and post-wetland/pond system, a 60% and 43% reduction in TP and DP (respectively) is noted (based on the values presented above).

Other sources of phosphorus to Lake McCarrons have been estimated and are small in comparison to the phosphorus in surface runoff. For example, atmospheric phosphorus (in rain and windblown) is about 15 pounds per year and phosphorus from aquatic plant decay is about 33 pounds per year. Other internal phosphorus sources are important, especially as they affect summer surface phosphorus concentrations in the lake. The Technical Group will help to better characterize all phosphorus sources. Groundwater phosphorus sources have not been estimated as part of the previous studies, but are probably small.

It is clear from these studies that the water quality of Lake McCarrons has not improved following the implementation of the wetland/pond system in 1987. Based on contemporary studies, it appears the Villa Park Ponds can be modified to improve their pollution treatment capabilities. In addition to the modifications to the ponds, internal phosphorus recirculation will need to be addressed if water quality improvements are to occur.

IV. DEVELOPMENT OF THE LAKE MCCARRONS MANAGEMENT PLAN

Dick Osgood of THE OSGOOD GROUP with the assistance of Greg Wilson of BARR ENGINEERING, facilitated an Advisory Group and a Technical Group (see Appendix IV-1) to develop this management plan. The charge to the Advisory Group was to:

Serve as a ‘sounding board’ and provide input to a) understand the breadth of problems and concerns experienced by lake users, b) develop management goals and objectives, c) explore alternative feasible management approaches and d) draft a plan to present to the CRWD Board for adoption.

The Advisory Group decided early on that the management plan for Lake McCarrons should encompass more than strictly water quality management. While very important, other issues were important too. Thus, the Advisory Group agreed that any issue or concern affecting the use and enjoyment of Lake McCarrons should be included in this plan.

The Advisory Group was assisted by a Technical Group, composed of people from agencies and municipalities, who were familiar with Lake McCarrons as well as technical and regulatory matters. The Technical Group provided technical oversight to assure the management plan stayed on track and was technically credible.

Figure IV-1
Advisory Group



The respective Groups held a series of meetings between January and June 2002 with these agenda topics:

Advisory Group

Meeting #1	General Overview	January 22
Meeting #2	Review & Evaluate Water Data	February 26
Meeting #3	Management Concerns	March 20
Meeting #4	Management Goals & Objectives	April 16
Meeting #5	Implementation Activities	May 15
Meeting #6	Evaluate Citizen & Agency Roles	May 30
Meeting #7	Review Report Draft	June 18

Technical Group

Meeting #1	Review Technical Reports	January 24
Meeting #2	Management Goals & Objectives	April 2
Meeting #3	Review Management Actions	April 22

Project Work Plan

The work plan for this project included these tasks:

- **Facilitate the Organization & Operation of the Advisory Group.**

Develop a roster of Advisory Group and Technical Group members. All interested persons and groups were identified and invited to participate in the Advisory and Technical Groups. Those people representing lake residents, lake and park user groups, conservation groups or other citizens formed the Advisory Group. Those individuals with technical expertise or regulatory authorities representing management, municipal or regulatory agencies formed the Technical Group.

Osgood worked with Project staff to organize separate Advisory and Technical Groups who played key roles in developing the strategic management plan. Osgood assisted with the identification, recruitment and invitation of members for the respective Groups.

Plan and facilitate Advisory Group meetings. Osgood planned and facilitated all Advisory Group meetings. This responsibility included working with Project staff and Advisory Group members developing agenda, preparing meeting materials, facilitating meetings and preparing minutes. Seven Advisory Committee meetings were planned, each designed to accomplish the main project work elements.

Plan and facilitate Technical Group meetings. Osgood and the Barr team planned and facilitated all Technical Group meetings. This responsibility included working with Project staff and Technical Group members developing agenda, preparing meeting materials, facilitating meetings and preparing reports to the Advisory Committee. Three Technical Committee meetings were planned.

The agenda for the Technical Group meetings were designed to complement and support the work of the Advisory Group.

In addition to participating in the formal Technical Group meetings, each member of the Technical Group received the same information (packets, agenda, minutes, etc.) as the Advisory Group members so they had the chance to keep abreast of the Advisory Group's deliberations. The Advisory Group could also refer technical concerns to the Technical Group for their input.

- **Review Watershed and Water Quality Information**

Osgood and the Barr team assembled, evaluated and summarized all available watershed and water quality data. This information was presented in a comprehensive, highly readable, technically credible, concise report to the Advisory Group (see Chapter III, STATE-OF-THE-LAKE). The purpose of this report was to give the Advisory Group an objective point of departure for their deliberations. A draft of this report was reviewed by the Technical Group at their first meeting then forwarded to the Advisory Group for their second meeting.

- **Identify Management Priorities**

Multiple lake management concerns for Lake McCarrons were identified. These concerns include water quality improvement, nuisance aquatic plant control, Eurasian watermilfoil, fisheries, recreational use, winterkill, wetland system operation and coordination among jurisdictions.

- **Identify Management Goals and Objectives**

Osgood and the Barr team drafted preliminary management goals and objectives based on the outcome of Advisory Group meeting #3. This document was reviewed by the Technical Group (meeting #2), then forwarded to the Advisory Group to initiate their deliberations (meeting #4).

- **Enumerate Implementation Activities**

Osgood and the Barr team developed a list of implementation activities that support the management goals and objectives identified by the Advisory Group (meeting #4). This list was reviewed by the Technical Group to assure the implementation activities were feasible and addressed the management objectives (meeting #3). The list was forwarded to the Advisory Group for their deliberations (meeting #5). The Advisory Group's task was to agree upon appropriate implementation actions.

- **Evaluate Citizen and Agency Roles**

Osgood facilitated an evaluation of the kinds of partnerships or agreements that made most sense for the implementation actions being considered by the Advisory Group. The Advisory Group discussed and agreed upon specific roles for citizens and agencies to implement the management plan for the long run.

- **Prepare Final Report**

Osgood prepared a draft final report for the Advisory Group's review (meeting #7), then prepared a final report based on their input.

V. PROBLEMS & CONCERNS

The Advisory Group identified several problems and areas of concern with respect to the quality and conditions of Lake McCarrons. These problems and concerns form the basis for the development of management goals and objectives (in VI. MANAGEMENT GOALS & OBJECTIVES), which in turn form the basis for specific management actions (in VII. MANAGEMENT ACTIONS).

As the Advisory Group considered problems and concerns, they distinguished between concerns relative to the lake's quality or condition (or lack of) versus concerns they may have relative to management strategies or methods.

The Advisory Group did not limit their considerations to strictly water quality concerns, but rather they identified any concern they had relative to the appearance, aesthetic enjoyment, environmental quality and overall condition of the lake and its nearshore environs. In this vein, lake surface use for example is relevant to the management of the lake and therefore to this management plan (see Osgood 2000).

The concerns identified by the Advisory Group have not been assigned any priority rankings.

A. Lake Quality / Lake Health

1. Excessive Algae. Algae growth in Lake McCarrons is seasonal, tending to be most problematic later in the summer. During these times, algae blooms, as indicated by visible 'clumps' and surface scums, are undesirable. It is desirable that swimmers be 'algae-free' when they get out of the water. It was also noted that excess algae smells.

As to the question regarding how much algae growth should be reduced, the group wanted to balance the costs for controls with the benefits. There was discussion regarding what might be the norm for Lake McCarrons and what might be reasonable. Lake McCarrons is now graded a 'C' as described in the State-of-the-Lake (Chapter III), which means it is about average compared to other metro lakes. As to what might be a reasonable goal for reducing algae in the lake, we discussed the likelihood that Lake McCarrons was probably cleaner in the past, say at least 30 or 40 years ago, and that condition would be a reasonable goal.

The group also discussed that there may be circumstances where there could be too little algae. As there is also a concern with nuisance rooted aquatic plants (see below), there could be a point where clear water may lead to an undesirable proliferation of nuisance plants. It was agreed that this concern should not limit actions to reduce excessive algae. It was further agreed that an interim goal might be a workable solution. In this scenario, an algae reduction goal between its present condition and what is reasonably attainable would be sought, then once attained, a re-examination of the lake's condition could be done to see if rooted plants are more problematic as a result of less algae.

2. Fish. A diversity of game fish in Lake McCarrons is desirable. The Group felt the size of largemouth bass had decreased. In this vein, the Group discussed the fact that fish populations normally fluctuate. The Group felt other desirable game fish, such as sunfish and crappies, were very consistently small. Carp are also identified by the Advisory Group as being problematic, but the Technical Group pointed out that carp in Lake McCarrons were found in numbers lower than average.

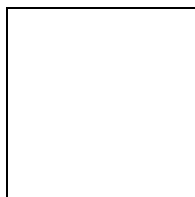
Winterkill was identified as a problem, but the Group also recognized that to some extent, this is a natural phenomenon in Lake McCarrons.

There was awareness that the edibility of fish is an issue in Minnesota lakes, but the Advisory Group did not think this was an immediate management concern for Lake McCarrons. Fish from Lake McCarrons have not been tested. Those with specific concerns about tainted fish can refer to the MN Department of Health's web site for consumption guidelines (see Appendix II-5).

3. Nuisance Aquatic Plants. Prior to Eurasian watermilfoil infesting Lake McCarrons (first discovered in 2000), northern watermilfoil was often a nuisance, especially when it formed surface mats. The mats interfered with boating as well as trapped algae and other floating debris. Other plants are sometimes a nuisance too. Several people noted ineffective herbicide treatments in recent years, even after several repeated attempts by commercial herbicide applicators.

Figure V-1

Nuisance Aquatic Plants in Lake McCarrons, May 1995 (from Diane Hilden).



Filamentous algae, sometimes called angel hair, grows attached on rooted plants. This is undesirable.

Because Eurasian watermilfoil is a recent invader, it is not yet a visible nuisance. Based on its normal progression, people are concerned it may crowd out beneficial plants and cause additional nuisances.

There is a recognition that native plants are also beneficial and worthy of protection. Water lilies and rushes were specifically mentioned for protection.

Numerous individuals contract with commercial herbicide applicators to control nuisance plants each year. There was a concern that the individual treatments were uncoordinated and thus performed outside the context of a more comprehensive plan.

4. Exotic Species. The discussion of Eurasian watermilfoil raised the related concern regarding the possibility of other exotic species introductions into Lake McCarrons. Efforts to prevent the introductions of other exotic species are desirable.
5. Diversity. The diversity of plants and animals is a concern among Advisory Group members as it indicates overall ecosystem health. The Advisory Group discussed lakeshore plant diversity and lakescaping as ways to address concerns with erosion and provide wildlife habitat - this is discussed further below.

B. Recreational Use

1. Surface Use. Wakes caused by large boats and 'boogie boards' were noted as a serious concern with respect to shoreline erosion and causing unpleasant conditions on the lake. Further, wake jumping by personal watercraft was viewed as dangerous and inconsiderate. Boater behavior was noted as a concern, especially the practice of motoring between anchored rafts and shore, which is unsafe.

Because Lake McCarrons is so small, normal concerns with boat speed, wakes, traffic direction and congestion are amplified. Enforcement of existing rules and regulations was seen as substantially lacking.

The Group asked to get more information regarding authorities and options for instituting surface use ordinances on the lake. This information should be included in this plan so all are aware of existing regulations and authorities.

2. Lakeshore Use. The Group was concerned about the visible appearance of the lakeshore. Debris, abandoned docks and other discarded items were mentioned as particularly problematic. Lakescaping was mentioned as a way to improve the aesthetic appearance as well as provide fish and wildlife habitat, goose control and erosion control.

The Group asked to get more information about Roseville's shoreland ordinance to determine whether some of these concerns could be addressed through official controls. This information should be included in this plan so all are aware of existing regulations and authorities.

C. Other Concerns

1. The Ramsey County Park at Lake McCarrons Beach was viewed as a good neighbor, especially with the restoration of the wetland area. There were concerns regarding the stark appearance of the boat ramp area and with the need for improved trash pick up.

There is an additional parcel of Ramsey County Park property located on South McCarrons Blvd. which is used for fishing access. The area was described as a 'forgotten' piece which is isolated and poorly maintained.

2. There were concerns that the topics of education and enforcement were not specifically discussed as issues relevant to 'problems and concerns.' The group agreed that education and enforcement were legitimate lake management concerns, meaning education and enforcement are critical to the effective management of Lake McCarrons.

VI. MANAGEMENT GOALS & OBJECTIVES

Management goals and objectives were developed by the Advisory Group to address the problems and concerns identified in the previous chapter. The Technical Group provided input with respect to the technical adequacy and feasibility of the goals and objectives.

Background - Vision, Goals & Objectives

Effective management plans have meaningful and measurable goals and objectives to provide a context for the management actions that are prescribed and recommended. The goals and objectives also provide a framework so the results of management actions can be objectively evaluated.

Management plans contain specific statements that result in meaningful action. Below is a description of the relevant planning terms (from Osgood 2001a):

Vision – general statements of where the lake community wants to go and what it will accomplish in the future.

Goals – more specific than vision, break into logical pieces what is needed to attain the vision, refer to components of the overall effort, sometimes quantifiable.

Objectives – steps to achieve the goals, describe types of management or activities and are quantifiable where possible.

Actions – explain who is going to do what, where, and when; actions generally articulate how to implement the objectives and should be quantifiable; benchmarks of existing conditions or indicators should be included. Management actions may be in the form of projects, programs, policies and plans (from Osgood 2001b):

Projects – Specific actions designed to accomplish a specific objective. For example, a lake treatment is a project designed to attain a specific water quality goal.

Programs – Broader, less specific initiatives aimed at accomplishing more general objectives. For example, an education program to change attitudes or behavior.

Policies – Guiding principles aimed at stimulating systemic or regulatory change. For example, a phosphorus fertilizer ordinance to provide an overall reduction in nutrients.

Plans – Further planning aimed at providing clear guidance for a specific problem or situation to be addressed as part of a large lake management effort. For example, a lake management plan may have identified a need for a detention basin. The next appropriate action would be to design that basin. This is categorized as a plan because we do not know the outcome of the design process. Where the pond will go, what it will cost, whether the land is available – all are questions to be answered.

A Vision for the Management of Lake McCarrons

The Advisory Group adopted this vision for the management of Lake McCarrons:

Lake McCarrons is an invaluable community and regional asset. Investments will be made to improve and insure sound environmental, aesthetic and recreational practices. Education and enforcement will sustain needed lake improvement.

Management Goals & Objectives

The Advisory and Technical Groups, through several meetings, agreed upon management goals and objectives for Lake McCarrons. In addition to the seven goals that address specific areas of problems and concerns (listed as goal nos. 1-7 below), three other goals - dealing with education, monitoring and administration - are included here.

GOAL #1 Control or minimize summer algae blooms

This goal addresses the problem of excessive algae in Lake McCarrons. Algae blooms that occur in the open water, referred to as planktonic algae, versus nuisance algae that grows attached to rooted lake plants, referred to as epiphytic algae and sometimes called angle hair are addressed here. Open water algae nuisances are caused by excessive phosphorus in the water.

Because algae nuisances depend on the amount of phosphorus in the lake water, it makes sense to identify a management objective that is keyed to lake phosphorus concentration with some assurance that attaining a desired phosphorus level will result in less algae.

Fortunately, Lake McCarrons has a long record of monitoring observations. From these data, statistical correlations can be derived and used to evaluate the outcome of reducing lake phosphorus concentration. This information will be useful in evaluating the specific lake phosphorus objective.

In deciding on a phosphorus objective for Lake McCarrons, it makes sense to aim for a level that is low enough to result in a meaningful improvement, yet is also realistically attainable. There were some concerns among Advisory Group members that the phosphorus concentration should not be lowered too low, because rooted plants, another identified nuisance, could become more of a nuisance. Upon further consideration, the Advisory Group decided this was not a serious concern and in the eventuality lake phosphorus got too low, the rooted plant nuisances could be re-evaluated.

Based on measurements made by the Metropolitan Council and Ramsey County Public Works, lake phosphorus concentration in Lake McCarrons has ranged from 28 to 85 ppb (Metropolitan Council) and 25 to 81 ppb (Ramsey County Public Works). One measure of 'reasonableness' is to 'ratchet down' this range to the first quartile². In this case, the phosphorus concentration of the first quartile is 34 ppb and 32 ppb for the two agencies (respectively). We know this level is reasonably attainable because it has actually been attained 25% of the time.

² The quartile refers to the lower 25% of all observations ranked from lowest to highest.

Another way to test reasonableness is to compare lake phosphorus concentration to ecoregion criteria. Heiskary and Wilson (1989) developed ecoregion criteria for Minnesota Lakes and recommended these criteria for lakes in the North Central Hardwood Forest ecoregion (where Lake McCarrons is located):

- 30 ppb for drinking water supply lakes
- 40 ppb for primary recreation and aesthetics

These values were derived from observations of many lakes in each ecoregion and are (approximately) the 25th percentile and therefore deemed attainable. Further analysis indicated that as average chlorophyll concentrations rose above 10 ppb, algae bloom frequencies and algae nuisance increased above a level commonly perceived to be 'impaired' for swimming (in Heiskary 1997). In fact, the chlorophyll concentration for lakes in this ecoregion can be estimated according to Fig. 3a (in Heiskary 1997). At a phosphorus concentration of 33 ppb (see above), the expected chlorophyll concentration is 10 ppb.

Based on this analysis, a lake phosphorus concentration of 33 ppb in Lake McCarrons appears to be attainable and will accomplish the goal of minimizing summer algae blooms.

Actual observations for Lake McCarrons also show that chlorophyll concentrations decrease in summers with lower phosphorus concentrations. Indeed there is a statistical correlation between lake phosphorus concentration and chlorophyll concentration (from the table on page 10). The correlations are somewhat different when comparing the Metropolitan Council and Ramsey County Public Works data. Nonetheless, both data sets indicate less algae with lower phosphorus in Lake McCarrons.

As a result of the thorough discussions and evaluations, it is appropriate to provide more detailed background, explanation and justifications for the management actions in the following section (see Appendix VI-1).

Based on this analysis above as well as the analysis presented in Appendix VI-1, the following management objective has been adopted:

Objective 1a – Manage phosphorus so summer average lake concentration is 33 ppb or less.

GOAL #2 Improve the fishery by a) eliminating winter fish kills and b) maintaining a diversity of gamefish.

The MN DNR completed a fisheries management plan in 1999 (see Appendix VI-2). This plan contains goals and objectives. The Advisory Group recognizes the MN DNR as the lead partner in managing the fisheries of Lake McCarrons, so has agreed that the DNR's management plan should be implemented to address their concerns and the above-stated management goal.

Objective 2a – Keep winter dissolved oxygen concentrations above 3 mg/L in the top four feet of the lake during the winter.

The Technical Group agreed that attaining this level of oxygen in Lake McCarrons will prevent winter fish kills.

Objective 2b – Implement the DNR’s fisheries management plan.

The Advisory and Technical Groups agreed the DNR’s management plan serves to maintain the diversity of gamefish now in Lake McCarrons.

GOAL # 3 Maintain and improve healthy native aquatic plants that a) provide minimal distraction from recreational activities, b) provide quality fish and wildlife habitat, c) minimize the ecological impacts and recreational nuisances of non-native plants and d) provide for coordination of management and control activities.

The recent introduction of Eurasian watermilfoil is a ‘wild card’ with regard to the management and control of rooted aquatic plants in Lake McCarrons. Because milfoil infestations proceed differently in lakes, we do not yet know to what extent it will be problematic in Lake McCarrons. In addition, there is an incomplete baseline to evaluate prior conditions.

There are concerns that non-native plants, like Eurasian watermilfoil and curly-leaf pondweed, will cause their own nuisances as well as harm healthy native plants. The past practice for nuisance aquatic plant control activities in Lake McCarrons has been uncoordinated. In the future, it makes sense to coordinate aquatic plant management activities in the context of a comprehensive aquatic plant management plan that is based on good baseline information.

Objective 3a – Develop and implement a comprehensive aquatic plant management plan that protects and restores beneficial native plants and minimizes the nuisances and ecological impacts of non-native plants.

The plan will provide for the coordination of plant management activities. To support this planning task and prevent delays, Ramsey County Public Works has agreed to conduct a comprehensive aquatic plant inventory in 2002.

GOAL #4 Keep new exotic species out of the lake.

Intentional actions to prevent the introduction of new (to Lake McCarrons) exotic species are appropriate. A point was made at the Technical Group to describe these as ‘invasive’ or ‘harmful’ to distinguish them from other exotic species that are intentionally put in the lake, for example walleye. A point was also raised that keeping such invaders out of the lake is a large challenge and may fail. The following objectives have been agreed to by the Advisory and Technical Groups:

Objective 4a – Use every reasonable means to prevent new invasive, exotic species from entering Lake McCarrons.

Objective 4b – Monitor Lake McCarrons for new invasive, exotic species infestations.

Objective 4c – Develop contingency plans for the introduction of new exotic species into Lake McCarrons.

GOAL #5 Assure that boating activities are safe, courteous and do not add to shoreline erosion.

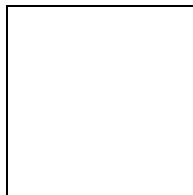
In addition to applicable state-wide boating regulations, Roseville ordinance provisions (Chapter 702) applicable to Lake McCarrons include:

- **Speed Limit:** Motorboats are not to be operated at a speed greater than is reasonable and proper having due regard to safety of other boats and persons.
- **Water-Skiing or Surfboarding:** No motorboat shall be used for the purpose of water-skiing, surfboarding or other similar device, unless such operation is performed in a manner so that neither the boat nor the skier or surfboard rider come within 300 feet of the shoreline, docks, swimmers or other boats.
- **No Wake Zone:** No person shall operate a motorboat or be towed on water skis or similar device at greater than slow-no wake speed within 300 of shore. Launching or landing a skier by the most direct route to open water shall be exempt from this provision.

Lake McCarrons is about 1,000 feet wide at its narrowest point. This means boating at greater than slow-no wake speed can occur in the center of the lake within a 400-foot wide zone.

Figure VI-3

A Depiction of the 300-Foot Slow, No Wake Buffer on Lake McCarrons.
The single-hatched area (diagonal lines) is where no wakes are allowed to be made)



The Advisory Group agreed that the existing ordinances, if enforced and abided by, would address their concerns and the above-stated management goal. Two management objectives were developed.

Objective 5b – Manage watercraft in such a way so their wakes do not add to or increase the natural shoreline erosion from wind generated waves.

Objective 5b – Evaluate and enforce surface regulations to promote safe and courteous boating.

GOAL #6 **Improve the lakeshore by a) removing unsightly debris, b) adding native plants to provide wildlife habitat and minimize the use of artificial erosion control structures and c) keep geese and nuisance waterfowl away.**

To address general concerns with the appearance of the lakeshore as well as to improve fish and wildlife habitat, the Advisory Group adopted these objectives:

Objective 6a – Remove debris and abandoned docks from the lakeshore. Once removed, assure unwanted debris is not dumped on the lake or on the lakeshore in accordance with Roseville's nuisance ordinance (Chapter 407).

Objective 6b – Implement lakeshore protection, restoration and erosion control projects around 50% of the suitable lakeshore using lakescaping or other non-structural methods.

Objective 6c – Prevent geese and other waterfowl from becoming pests.

GOAL #7 **Address concerns with maintenance of the a) public boat ramp on the northeast end and b) fishing access on the southwest end of the lake.**

Specific objectives were developed to make the public areas on the shore of Lake McCarrons more attractive to visitors and lakeshore residents.

Objective 7a – Develop and implement a plan to improve and maintain the appearance of the public boat ramp.

Objective 7b – Develop the South McCarrons Blvd. parcel as a model for educating lakeshore stakeholders about methods for improving aesthetic appearance and providing fish and wildlife habitat, goose control and erosion control for Lake McCarrons.

VII. MANAGEMENT ACTIONS

Management Actions

Specific management actions have been developed to accomplish the management objectives. This chapter provides a rationale for the management actions and is organized according to the framework of the goals and objectives from the previous chapter.

The recommendations of the Advisory Group are contained in action statements, called Management Actions. These statements are ‘action-oriented,’ therefore contain words like ‘will’ instead of ‘should’ in reference to the implementation of the action. In many cases, the entity identified to implement many of these actions has agreed they will indeed do what is indicated. However, the final coordination and implementation of this plan is subject to review by the CRWD and other partners.

The responsible agency or agencies are indicated following each action. Additional implementation details as well as project partners and cooperators are provided in the IMPLEMENTATION PLAN.

GOAL #1 Control or minimize summer algae blooms

Objective 1a – Manage phosphorus so summer average lake concentration is 33 ppb or less.

The goals, objective and actions relating to controlling algae in Lake McCarrons were the subject of the majority of the Advisory and Technical Groups’ time and attention. In addition to concerns with controlling the algae, there were also concerns with respect to the best, most appropriate methods and approaches for controlling nuisance algae. The concerns spanned the topics of long-term versus short-term management, managing internal versus external nutrient sources, controlling sources versus managing symptoms, being expeditious versus being comprehensive and so on.

The numerical order of the management actions presented here does not reflect any priority. The Advisory Group felt all of these actions were critical for accomplishing the management objective.

As a result of recent changes, the phosphorus reduction target of 166 to 221 pounds noted above, may be adjusted to a reduction target of 65 to 120.

Management Action 1 - Maintenance of Villa Park Ponds.

The phosphorus removal efficiency of the Villa Park Pond system has been diminished over the years. The Metropolitan Council studies as well as work by Barr Engineering has shown the system’s phosphorus removal efficiency has been reduced from about 70% in 1986-1988 to only about 4% in 1995-1996. Numerous recommendations have been made to maintain the system.

The system can be maintained and improved according to recommendations in the Barr Engineering study (1999) to remove phosphorus with a greater efficiency. Specific improvements are detailed in Appendix VII-1 and will result in the removal of 278 pounds of phosphorus per

year. This action alone will more than satisfy the 65 to 120 pound reduction in annual phosphorus inputs that have been targeted.

The CRWD will conduct baseline monitoring at the outlet of the Villa Park Ponds to evaluate overall system performance. This monitoring should involve continuous flow gauging along with grab samples for water quality analysis. The cost for this program is approximately \$10,000 per year, but a more detailed monitoring plan and cost estimate will be prepared prior to implementation.

The estimated capital and maintenance costs for this action are also detailed in Appendix VII-1. There will be additional costs if the CRWD decides to seek further analysis or technical input.

Responsible Agency: CRWD

Management Action 2 - Implement sediment best management practices (BMPs) in subwatershed nos. 3, 7 and 8.

To protect the functioning of the Villa Park Ponds system, watershed BMPs (See Appendix VII-2 for a summary of BMPs) that emphasize sediment reductions should be implemented in the subwatersheds directly tributary to the system (nos. 3, 7 and 8). These practices may be selected from a suite of housekeeping management practices that are designed for sediment reductions. Reductions in sediment input to the Villa Park Pond system have not been specified.

There are a number of pollution prevention practices that reduce suspended sediments in runoff (Barr Engineering 2001). The following practices have suspended sediment removal as their primary design benefit:

Sediment Controls

Inlet Protection
Temporary Sedimentation Basins/Traps
Check Dams

Housekeeping Practices

Pavement Management (street sweeping)
BMP Maintenance

These practices are routinely implemented construction controls or public works activities. The City of Roseville, is the local municipal authority, so is the logical agency to oversee and implement sediment control practices. The CRWD, as the coordinator of the Lake McCarrons Management Plan, will have a coordination role.

Sediment BMPs are assumed to provide no phosphorus reduction.

No additional costs for the oversight and implementation of sediment control activities have been included here because this is an ongoing activity for Roseville. The cost for the CRWD is estimated to be \$6,000 per year (\$500 per month) for their coordination activities.

Responsible Agency: Roseville

Management Action 3 - Implement watershed BMPs to remove phosphorus in subwatershed nos. 2, 4, 5 and 6.

Subwatershed no. 4 drains directly into Lake McCarrons, so runoff management practices designed to remove phosphorus will provide a direct benefit to the lake. Subwatershed nos. 2, 5 and 6 are routed through a small pond in subwatershed no. 6 that provides some removal of phosphorus. Runoff management practices designed to remove phosphorus will have a lesser, but significant benefit to Lake McCarrons.

Homeowner education and voluntary implementation of housekeeping practices will result in measurable reductions in phosphorus inputs to Lake McCarrons. Typical rates of phosphorus reduction in urban areas have been estimated using the Watershed Treatment Model (Caraco 2002). Model outputs and assumptions are included in Appendix VII-3.

Approximately 29 pounds of phosphorus per year can be eliminated from subwatershed nos. 2, 4, 5 and 6 by providing homeowner education and awareness. The CRWD can design and implement an education and awareness program emphasizing lawn care and pet waste reductions as part of a larger watershed-wide campaign. The CRWD can also provide information and incentives for increasing water infiltration on a watershed-wide basis. Because these activities will be applied more broadly than just subwatershed nos. 2, 4, 5 and 6, no additional costs are included here.

Responsible Agency: CRWD

Management Action 4 - Implement watershed-wide BMPs on a voluntary basis.

All areas tributary to Lake McCarrons have a responsibility and an obligation to reduce pollution in runoff. These actions are referred to as voluntary because action nos. 1-3 will more than accomplish the phosphorus reduction targets, thus further reductions are not strictly needed.

The CRWD will implement educational and awareness programs, provide incentives and demonstration projects to encourage voluntary implementation of BMPs throughout the Lake McCarrons watershed. The phosphorus removal benefit resulting from these efforts will be minimal because runoff is routed through the Villa Park Ponds (except for those subwatersheds in Management Action 3). However, there are pollution removal benefits in addition to phosphorus removal that justify these actions.

The State of Minnesota has recently passed a law requiring the use of zero-phosphorus fertilizers in the Twin Cities metro area. This law takes affect in 2004.

The cost of implementing watershed-wide BMP's is estimated in Appendix VII-4.

Responsible Agency: CRWD

Management Action 5 - Alum application.

An alum application to control internal phosphorus recycling is proposed. Alum, or aluminum sulfate, will be applied to the lake in a bulk application designed to bind phosphorus in the lake sediments, thereby preventing it from contributing to algae blooms. The alum application can be implemented following the collection and analysis of sediment samples that are needed to calculate the appropriate dose.

Alum applications provide a chemical barrier on the lake bottom to retard the movement of phosphorus back into the lake water. Due to the fact that this layer slowly settles into the mucky sediments as well as the fact that new phosphorus continues to be deposited in the lake, these treatments are normally effective for 10 to 15 years (Welch and Cooke 1999). For Lake McCarrons, even though the watershed phosphorus inputs are to be greatly reduced, there will still be enough phosphorus coming into (and staying in) the lake to require periodic re-applications of the alum. In this context, long-term reductions in watershed phosphorus inputs and periodic whole-lake alum applications are required to sustain an improved condition in Lake McCarrons.

Alum, when applied as recommended here, is safe for humans and aquatic life. The aluminum hydroxide floc that is formed immediately after an alum application is chemically stable and non-toxic. In fact, aluminum hydroxide is the active ingredient in over-the-counter antacids. The floc precipitates through the water and settles on the lake bottom. This material may cover bottom-dwelling organisms, thus killing them. In Lake McCarrons, because the lake bottom is anoxic, there are probably few such organisms in the first place. Alum has been applied to hundreds of lakes worldwide. While the results have not always been positive in terms of phosphorus reductions (see Welch and Cooke 1999), there have been no reported cases of toxicity.

There are two considerations in evaluating the timing of the alum treatment: 1) to provide prompt reduction in lake phosphorus and therefore immediate improvements in nuisance algae or 2) delay the treatment to wait for the watershed treatments to be implemented. Either approach is acceptable and has advantages. The advantage of providing a prompt treatment is there will be prompt results. Because periodic re-treatments will be necessary in the long run, the small loss in longevity is offset by the benefit of several years of improved condition. The advantage of delaying the treatment is potentially greater longevity. Also, a delayed treatment could take away the motivation for following through with the watershed improvements. In this case, a prompt alum application is recommended because the CRWD has demonstrated its desire to follow through with a comprehensive watershed cleanup. Furthermore, Lake McCarrons watershed improvements, which began in 1986, still have resulted in no visible water quality improvements in the lake. It is reasonable to provide prompt improvements at this time.

An alum application requires a permit from the MN DNR. When received, the application is reviewed by MN DNR staff as well as other state agencies to assure the proposed treatment is safe and appropriate. At the time a permit is requested, the applicant should also conduct a public awareness campaign to advise and assure concerned citizens the application of alum is safe and is part of a more comprehensive management effort.

Details of the proposed alum application are presented in Appendix VII-5. Monitoring to track the effectiveness of the treatment is included in Management Action 25.

Responsible Agency: CRWD

After five years, the effectiveness of actions 1 - 5 should be evaluated to see if the actual phosphorus reductions have occurred and if algae blooms have been controlled or minimized. Also at this time, it should be determined whether the original objective has been met and reconsider whether additional phosphorus reductions and algae controls may be appropriate.

Management Action 6 - Evaluation of algae control actions.

The Advisory Group should be re-convened to evaluate the results of the management actions and adjust the goals, objectives and actions as appropriate. The cost for this action is estimated to be \$10,000 to \$15,000.

Responsible Agency: CRWD

Official programs and controls should support the watershed management activities proposed here. Land use modifications, through development and re-development, should be controlled in such a way as to assure that runoff and pollution inputs do not increase.

Management Action 7 - Develop subwatershed target pollution standards.

The Capitol Region Watershed District water management plan calls for developing target pollution loads or benchmarks for subwatersheds to McCarrons Lake in cooperation with the City of Roseville. These 'performance-based standards' refer to controls applied to development and redevelopment occurring in the Lake McCarrons watershed. This activity is important to validate and assure the phosphorus targets are appropriate.

In addition to phosphorus, the pollutant addressed in the above management actions, there are other kinds of pollution that reach Lake McCarrons. These other pollutants may include heavy metals (like mercury and lead), hydrocarbons (like gasses and oils) or organic chemicals (like PCBs). It makes sense to minimize the input of all pollution in stormwater when considering target pollution standards.

The CRWD has included a budget of \$50,000 in their capital improvement plan for this action.

Responsible Agency: CRWD**GOAL #2 Improve the fishery by a) eliminating winter fish kills and b) maintaining a diversity of gamefish.**

Objective 2a – Keep winter dissolved oxygen concentrations above 3 mg/L in the top four feet of the lake during the winter.

It is possible that by implementing management actions 1-5, the frequency and severity of winter fishkills will be reduced to an acceptable level. Thus, it makes sense to re-evaluate the need to mitigate in the future.

Management Action 8 - In five years, re-evaluate the need for artificially aerating Lake McCarrons during the winter.

The estimated cost for implementing this action is \$2,000.

Responsible Agency: CRWD

Objective 2b – Implement the DNR’s fisheries management plan.

The DNR’s fisheries management plan will substantially accomplish the goal of maintaining a diverse game fishery in Lake McCarrons. Thus, the DNR should proceed with implementing its plan.

Management Action 9 - The DNR will continue implementing its fisheries management plan for Lake McCarrons.

The costs for implementing this plan are summarized in Appendix VI-2. Actual costs will be evaluated as opportunities and need arise for specific projects.

Responsible Agency: DNR

GOAL # 3 **Maintain and improve healthy native aquatic plants that a) provide minimal distraction from recreational activities, b) provide quality fish and wildlife habitat, c) minimize the ecological impacts and recreational nuisances of non-native plants and d) provide for coordination of management and control activities.**

Objective 3a – Develop and implement a comprehensive aquatic plant management plan that protects and restores beneficial native plants and minimizes the nuisances and ecological impacts of non-native plants.

Developing an aquatic plant management plan requires a comprehensive aquatic plant inventory to use as a baseline. Ramsey County Public Works and the CRWD conducted a plant survey in 2002, so the aquatic plant management plan could be developed in 2003.

Management Action 10 - Develop an aquatic plant management plan in 2003 with actual implementation to occur later.

The CRWD will be the lead agency with RCPW, DNR and the LMNA as partners. The estimated cost for developing the plan is \$6,000. It would be very useful to include a field tour during the summer when the plan is being prepared so stakeholder observations and concerns can be matched to field data from a recent plant inventory.

Responsible Agency: CRWD

GOAL #4 Keep new exotic species out of the lake.

Objective 4a – Use every reasonable means to prevent new invasive, exotic species from entering Lake McCarrons.

Management Action 11 - Implement an exotic species prevention program.

New exotic species infestations are most likely to be introduced through the public access or by lakeshore owners. Possible prevention actions range from relying on existing state education and awareness programs to a comprehensive inspection and cleaning program. The most practical actions involve providing visible and informative displays at the public access as well as keeping the lakeshore owners fully informed and aware of new exotic species.

Due to the ready availability of quality educational materials from the DNR, a program to distribute these materials is easy to coordinate. The CRWD and the Lake McCarrons Neighborhood Association should coordinate this activity. In addition, Ramsey County Parks should design an informational kiosk to be placed at the boat ramp.

Responsible Agency: CRWD, RCP & LMNA

Objective 4b – Monitor Lake McCarrons for new invasive, exotic species infestations.

Management Action 12 - Monitor Lake McCarrons for new invasive, exotic species infestations.

The CRWD in cooperation with the DNR and the Lake McCarrons Neighborhood Association will coordinate monitoring activities to identify new invasive exotic species, should they occur, in Lake McCarrons.

Responsible Agency: CRWD

Objective 4c – Develop contingency plans for the introduction of new exotic species into Lake McCarrons.

Management Action 13 - Contingency plan(s) will be developed for possible new exotic species.

The CRWD will develop contingency plan(s) to coordinate the response to possible new exotic species introductions in Lake McCarrons. These plans will be completed in 2003 and reviewed every other year.

Responsible Agency: CRWD

GOAL #5 Assure that boating activities are safe, courteous and do not add to shoreline erosion.

Objective 5b – Manage watercraft in such a way so their wakes do not add to or increase the natural shoreline erosion from wind generated waves.

Objective 5b – Evaluate and enforce surface regulations to promote safe and courteous boating.

The existing surface water ordinances, if abided by, appear to adequately address the objectives. A possible exception may be during periods of high water, which tend to occur when the lake's outlet is blocked.

Management Action 14 - Design and install signs at the public boat launch that clearly indicate applicable surface use regulations for Lake McCarrons.

Ramsey County Parks will implement this action.

Responsible Agency: RCP

Management Action 15 - Design and distribute an informational flyer to lakeshore owners.

The Lake McCarrons Neighborhood Association will implement this action.

Responsible Agency: LMNA

Management Action 16 - Implement a lake use study to evaluate the environmental and aesthetic impacts of boating.

There remain concerns regarding the impact of boating on Lake McCarrons. Further, there are differing views regarding the need for the 300-foot slow, no wake buffer. Lacking objective information, neither the concerns nor the differing views can be addressed effectively. The CRWD should implement a lake use study in 2003.

Responsible Agency: RCP

Management Action 17 - Clear the lake's outlet of debris on a daily basis.

Ramsey County Parks staff will remove debris that block water flow from the lake's outlet on a regular basis, especially following storm events, from April through October.

Responsible Agency: RCP

GOAL #6 **Improve the lakeshore by a) removing unsightly debris, b) adding native plants to provide wildlife habitat and minimize the use of artificial erosion control structures and c) keep geese and nuisance waterfowl away.**

Objective 6a – Remove debris and abandoned docks from the lakeshore. Once removed, assure unwanted debris is not dumped on the lake or on the lakeshore in accordance with Roseville's nuisance ordinance (Chapter 407).

Management Action 18 - The Lake McCarrons Neighborhood Association will organize an annual lakeshore cleanup event in May.

In addition, the City of Roseville will enforce its nuisance ordinance as applicable.

Responsible Agency: LMNA

Objective 6b – Implement lakeshore protection, restoration and erosion control projects around 50% of the suitable lakeshore using lakescaping or other non-structural methods.

Management Action 19 - The Ramsey SWCD will conduct a shoreline inventory to determine the amount of shoreline suitable for lakescaping as well as the shoreline subject to erosion.

Responsible Agency: RSWCD

Management Action 20 - The Ramsey SWCD will provide technical assistance and the CRWD will provide educational materials and cost sharing for lakescaping to lakeshore owners on Lake McCarrons.

Responsible Agency: RSWCD & CRWD

Objective 6c – Prevent geese and other waterfowl from becoming pests.

Management Action 21 - Ramsey County Parks, the city of Roseville and other local units of government, in cooperation with the University of Minnesota will continue the goose control program.

Funding for this program is becoming a concern. It appears that either additional partners will need to contribute or the level of control activities will diminish.

Responsible Agency: RCP

GOAL #7 **Address concerns with maintenance of the a) public boat ramp on the northeast end and b) fishing access on the southwest end of the lake.**

Objective 7a – Develop and implement a plan to improve and maintain the appearance of the public boat ramp.

Management Action 22 - Ramsey County Parks will develop a plan and implement landscaping improvements around the boat ramp.

Responsible Agency: RCP

Objective 7b – Develop the South McCarrons Blvd. parcel as a model for educating lakeshore stakeholders about methods for improving aesthetic appearance and providing fish and wildlife habitat, goose control and erosion control for Lake McCarrons.

Management Action 23 - Ramsey County Parks, in cooperation with Ramsey SWCD and the CRWD, will develop and implement a lakescaping plan compatible with fishing activities to provide a model for lakeshore stakeholders.

Responsible Agency: RCP

Administration, Coordination & Oversight of the Management Plan

The Capitol Region Watershed District has accepted responsibility for the administration, coordination and oversight of this management plan. Simply, this entails assuring the management actions are implemented as scheduled and monitoring performance of the partners and cooperators. For the most part, the budget for this activity is embedded in the management actions detailed above.

Several additional management actions are included below to complete the implementation of this plan.

Management Action 24 - Plan administration.

The CRWD will administer, coordinate and oversee the implementation of this plan. It is anticipated this will require \$8,000 per year.

Responsible Agency: CRWD

Management Action 25 - Monitoring, Education and Report.

The CRWD will coordinate the monitoring activities of partners and cooperators. It is anticipated the present monitoring activities of Ramsey County Public Works (lake water quality and aquatic plant inventories) and MN DNR Fisheries (fish population assessments) will continue. In addition, educational activities, which are largely provided for in Management Actions 3 and 4, will be coordinated by the CRWD with assistance from numerous partners. The CRWD will summarize these results of these activities each year and present a report (or report card) to the CRWD Board of Managers. The estimated cost for this activity is \$5,000 per year.

Responsible Agency: CRWD

VIII. IMPLEMENTATION PLAN

The Implementation Plan summarizes the management actions, the agency responsible for taking the lead in implementing each action, partners and cooperators, and a budget estimate. The implementation plan consists of CRWD capital improvements, CRWD programs, CRWD operations and maintenance (O & M) and program costs of other agencies.

For reference, the partners and cooperators are abbreviated as follows:

Capitol Region Watershed District	CRWD
City of Roseville	Roseville
Lake McCarrons Neighborhood Association	LMNA
Metropolitan Council	MC
Minnesota Department of Natural Resources	DNR
Minnesota Department of Transportation	DOT
Ramsey County Parks	RCP
Ramsey County Public Works	RCPW
Ramsey Soil & Water Conservation District	RSWCD

The implementation occurs on a five-year schedule, beginning in 2002 and ending in 2006.

Management Actions

Management Action 1 - Maintenance of Villa Park Ponds.

Responsible Agency:	CRWD
Partners & Cooperators:	Roseville, MC
Implementation Schedule:	2003 (Capital) & Ongoing (O & M)
Estimated Cost:	\$ 443,900 (Capital)
	\$ 5,000 (Annual O & M)
	\$ 10,000 (Five-Year O & M)

Management Action 2 - Implement sediment best management practices (BMPs) in subwatershed nos. 3, 7 and 8.

Responsible Agency:	Roseville
Partners & Cooperators:	CRWD
Implementation Schedule:	Ongoing
Estimated Cost:	\$ 6,000 (Annual)

Management Action 3 - Implement watershed BMPs to remove phosphorus in subwatershed nos. 2, 4, 5 and 6.

Responsible Agency: CRWD
Partners & Cooperators: DOT
Implementation Schedule: Ongoing
Estimated Cost: \$ 0 (Included in other actions)

Management Action 4 - Implement watershed-wide BMPs on a voluntary basis.

Responsible Agency: CRWD
Partners & Cooperators:
Implementation Schedule: 2003 (Capital) & Ongoing (Program)
Estimated Cost: \$ 13,000 (Capital)
\$ 37,200 (Program)

Management Action 5 - Alum application.

Responsible Agency: CRWD
Partners & Cooperators:
Implementation Schedule: 2002 or 2003
Estimated Cost: \$ 39,500 to \$ 111,500 (Capital)

Management Action 6 - Evaluation of algae control actions.

Responsible Agency: CRWD
Partners & Cooperators: All
Implementation Schedule: 2006
Estimated Cost: \$ 10,000 to \$ 15,000 (Program)

Management Action 7 - Develop subwatershed target pollution standards.

Responsible Agency: CRWD
Partners & Cooperators: Roseville and the LMNA
Implementation Schedule: 2003
Estimated Cost: \$ 50,000 (Capital)

Management Action 8 - In five years, re-evaluate the need for artificially aerating Lake McCarrons during the winter.

Responsible Agency: CRWD
Partners & Cooperators: DNR and RCPW
Implementation Schedule: 2006
Estimated Cost: \$ 2,000 (Program)

Management Action 9 - The DNR will continue implementing its fisheries management plan for Lake McCarrons.

Responsible Agency: DNR
Partners & Cooperators: As identified by DNR
Implementation Schedule: ongoing
Estimated Cost: see Appendix VI-2

Management Action 10 - Develop an aquatic plant management plan in 2003 with actual implementation to occur later.

Responsible Agency: CRWD
Partners & Cooperators: RCPW, DNR & LMNA
Implementation Schedule: 2002/3
Estimated Cost: \$ 6,000

Management Action 11 - Implement an exotic species prevention program.

Responsible Agency: CRWD, RCP, LMNA
Partners & Cooperators: DNR
Implementation Schedule: Ongoing
Estimated Cost: \$ 2,000 (Program)
\$ 5,000 (RCP Capital)
\$ 1,000 (RCP Program)

Management Action 12 - Monitor Lake McCarrons for new invasive, exotic species infestations.

Responsible Agency: CRWD
Partners & Cooperators: LMNA, DNR
Implementation Schedule: Ongoing
Estimated Cost: \$ 2,000 (Program)

Management Action 13 - Contingency plan(s) will be developed for possible new exotic species.

Responsible Agency: CRWD
Partners & Cooperators: LMNA, DNR
Implementation Schedule: 2003, 2005 and every other year
Estimated Cost: \$ 4,000/plan cycle (Program)

Management Action 14 - Design and install signs at the public boat launch that clearly indicate applicable surface use regulations for Lake McCarrons.

Responsible Agency: RCP
Partners & Cooperators:
Implementation Schedule: 2002
Estimated Cost: \$ 5,000 (RCP Program)

Management Action 15 - Design and distribute an informational flyer to lakeshore owners.

Responsible Agency: LMNA
Partners & Cooperators:
Implementation Schedule: Ongoing
Estimated Cost: \$ 500 (LMNA Program)

Management Action 16 - Implement a lake use study to evaluate the environmental and aesthetic impacts of boating.

Responsible Agency: RCP
Partners & Cooperators: LMNA, RCP
Implementation Schedule: 2003
Estimated Cost: \$ 12,000 (CRWD Program)

Management Action 17 - Clear the lake's outlet of debris on a daily basis.

Responsible Agency: RCP
Partners & Cooperators:
Implementation Schedule: Ongoing
Estimated Cost: \$??? (RCP Program)

Management Action 18 - The Lake McCarrons Neighborhood Association will organize an annual lakeshore cleanup event in May.

Responsible Agency: LMNA
Partners & Cooperators: Roseville
Implementation Schedule: Ongoing
Estimated Cost: n/a

Management Action 19 - The Ramsey SWCD will conduct a shoreline inventory to determine the amount of shoreline suitable for lakescaping.

Responsible Agency: RSWCD
Partners & Cooperators: CRWD
Implementation Schedule: 2002
Estimated Cost: \$ 2,000 (RSWCD)

Management Action 20 - The Ramsey SWCD will provide technical assistance and the CRWD will provide educational materials and cost sharing for lakescaping to lakeshore owners on Lake McCarrons.

Responsible Agency: RSWCD & CRWD
Partners & Cooperators:
Implementation Schedule: Ongoing
Estimated Cost: \$ 0 (RSWCD Existing Program)
\$ To be determined (CRWD Capital)

Management Action 21 - Ramsey County Parks, the city of Roseville and other local units of government, in cooperation with the University of Minnesota will continue the goose control program.

Responsible Agency: RCP
Partners & Cooperators: Roseville & Other local units
Implementation Schedule: Ongoing
Estimated Cost: \$??? (RCP Program)

Management Action 22 - Ramsey County Parks will develop a plan and implement improvements around the boat ramp.

Responsible Agency: RCP
Partners & Cooperators:
Implementation Schedule: 2003
Estimated Cost: \$??? (RCP Program)

Management Action 23 - Ramsey County Parks, in cooperation with Ramsey SWCD and the CRWD, will develop and implement a lakescaping plan compatible with fishing activities to provide a model for lakeshore stakeholders.

Responsible Agency: RCP
Partners & Cooperators: RSWCD & CRWD
Implementation Schedule: 2003
Estimated Cost: \$??? (RCP Program)

Management Action 24 - Plan administration.

Responsible Agency: CRWD
Partners & Cooperators:
Implementation Schedule: Ongoing
Estimated Cost: \$ 8,000 (Program)

Management Action 25 - Monitoring, Education and Report.

Responsible Agency: CRWD
Partners & Cooperators:
Implementation Schedule: Ongoing
Estimated Cost: \$ 15,000 (Program)

Implementation Budget

A Capitol Region Watershed District five-year implementation budget summary is presented in the table below.

CRWD 5-Year Implementation Plan Summary

Management Action	CRWD Capital Cost *	5-Year Program Costs				
		Year 1	Year 2	Year 3	Year 4	Year 5
1. Maintenance of Villa Park Ponds	\$443,900	\$5,000	\$5,000	\$5,000	\$5,000	\$15,000
2. Implement sediment BMPs.		\$6,000	\$6,000	\$6,000	\$6,000	\$6,000
3. Implement watershed BMPs						
4. Implement watershed-wide BMPs	\$13,000	\$37,200	\$37,200	\$37,200	\$37,200	\$37,200
5. Alum application	\$111,500					
6. Evaluation of algae control actions						\$15,000
7. Subwatershed pollution standards	\$50,000					
8. Evaluate need for winter aeration						\$2,000
9. DNR fisheries management						
10. Aquatic plant management plan		\$3,000	\$3,000			
11. Exotic species prevention program		\$2,000	\$2,000	\$2,000	\$2,000	\$2,000
12. Monitor for new exotic species		\$2,000	\$2,000	\$2,000	\$2,000	\$2,000
13. Exotic species contingency plans			\$4,000		\$4,000	
14. Boat launch signs						
15. Informational flyers						
16. Lake use study	\$12,000					
17. Keep lake outlet clear						
18. Annual lakeshore cleanup event						
19. Shoreline inventory						
20. Lakescaping assistance	tbd					
21. Goose control program						
22. Boat ramp landscaping						
23. South McCarrons lakescaping						
24. Plan administration		\$8,000	\$8,000	\$8,000	\$8,000	\$8,000
25. Monitoring, education and report		\$15,000	\$15,000	\$15,000	\$15,000	\$15,000
TOTALS	\$630,400	\$78,200	\$82,200	\$75,200	\$79,200	\$102,200

* Capital costs will be integrated into the annual program costs according to scheduling and funding priorities of the CRWD.

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X. GLOSSARY

Algae	Algae are small, usually microscopic, plants that are found in lakes. Algae come in three basic forms: unicellular (single cells), colonial (colonies of cells) and filamentous (cell filaments). Algae form the base of the aquatic food chain. When algae become overabundant, they may be perceived as a nuisance
Alum	Alum is a short-hand reference to the chemical aluminum sulfate. Alum, when applied to lakes, chemically binds with phosphorus to remove it from the water. The precipitate that forms, called a floc, settles to the lake bottom and forms a chemical barrier that retards phosphorus from being recycled back into the lake.
Anoxic	Meaning devoid of dissolved oxygen.
Blue-green algae	Blue-green algae are a particular kind of algae that tend to cause more nuisances compared to other kinds of algae. Blue-green algae often form surface scums and may accumulate on lake shores.
BMP	Refers to Best Management Practice.
Chlorophyll	Chlorophyll is a green plant pigment found in algae. Chlorophyll in lake water is used as a measurement for the presence of algae. It has been shown that chlorophyll concentration is correlated to the abundance of all algae.
Eutrophic	Eutrophic refers to a nutrient-enriched condition characterized by increased biological productivity. <i>Eutrophication</i> is the process by which lakes become eutrophic. Eutrophic lakes are generally considered to be impaired.
P8	P8 is a model that estimates pollution (like phosphorus) loads in stormwater. P8 stands for 'Program for Predicting Polluting Particle Passage through Pits, Puddles and Ponds.'
Phosphorus	Phosphorus is a chemical element essential for life. Phosphorus is critical in lakes because it is the element in lake water that is normally in shortest supply relative to the growth needs of algae. As a result, reducing phosphorus in lake water is an effective way to control algae growth.
Pollution	Pollution refers to any material or substance that causes an undesirable effect. In lakes, pollution is most often carried by water - runoff, groundwater or precipitation.
Sub-watershed	Sub-watersheds are small subdivisions of a watershed.

Thermocline	The thermocline is the area of greatest temperature change that separates the warmer surface waters from the cool bottom waters in a lake. The depth of a lake's thermocline varies, normally becoming shallower from spring to summer, then deeper from summer to autumn. At overturn, the thermocline disappears.
Trophic State	Trophic state is the degree of eutrophication, usually expressed on a continuum. Trophic state is commonly indicated by phosphorus concentration, algae abundances (as chlorophyll) or water clarity (Secchi disk), either singly or in combination.
Secchi Disk	An 8-inch white or black-and-white disk used to measure water clarity.
Water Quality	Refers to the condition of water. Water quality may be described or defined in many ways, ranging from subjective descriptions to legal standards. Water quality includes many aspects. Normally, water quality of lakes refers to the degree of eutrophication or trophic state.
Watershed	A lake's watershed is the land area around the lake that contributes surface runoff to the lake.
Winterkill	Winterkills occur when all the oxygen under the winter ice-covered lake is depleted and fish suffocate. A partial winterkill refers to a less severe condition where only the least tolerant fish are killed.

APPENDIX II-1

GOALS & POLICIES OF THE CAPITOL REGION WATERSHED DISTRICT

The goals and policies of the CRWD are categorized into four major areas: watershed management, water quality protection, water quantity management, wetland management groundwater quality protection and stewardship.

Major Areas of Watershed District Involvement

Major Area I – Watershed Management – (WM)

Purpose - Manage the watershed from an effective Watershed Management Plan that addresses short and long-term goals and that meet the needs of the watershed public.

Goal #1 – Intergovernmental Cooperation

Pursue partnerships to provide effective, efficient and consistent water management activities throughout the Watershed.

Action Policy WM1a

Minimize or eliminate duplication of water management activities within the watershed by organizing and sponsoring an annual watershed management forum(s). Forums will include all local governmental agencies, County agencies, state and federal agencies, Metropolitan Council, non-profit organizations, businesses and citizen groups to discuss each others' planned activities in the watershed, seek ways in which to cooperate and eliminate duplication of efforts and create joint efforts especially in the areas of education.

Action Policy WM1b

Ensure consistency of stormwater management activities between cities by fostering a culture of intergovernmental cooperation. This will be accomplished by organizing an ongoing committee with representation from each city and the County. They will meet quarterly to discuss stormwater management issues. The committee will report to the District Board of Managers semi-annually.

Action Policy WM1c

Assist cities in the preparation and updates of their local water management plans and regulatory programs. The District will work with city staff to formulate city rules and regulations.

Action Policy WM1d

Where appropriate, transfer the authority and responsibility to the cities for appropriate watershed management activities.

Action Policy WM1e

For all watershed district initiated projects, coordinate technical planning and project oversight with available local, county, agency, other organizations, and citizens.

Action Policy WM1f

Provide data developed by the watershed district to all requesting.

Action Policy WM1g

Where mutually beneficial, assist other governmental agencies and organizations achieve their goals and objectives for water management within the watershed.

Action Policy WM1h

Assist cities, other governmental agencies and organizations achieve their water quality and watershed education goals and objectives within the Watershed District.

Action Policy WM1i

Actively pursue environmental education projects with existing environmental education entities.

Goal #2– Integrated Resource Management

When planning and implementing water resource management activities within the Watershed, evaluate the effects on other natural resources and strive for a balanced approach.

Action Policy WM2a

Identify unique and high value natural resources associated with water resources, corridors between water resources, and buffers around water resources within the watershed and provide a strategy for their management.

Action Policy WM2b

Ensure that municipal and watershed district sponsored capital improvement projects (CIP) carefully consider the interrelation between all natural resources and where possible do not negatively impact them. This will be accomplished through the establishment of an interagency technical team that will review all CIPs. Develop a checklist or other mechanism to facilitate objective evaluation.

Goal #3 – Financing

Utilize long-term planning, education and partnerships to cost-effectively fulfill District goals and address water resource management issues.

Action Policy WM3a

Utilize appropriate financing mechanisms for the finance of all district activities, including but not limited to mechanisms and procedures outlined in MN. Statutes 103D and 103B.

Action Policy WM3b

Actively pursue non-tax levy funding sources in order to reduce the tax levy financing burden on the residents of the District and where appropriate seek partnerships and cooperative agreements to finance projects.

Action Policy WM3c

Cooperate in the funding of public education and outreach projects, activities and programs with a variety of environmental groups, cities, county and school districts.

Action Policy WM3d

Implement a stewardship fund program to evaluate, prioritize, and fund appropriate projects submitted to the District.

Action Policy WM3e

Analyze previous expenditures for the Trout Brook Stormsewer System to ensure that any acquisition costs for the System are fairly distributed among District residents.

Major Area II – Water Quality – (WQUAL)

Purpose – Protect and improve water quality to maintain or enhance the range of uses for the District's water resources.

Goal #1 – Water Body Management

Establish realistic levels of use for the water bodies within the District.

Action Policy WQUAL1a

Establish water quality standards for the lakes and wetlands within the District that will achieve the desired levels of use. Evaluate information from previous work, including the Como Lake Restoration Project Diagnostic Feasibility Report (1982), the Lake McCarrons Strategic Management Plan (May, 1996), and the District function and value assessment (1999), in a strategic planning process to identify the water quality standards.

Action Policy WQUAL1b

Establish target pollutant loads for subwatersheds throughout the District which will achieve water quality standards and that can be adopted by member communities.

Action Policy WQUAL1c

Evaluate the existing water quality monitoring programs to assess achievement of water quality standards and effectiveness of best management practices (BMPs).

Action Policy WQUAL1d

Set performance standards for the management of lake and wetland shoreline to protect and enhance the quality of water and other natural resources.

Action Policy WQUAL1e

Set performance standards for the management of aquatic and terrestrial habitats within and adjacent to water bodies. Standards shall maximize the recreational opportunities as well as fish and wildlife habitat.

Action Policy WQUAL1f

Establish TMDL's in cooperation with the MPCA for the Mississippi River, Como Lake and Lake McCarrons.

Action Policy WQUAL1g

Fulfill NPDES permit requirements for District owned storm sewers

Action Policy WQUAL1h

Study the effects of waterfowl droppings on the quality of Como and McCarrons lakes. If necessary, establish a management plan to minimize waterfowl impacts on the lakes.

Action Policy WQUAL1i

Study the effects of thermal pollutants on District waterbodies.

Goal #2 – Non-point Source Reduction

Reduce non-point source pollution loads to District water bodies.

Action Policy WQUAL2a

Require adherence to the Ramsey County Soil Erosion and Sediment Control Handbook for all construction sites within the District.

This shall be accomplished by requiring all cities within the watershed to develop and successfully implement an ordinance that requires the aforementioned handbook.

Action Policy WQUAL2b

Encourage/require resident, business, and local government “Good Housekeeping (BMPs)” practices for reduction of non-point sources of pollution throughout the watershed.

Action Policy WQUAL2c

Construct or implement regional structural or non-structural water quality treatment facilities where subwatershed pollutant loads exceed standards.

Action Policy WQUAL2d

Require on-site detention basins or alternative effective BMPs on all new development sites and redevelopment sites where water quality goals are not currently being met or where water quality goals can not be met through regional treatment facilities.

Action Policy WQUAL2e

Require NURP or similar criteria for wet detention ponds.

Action Policy WQUAL2f

Require the use of effective non-point source pollution reduction BMPs in development projects.

Action Policy WQUAL2g

Research and monitor BMPs to evaluate their effectiveness.

Action Policy WQUAL2h

Create and provide education to residents, businesses and local governments on nutrient reduction, sediment reduction and other sources of non-point source pollution.

Goal #3 – Retrofitting Existing Systems and BMPs

Require retrofitting of existing stormwater management facilities and BMPs where necessary to achieve water quality standards.

Action Policy WQUAL3a

Facilitate retrofitting opportunities with any public improvement projects.

Action Policy WQUAL3b

Incorporate the use of BMPs into redevelopment initiatives.

Action Policy WQUAL3c

Evaluate and facilitate implementation of beneficial land use BMPs.

Action Policy WQUAL3d

Inspect and maintain all components of the storm water management system.

Major Area III– Water Quantity Management – (WQUAN)

Purpose – Effectively manage the flow of floodwaters within the District without threatening life or permanent improvements.

Goal #1 – Flood Control

Preserve existing flood levels on District water bodies, excluding the Mississippi River, at or below the 100-year flood elevations.

Action Policy WQUAN1a

Inventory and define 100-year flood elevations for all water bodies within the district.

Action Policy WQUAN1b

Restrict the construction of structures within the 100-year flood elevation of any water body, excluding the Mississippi River, within the District.

Action Policy WQUAN1c

Require water quantity control practices on all new development and re-development to preserve existing 100-year flood elevations

Action Policy WQUAN1d

Develop subwatershed water quantity standards to preserve existing flood levels and reduce runoff rates and which are consistent with target pollutant loads.

Action Policy WQUAN1e

Evaluate the existing water quantity monitoring programs to assess achievement of water quantity standards.

Action Policy WQUAN1f

Evaluate the feasibility of retrofitting existing stormwater management systems to achieve water quantity standards.

Action Policy WQUAN1g

Inspect and maintain District owned storm sewers.

Action Policy WQUAN1h

Accept the Trout Brook Stormsewer System from the Metropolitan Council and the City of St. Paul under terms and conditions acceptable to the District Board of Managers.

Goal #2 – Runoff Rate Control

Reduce runoff rates to levels that allow for stable conveyance of flow throughout the water resources of the District.

Action Policy WQUAN2a

Require rate control practices on all new development and re-development to preserve runoff rates at a level that will not cause the degradation of water resources.

Action Policy WQUAN2b

Protect the stability and integrity of all watershed district managed conveyance systems. The cities will be responsible for the integrity of their systems.

Action Policy WQUAN2c

Create and provide education to residents, community groups, redevelopment planners and project designers on the importance of minimizing imperviousness and BMPs for flow reduction.

Action Policy WQUAN2d

Create and provide education to contractors and city and county staff on proper BMP installation.

Major Area IV– Wetland Management – (WTMGT)

Purpose – Manage wetlands to achieve no-net loss of acreage and functions and values, and where possible, strive to enhance the functions and values of existing wetlands within the District. Seek to achieve a net wetland gain within the Watershed by restoring previous impacted wetlands and creating new wetlands.

Goal #1 – Protection of Existing Wetlands

Develop and implement a wetland management program that allows for the proper use of the District's wetlands while maintaining their size and functions and values.

Action Policy WTMGT1a

Utilize information from the wetland inventory and function and value assessment of the wetlands within the District and identify priority wetlands for protection.

Action Policy WTMGT1b

Develop a wetland management plan which offers flexible management based on the function and value assessment.

Action Policy WTMGT1c

Prevent the degradation of wetlands by managing or buffering the direct and indirect activities which impact their quality.

Action Policy WTMGT1d

When managing a wetland for the primary purposes of quality management and flood retention, minimize detrimental effects to the other wetland functions and values such as wildlife habitat, species diversity, aesthetics, etc.

Goal #2 – Wetland Enhancement, Restoration, & Creation

Maintain, enhance, and restore where possible the functions and values of existing areas and wetlands within the District.

Action Policy WTMGT2a

Develop a wetland management plan which identifies and prioritizes degraded wetlands which have the potential to be restored.

Action Policy WTMGT2b

Conduct watershed-wide wetland enhancement by eliminating exotic and invasive vegetation.

Action Policy WTMGT2c

Seek opportunities to create new wetlands and restore previously impacted wetlands.

Action Policy WTMGT2d

Create and provide education to residents, community groups, redevelopment planners, project designers, city and county staff on the relationship between habitat and water quality and the importance of wetlands and riparian areas. Provide options for habitat enhancement and restoration as a component of any development or redevelopment design.

Action Policy WTMGT2e

Seek opportunities to infiltrate storm water runoff in association with wetland functions and values.

Major Area V– Groundwater Quality Protection – (GWQP)

Purpose – Protect and conserve the groundwater resource and encourage the infiltration of properly treated surface water to recharge groundwater.

Goal #1 – Groundwater Protection

Protect groundwater sources and recharge areas consistent with the responsibilities identified in the Ramsey County Groundwater Quality Protection Plan.

Action Policy GWQP1a

Work with local and county agencies to encourage practices that minimize the risk of groundwater pollution. Require cities within the watershed to adopt the Ramsey County Groundwater Quality Protection Plan in their local water plan.

Action Policy GWQP1b

Work with local and county agencies to develop policies that encourage groundwater recharge and discourage over-pumping of aquifers.

Action Policy GWQP1c

Adopt the Ramsey County Groundwater Quality Protection Plan and assist in implementing its recommendations.

Action Policy GWQP1d

Participate in groundwater monitoring, wellhead protection efforts, education, and abandoned well sealing programs with Ramsey SWCD.

Goal #2 – Infiltration

Encourage the infiltration of properly treated surface water into the groundwater system, where appropriate.

Action Policy GWQP2a

Incorporate infiltration techniques into District stormwater management projects.

Action Policy GWQP2b

Encourage infiltration on development and redevelopment sites in the District.

Action Policy GWQP2c

Study and research infiltration methods and techniques.

Action Policy GWQP2d

Encourage infiltration on residential and small commercial/business sites in the District through education.

Major Area VI – Stewardship – (STEW)

Purpose – Provide those living, working and recreating in the Capitol Region Watershed District with the knowledge and skills required to assure protection and improvement of the Watershed District's surface water and groundwater resources.

Goal #1 – Watershed Concept

Residents, community members, government officials, and government staff will understand the concept of the watershed and that individual combined land use practices determines the quality of shared water resources.

Goal #2 – Understand Water Resources

Residents, community members, government officials, and government staff will understand the basics of lake, stream, groundwater and wetland science and the factors that impact water quality, public health, flood control and wildlife habitat.

Goal #3 – The District, Its Purpose and How it Works

Residents, community members, government officials, and government staff will know they live or work in the Capitol Region Watershed District, know the District's purpose, be able to identify the District's major water resources, know how to contact the District and know what issues the District should be contacted for.

Goal #4 – Understand Best Management Practices

Residents, community members, government officials, and government staff will understand and be able to carry out practices that protect and enhance the lakes, streams, groundwater and wetlands of the Capitol Region Watershed District.

Goal #5 – Intergovernmental Communications

Local, county state, and federal government officials will be given regular updates of District initiatives, projects and problems.

The Stewardship Action Policies can be applied broadly to all of the Stewardship Goals as well as the other Major Areas of Watershed District Involvement; accordingly, they are shown together below independent of the Goals.

Action Policy STEWa

Maintain an active citizen advisory committee to provide input and assistance on District activities.

Action Policy STEWb

Participate in existing water resource educational outreach programs.

Action Policy STEWc

Provide information to agency staff on the impact of land use decisions and infrastructure management on water resources.

Action Policy STEWd

Pursue educational programs targeted to the diverse population of the District with the cooperation of a variety of environmental groups and local groups.

Action Policy STEWe

Develop and provide education/information pieces on the who, what, where and importance of Watersheds.

Action Policy STEWf

Involve citizens in water resource implementation and restoration activities, where feasible.

APPENDIX II-2

CITY OF ROSEVILLE - SHORELAND, WETLAND, AND STORM MANAGEMENT ORDINANCE

Roseville's Shoreland, wetland, and storm management ordinance, chapter 1016, was adopted in 1994. This ordinance applies to shoreland, wetland and storm water management overlay districts and the city in general. The sections relevant to the Lake McCarrons Management Plan are annotated below.

§ 1016.11 Administration

A. Enforcement. The Community Development Director is responsible for enforcing this chapter

§ 1016.13 Shoreland Classification

Lake McCarrons is classified as 'General Development, meaning minimum lot sizes for riparian and nonriparian lots are specified as follows:

R-1 Single-Family

Riparian	15,000 square feet (area above OHW)	100 feet (width)
Nonriparian	11,000 square feet (area above OHW)	85 feet (width)

R-2 Duplex

Riparian	26,000 square feet (area above OHW)	135 feet (width)
Nonriparian	17,500 square feet (area above OHW)	135 feet (width)

§ 1016.17 General Design Criteria for Structures:

C. Water-Oriented Accessory Structures. Each lot may have one water-oriented nonhabitable accessory structure not meeting the normal structure setback.

D. Stairways, chair lifts and deck landings in the bluff zone. Provides specifications.

§ 1016.22 Nonconformities. All legally established as the date of the code nonconformities may continue. This section provides conditions for variances, additions and expansions, and decks.

§ 1016.25 Grading, filling and Land Alteration

D. Shoreland Alterations. Regulated to prevent erosion, fix nutrients, preserve aesthetics, prevent slumping, and protect fish and wildlife habitat.

- E. Vegetation Alterations in Shoreland Areas. Intensive vegetation clearing not allowed in shore and bluff impact zones (limited clearing, pruning and trimming is allowed).

§ 1016.26 Storm Water Management. Applies to all developments in the city.

- A. General Standards. Provides for use of existing drainage ways (when possible), minimum disturbances and the use of constructed facilities.

- B. Specific Standards

- Impervious coverage not to exceed 25%.
- All storm water facilities to comply with city's surface water management plan NURP standards, MPCA's Urban BMP and established standards.
- All developments of more than 5 acres must be served by a storm water pond that removes 90% of the sediments, provide for on-site settling,

APPENDIX II-3

CITY OF ROSEVILLE - SURFACE WATER MANAGEMENT PLAN (1990)

Roseville's surface Water Management Plan, adopted in February 1990, meets these requirements:

- Describes existing and proposed physical environment and land use
- Defines drainage areas, drainage paths, volumes and rates of runoff, and areas and elevations of storage basins
- Defines water quantity and quality protection
- Identifies regulated areas
- Develops an implementation program including official controls and a capital improvement program.

The plan is organized in these sections:

Section 1 Introduction

- 1.1 Background
- 1.2 Planning Process
- 1.3 Plan Summary

Section 2 Water Management Organization Goals

- 2.1 General

Section 3 Physical Environment

- 3.1 Topography & Geology
- 3.2 Soils
- 3.3 Land Use
- 3.4 Public Utilities

Section 4 Hydrologic System

- 4.1 General
- 4.2 Method of Analysis
- 4.3 Study Results

Section 5 Water Quality

- 5.1 General
- 5.2 Monitoring
- 5.3 Modeling
- 5.4 Classification of Wetlands
- 5.5 Lakes
- 5.6 Water Quality Plan

Section 6 Goals and Policies

- 6.1 General
- 6.2 Mission Statement
- 6.3 Water Quantity
- 6.4 Water Quality
- 6.5 Erosion and Sedimentation
- 6.6 Ground Water
- 6.7 Recreation, fish & Wildlife
- 6.8 Regulatory Responsibility

Section 7 Management Strategy

- 7.1 Management Practices
- 7.2 Problem Identification
- 7.3 Water Resources Inventory
- 7.4 Classification of Water Bodies

Section 8 Implementation Plan

- 8.1 General
- 8.2 Administrative Process
- 8.3 Regulations
- 8.4 Capital Improvement Program
- 8.5 Financing
- 8.6 Amendment Procedure

Appendices

APPENDIX II-4

CITY OF ROSEVILLE - NUISANCE ORDINANCE (CHAPTER 407)

The sections relevant to the Lake McCarrons Management Plan are annotated below. Those sections deemed not relevant have been deleted with a note saying, 'not listed here.'

407.01: DEFINITIONS:

ABANDONED VEHICLE: not listed here.

FRONT YARD AREA: All that area between the front property line and a line drawn along the front face or faces of the principal structure on the property extended to the side property lines. The front side of the property shall be determined as specified in title 11 of this code.

INOPERABLE CONDITION: not listed here.

JUNK VEHICLE: An inoperable motor vehicle which is partially dismantled, which is used for sale of parts or as a source of repair or replacement parts for other vehicles, or which is kept for scrapping, dismantling or salvage of any kind unless such vehicle is kept in an enclosed garage. An abandoned vehicle shall also be considered a junk vehicle for the purpose of this chapter.

NUISANCE: Any act, substance, matter emission or thing which creates a dangerous or unhealthy condition or which threatens the public peace, health, safety or sanitary condition of the city or which is offensive or has a blighting influence on the community and which is found upon, in, being discharged or flowing from any street, alley, highway, railroad right of way, vehicle, railroad car, water, excavation, building, erection, lot, grounds, or other property located within the city of Roseville. Nuisances shall include, but not be limited to, those enumerated below:

A. Maintains or permits a condition which unreasonably annoys, injures or endangers the safety, health, comfort or repose of members of the public; or

B. Interferes with, obstructs or renders dangerous for passage, any public road or right of way, street, alley or highway or waters used by the public; or

C. Is guilty of any other act or omission declared by law to be a public nuisance specifically provided; or

D. Anything left or displayed for sale on public or private property without written permission by the owner or person in control of the property may be tagged and/or towed at the owner's expense.

E. In any way render the public insecure in life or in use of property.

OCCUPANT: Includes any person living in or in control of any dwelling unit upon property wherein a motor vehicle is parked.

VEHICLE OR VEHICLES: Any "motor vehicle" as defined in Minnesota Statutes but excluding the following:

A. Trailers with weight classifications of A and B as provided in Minnesota Statutes.

B. Snowmobiles, and

C. "All-terrain vehicles" as defined in Minnesota Statutes.

VITAL COMPONENT PARTS: not listed here.

407.02: NUISANCES AFFECTING HEALTH, SAFETY, COMFORT OR REPOSE:

The following are hereby declared to be public nuisances affecting health, safety, comfort or repose:

- A. Diseased Animals: All diseased animals running at large.
- B. Carcasses: Carcasses of animals not buried or destroyed within twenty four (24) hours after death.
- C. Weeds: All noxious weeds are prohibited. Tall grasses, nuisance weeds and rank vegetative growth shall be maintained at a height of eight inches (8") or less in locations closer than forty feet (40') to:
 - 1. An occupied principal structure;
 - 2. Any property line with an occupied structure on abutting property; and
 - 3. A public road pavement edge.This section shall not apply to natural areas such as woods, bogs, marshes, ground covers, wildflower or prairie restoration and public open space or park lands as determined by the city forester or naturalist designated by city manager. (Ord. 1136, 2-28-1994)
- D. Debris: An accumulation of tin cans, bottles, trash or debris of any nature or description and the throwing, dumping or depositing of any dead animals, manure, garbage, waste, decaying matter, ground, sand, stones, ashes, rubbish, tin cans or other material of any kind on private property.
- E. Smoke And Fumes: Dense smoke, noxious fumes, gas and soot or cinders in unreasonable quantities. (Ord. 207, 11-9-55)
- F. Backyard Composting: All composting consisting of yard waste and/or kitchen waste which have been left unattended and which cause offensive odors, attract rodents and/or pests or are unsightly. (Ord. 1092, 6-10-91)
- G. Keeping Of Farm Animals: The keeping of cows, horses, sheep, goats or any four (4) legged animal commonly known as farm animals, other than those commonly called poultry, in any pasture, stable or any enclosure within three hundred feet (300') or less of any other lot in any residence district. (Ord. 629, 9-28-70)
- H. Peddling: not listed here.
- I. Service Stations: not listed here
- K. Standards: Any building, fence or other structure is a public nuisance if it does not comply with the following requirements:
 - 1. All wires which are strung less than fifteen feet (15') above the surface of any public street or alley.
 - 2. All exterior doors and shutters shall be hung properly and have an operable mechanism to keep them securely shut or in place.
 - 3. All cornices, moldings, lintels, bay or dormer windows and similar projections shall be kept in good repair and free from cracks and defects which make them hazardous or unsightly.
 - 4. Roof surfaces shall be tight and have no defects which admit water. All roof drainage systems shall be secured and hung properly.
 - 5. Chimneys, antennae, air vents and other similar projections shall be structurally sound and in good repair. Such projections shall be secured properly where applicable to an exterior wall or exterior roof.
 - 6. All foundations shall be structurally sound and in good repair.
- L. Declaration Of Nuisance: The outside parking and storage on residentially-zoned property of vehicles, materials, supplies or equipment not customarily used for residential purposes in violation of the requirements set forth below is declared to be a public nuisance because it: 1) obstructs views on streets and private property, 2) creates cluttered and otherwise unsightly areas, 3) introduces commercial advertising signs into areas where commercial advertising signs are otherwise prohibited, 4) decreases adjoining landowners and occupants' enjoyment of their property and neighborhood, and 5) otherwise adversely affects property values and neighborhood patterns. Service vehicles with a

manufacturer's rated capacity of two thousand (2,000) pounds or less are exempt from this provision.

M. Unlawful Parking And Storage:

1. No person may place, store, or allow the placement or storage of ice fish houses, skateboard ramps, play houses, or other similar nonpermanent structures outside continuously for longer than twenty four (24) hours in the front-yard area of residentially-zoned property.
2. No person may place, store or allow the placement or storage of pipe, lumber, steel, machinery or similar materials including all materials used in connection with a business, outside on residentially-zoned property.
3. No person shall cause, undertake, permit or allow the outside parking and storage of vehicles in residentially-zoned property for more than thirty (30) days unless it complies with the following requirements.
 - a. Vehicles which are parked or stored outside shall be on an improved surface as defined in this Code.
 - b. All vehicles, watercraft and other articles stored outside on residential property must be owned by a person who is a legal resident of that property.
4. No person, owning, driving or in charge of any vehicle with a manufacturers rated capacity of more than one ton, as specified in Minnesota Statutes, may cause or permit that vehicle to be parked outside or stand continuous for more than two (2) hours on property or public street within a residential zone in the City.

N. Exceptions: The prohibitions of this Section shall not apply to the following:

1. Any motor truck, pickup truck, or similar vehicle being used by a public utility, moving company, or similar company, which is actually being used to service a residence not belonging to or occupied by the operator of the vehicle.
2. Any vehicle which is actually making a pickup or delivery at the location where it is parked. Parking for any period of time beyond the period of time reasonably necessary to make such a pickup or delivery and in excess of the two (2) hour limit shall be unlawful.

O. Vehicles Constituting A Public Nuisance:

1. Abandoned And Junk Vehicles Create Hazard: Abandoned and junk vehicles are declared to be a public nuisance creating hazard to the health and safety of the public because they invite plundering, create fire hazards, attract vermin, and present physical dangers to the safety and well being of children and other citizens. The accumulation and outside storage of such vehicles is in the nature of rubbish, litter and unsightly debris and is a blight on the landscape and a detriment to the environment. It shall be unlawful for a person to pile, store or keep wrecked, junked or abandoned motor vehicles on private or public property.
2. Vehicles Impeding Traffic Flow: Any vehicle, whether occupied or not that is found stopped, standing or parked in violation of any ordinance or State statute; or that is reported stolen; or that is found impeding firefighting, snow removal or plowing or the orderly flow of traffic is declared to be a public nuisance.
3. Vehicles Impeding Road And Utility Repair: Any vehicle which is impeding public road or utility repair, construction or maintenance activities after reasonable notice of the improper activities has been given to the vehicle owner or user at least twelve (12) hours in advance, is declared to be a public nuisance.
4. Vehicles Without License Plates: Any vehicle shall be deemed to be junked or abandoned vehicle if said vehicle does not have attached thereto a valid and current license plate issued by the proper State agency.

P. Abatement Of Vehicles:

1. Impounding: Any police officer or other duly authorized person may order any vehicle constituting a public nuisance to be immediately removed and/or impounded. The impounded vehicle shall be surrendered to the duly identified owner by the towing contractor only upon payment of the required impound, towing and storage fees.
2. Sale: Notice and sale of any vehicle impounded under this Chapter shall be conducted in accordance with Minnesota Statutes chapter 168B governing the sale of abandoned motor vehicles. (Ord. 1162, 7-10-95)

407.03: NUISANCES AFFECTING PEACE AND SAFETY:

The following are declared to be nuisances affecting public peace and safety:

- A. Snow On Nonmotorized Pathways: not listed here.
- B. Low Wires: not listed here.
- C. Dangerous Buildings: not listed here.
- D. Explosives: not listed here.
- E. Noises: All unnecessary noises and annoying vibrations.
- F. Radio Aerials: not listed here.
- G. Storage Of Wood: The storage of any wood or wood product used or intended to be used as fire wood on residential properties within the City unless wood piles are erected, located and maintained in a safe and orderly fashion:
 1. In neat and secure stacks elevated six inches (6") off the ground;
 2. A maximum height allowed for a wood pile is six feet (6'); and
 3. Fire wood shall only be stored in a side or rear yard.The City Council may issue permits for the storage of wood in situations where unique circumstances preclude the ability to meet the standards of the Code. (Ord. 522, 1-9-67; amd. 1995 Code)
- H. Junk: The outside piling, storing or keeping of old machinery, furniture, household furnishings or appliances or component parts thereof, rusting metal inoperable/unusable equipment, or other debris visible on private or public property. (Ord. 1162, 7-10-1995)
- I. Obstruction Of Streets: Any use of property abutting on a public street or sidewalk or any use of a public street or sidewalk which causes large crowds of people to gather obstructing traffic and the free use of public streets or sidewalks.
- J. Dangers Attractive To Children: All dangerous, unguarded machinery, equipment or other property in any public place or so situated or operated on private property as to attract minor children.
- K. Material From Air: not listed here.
- L. Interfering With Drainage: Placing entrance culverts or doing any act which may alter or affect the drainage of public streets or alleys or the surface or grade of public streets, alleys or sidewalks without proper permit.
- M. Repairing Vehicles Or Tires In Streets: Making repairs to motor vehicles or tires in public streets or alleys, excepting only emergency repairs when it will not unduly impede or interfere with traffic.
- N. Trash In Streets: Throwing, placing, depositing or burning leaves, trash, lawn clippings, weeds, grass or other material in the streets, alleys or gutters.
- O. Unauthorized Signs: Erecting, painting or placing of unauthorized traffic signs or advertising signs in streets, alleys or on sidewalks.
- P. Interference With Radio Or TV: not listed here.
- Q. Storing Of Boats, Trailers And Inoperative Motor Vehicles In Front Yards:
 1. The storing of the following things for a period longer than seventy two (72) hours in the front yard of any residential zoned area:
 - a. Trailers of any kind, unless supporting a boat of twenty feet (20') or less.

- b. Boats or watercraft of any kind in excess of twenty feet (20').
 - c. Inoperative motor vehicles of any type.
 - d. Campers and camper buses.
2. For the purpose of this Section, "front yard" means any area between any public street and a line parallel to the public street at the building line. (Ord. 522, 1-9-1967; 1995 Code)

407.04: PUBLIC NUISANCE UNLAWFUL:

It shall be unlawful for any person, firm, corporation or association to maintain any public "nuisance" as defined in this Chapter and it shall further be unlawful to do any act which act is defined as a public "nuisance" in this Chapter. (Ord. 320, 6-9-1961)

407.05: CITY COUNCIL MAY ENFORCE:

The City Council may enforce the provisions of this Chapter and may, by resolution, delegate to other officers or agencies power to enforce particular provisions of this Chapter, including the power to inspect private premises. The officers charged with enforcement of this Chapter shall take all reasonable precautions to prevent the occurrence and continuance of public nuisances. (Ord. 1185, 7-28-1997)

407.06: POWERS OF OFFICERS:

- A. Notice: Whenever the officer charged with enforcement determines that a public nuisance is being maintained or exists on premises in the City, the officer shall notify, in writing, the owner or occupant of the premises of such fact and order that such nuisance be terminated or abated.
- B. Service Of Notice: The notice shall be served in person or by certified or registered mail. If the premises are not occupied and the owner is unknown, the notice may be served by posting it on the premises. The notice shall specify the steps to be taken to abate the nuisance and the time, not exceeding thirty (30) days, within which the nuisance is to be abated.
- C. Noncompliance: If the notice is not complied with within the time specified, the enforcing officer shall immediately report that fact to the City Council.
- D. Action Of City Council: Upon notice from the enforcing officer of noncompliance, the City Council may, after notice to the owner or occupant and an opportunity to be heard, provide for abating the nuisance by the City.
- E. Notice By City Council: The notice shall be served in the same manner as notice by the enforcing officer is served and shall be given at least ten (10) days before the date stated in the notice when the City Council will consider the matter. If the notice is given by posting, at least thirty (30) days shall elapse between the day of posting and the hearing.
- F. Immediate Threat: If the nuisance poses an immediate threat to the health or safety of the public, the City may abate the nuisance immediately with no hearing. (Ord. 1016, 6-8-1987)

407.07: RECOVERY OF COST:

- A. Personal Liability: The owner of premises on which a nuisance has been abated by the City shall be personally liable for the cost to the City of the abatement, including administrative costs. As soon as the work has been completed and the cost determined, the City Manager, or other official designated by the City Council, shall prepare a bill for the cost and mail it to the owner. The amount shall be immediately due and payable at the office of the City Manager.
- B. Assessment: If the nuisance is a public health or safety hazard on private property, the accumulation of snow and ice on public sidewalks, the growth of weeds on private property or outside the traveled portion of streets, or unsound or insect infected trees, the city manager shall, on or before September

1 next following abatement of the nuisance, list the total unpaid charges along with all other such charges, as well as other charges for current services to be assessed under Minnesota Statutes section 429.101 against each separate lot or parcel to which the charges are attributable. The city council may then spread the charges against such property under that statute and other pertinent statutes for certification to the County Auditor and collection along with current taxes the following year, or in annual installments not exceeding ten (10), as the city council may determine in each case. (Ord. 1016, 6-8-1987)

407.08: ACCELERATED ABATEMENT PROCESS FOR CERTAIN NUISANCES:

- A. Notwithstanding the provisions of section 407.06 of this chapter, city officers charged with enforcement of this chapter shall follow the accelerated procedure described below for abating accumulations of snow and ice under subsection 407.03A of this chapter and tall grasses, nuisance weeds and other vegetative growth under subsection 407.02C of this chapter.
1. Notice Of Violation: Whenever the officer charged with enforcement determines that a nuisance proscribed under subsection 407.03A or 407.02C of this chapter is being maintained or exists on premises in the city, written notice by certified first-class mail shall be provided to the property owner or occupant. If the premises are not occupied and the owner is not known, the notice may be served by posting it on the premises. The certified notice shall specify the nuisance to be abated, that the nuisance must be abated within five (5) working days, and that if the nuisance is not abated within five (5) working days, that the city will have the nuisance abated and the cost of abatement certified against the property for collection with taxes.
 2. Abatement By City: If the owner or occupant fails to comply with the certified mail notice, within five (5) days, the city shall provide for abatement of the nuisance. The officer charged with enforcement shall keep records of the cost of abatement and shall provide this information to the city manager for assessment against the property pursuant to section 407.07 of this chapter. (Ord. 1228, 7-12-1999)

APPENDIX II-5

CONTACT INFORMATION

Agencies

Capitol Region Watershed District (web:ramseyconservation.org/crwd/capitol)

2015 Rice Street, Roseville, MN 55113-6814 [This changes in January 2003]

Contact:

[This number changes in January 2003] (651) 488-1476 ext. 14

Metropolitan Council Environmental Services (web: metcouncil.org)

230 East 5th Street, St. Paul, MN 55101 (651) 602-1000

Contacts:

Randy Anhorn (lakes) (651) 602-8743

Minnesota Department of Health (web: health.state.mn.us)

Fish Consumption Advisory see web site

Minnesota Department of Natural Resources (web: dnr.state.mn.us)

500 Lafayette Road, St. Paul, MN 55155 (651) 296-6157

Contacts:

Chip Welling, Eurasian Watermilfoil Coordinator (651) 297-8021

Metro Region 6 Office (651) 772-7990
1200 Warner Road, St. Paul, MN 55106

Contacts:

Dave McCormick, Aquatic Nuisance Control Specialist (651) 772-7956

Joe Richter, Div. of Waters

Dave Zappetello, Metro East Fisheries Manager (651) 772-7963

Minnesota Pollution Control Agency (web: pca.state.mn.us)

520 Lafayette Road, St. Paul, MN 55155

24 Hour Emergency (651) 296-6300

Ramsey County (web: co.ramsey.mn.us)

3377 N. Rice Street, Shoreview, MN 55126

Contact:

Terry Noonan, Environmental Services Manager (651) 482-5230

6015 N. Van Dyke Street, Maplewood, MN 55109

Contact:

Greg Mack, Director of Parks and Recreation (651) 748-2500

Ramsey Soil & Water Conservation District (web: ramseyconservation.org)

2015 Rice Street, Roseville, MN 55113-6814

Contact:

Tom Petersen, Administrator (651) 488-1476 ext. 11

Dave Bauer, Natural Resources GIS Specialist (651) 488-1476 ext. 13

City of Roseville (web: ci.roseville.mn.us)

2660 Civic Center Drive, Roseville, MN 44113

Contacts:

Duane Schwartz, Public Works (651) 490-2220

Lonnie Brokke, Parks (651) 415-2107

Maintenance (651) 490-2310

Emergency (651) 484-1700

University of Minnesota Water Resources Center (web: wrc.coafes.umn.edu)

173 McNeal Hall (612) 624-9282

1985 Buford Ave

St. Paul, MN 55108

Other Lake, Watershed & Environmental Organizations

Aquatic Plant Management Society (web: apms.org)

Center for Watershed Protection (web: cwp.org)

Minnesota Center for Environmental Advocacy (web: mncenter.org)

Minnesota Lakes Association (web: mnlakes.org)

Minnesota Sea Grant (web: seagrant.umn.edu)

North American Lake Management Society (web: nalms.org)

Shoreland Restoration (web: uwex/ces/shoreland)

APPENDIX IV-1

ADVISORY & TECHNICAL GROUP ROSTERS

These individuals have attended at least one meeting or have specifically asked to be included on the project mailing list.

Advisory Group

Marj Ebensteiner	Ramsey Soil & Water Conservation District Board
Joe Englund	Watershed Resident
Judy Erdman	Watershed Resident
Joe Fox	Ramsey Soil & Water Conservation District Board
Rep. Mindy Greiling	Roseville State Representative
John Hanna	Watershed Resident
Duane Haukebo	Lake McCarrons Neighborhood Association
Denise Hermes	Lake McCarrons Neighborhood Association (past board member)
Frank or Roger Hess	Lake Residents
Diane Hilden	Lake McCarrons Neighborhood Association
Nan Jahnke	Lake McCarrons Neighborhood Association
George Johnson	Lake McCarrons Neighborhood Association (past board member)
Gregory Mack	Director, Ramsey County Parks and Recreation
Jim Moncur	Lake McCarrons Neighborhood Association (past board member)
Phyllis Marsili	Watershed Resident
Sen. John Marty	Roseville State Senator
Bob & Margie McCarron	Watershed Resident
Mary Jo McGuire	Roseville State Representative
Janet Olson	Roseville Planning Commission
John Plummer	Watershed Resident
Maryjane Reagan	Ramsey Soil & Water Conservation District Board
Steve Schroeder	Watershed Resident
Roberta Sladky	Lake McCarrons Neighborhood Association
Jan Wiessner	Ramsey County Commissioner
Ernie Willenbring	Watershed Resident
Chuck Woods	Lake McCarrons Neighborhood Association (past board member)

Technical Group

Randy Anhorn	Metropolitan Council Environmental Services
David Bauer	Ramsey Soil & Water Conservation District
Deb Bloom	Assistant Public Works Director, Roseville
Keith Cherryholmes	MN PCA - REM Division
Jeff Gorton	MN DNR - Metro East Fisheries
Brian Grundtner	Ramsey County Public Works
John Hensel	MN PCA - REM Division
Larry Holmberg	Ramsey County Parks and Recreation
Karen Jensen	Metropolitan Council Environmental Services
Mary Laeho	MN DOT WRE
Terry Noonan	CRWD Staff & Ramsey County Public Works
Tom Petersen	CRWD Staff & Ramsey Soil & Water Conservation District
Nick Proux	MN DNR - East Metro
Joe Richter	MN DNR – Metro Waters
Duane Schwartz	Public Works Director, Roseville
Chip Welling	MN DNR – Ecological Services
Dave Zappetillo	MN DNR – East Metro Fisheries

Capitol Region Watershed District

Jane Dusek	District Assistant
Mary Jo Murray	Manager, Public Relations and Information
Bob Piram	Board Chair
Michael Thienes	Manager, Treasurer
Jerome Wagner	Citizens Advisory Committee

Project Consultants

Dick Osgood	THE OSGOOD GROUP
Greg Wilson	BARR ENGINEERING

APPENDIX VI - 1

BACKGROUND, EXPLANATION & JUSTIFICATION FOR MANAGEMENT ACTIONS TO CONTROL OR MINIMIZE SUMMER ALGAE BLOOMS IN LAKE MCCARRONS

What was Lake McCarrons like prior to settlement?

In its original conditions, Lake McCarrons was much different. The lake basin was formed about 10,000 years ago by a left over ice block from a retreating glacier. As the ice melted, it left a depression that eventually filled with water. The condition of the surrounding landscape was largely unchanged until the settlement of Europeans. At this time, say about 1800, the condition of Lake McCarrons was substantially more pristine compared to now.

The lake received water from a much smaller surface watershed. Today, the lake's tributary watershed is 1,067.5 acres. In 1800, the tributary watershed was about 1/3 its present size (rough approximation). This smaller size is estimated from the present land contours and examining the artificial outlets and drainage conveyances now in place. Prior to urbanization, many of the outlying ponds and wetlands were 'internally drained,' meaning they did not overflow and were therefore not tributary to Lake McCarrons.

Because there was a smaller tributary area as well as a lower runoff rate, about 20% of today's rate (rough approximation), there was substantially less runoff volume (33% x 20%, or about 7%) flowing to Lake McCarrons. Even though there was less surface water flowing into Lake McCarrons, there was probably more subsurface (=groundwater) water flowing into the lake, thus the influence of groundwater has probably decreased.

The amount of phosphorus carried in the runoff water was also substantially less than today. The rate of phosphorus runoff today is about 1 pound per acre per year (from the immediate surrounding subwatershed). Prior to settlement, that rate was about 1/10 pound per acre per year (a rate appropriate for undeveloped open space). This, in combination with a smaller tributary area, resulted in a phosphorus input about 6% of what occurs today.

The lower phosphorus input into a more pristine lake means the lake phosphorus concentration was about 3 ppb, as estimated by a lake model. Sediment data have also been used to estimate past phosphorus conditions. According to this method, Lake McCarrons phosphorus concentration was 24 ppb. Both methods indicate a lower phosphorus concentration in the lake compared to what has been measured over the past 18 years. The corresponding algae levels were much lower, the corresponding clarity was much higher and the corresponding oxygen levels were much higher. Internally recycled phosphorus was not a factor.

How did Lake McCarrons get like it is?

As settlement occurred, land clearing for agriculture resulted in the removal of native trees, the compaction and tilling of soils and an increase in runoff. Further, ditches were likely dug to facilitate

drainage, which resulted in adding new areas to the watershed, thereby increasing the amount of runoff and the phosphorus content in the runoff. Later, perhaps in the 1930s and 1940s, roads were constructed and the start of urbanization occurred, which further increased runoff and phosphorus inputs to the lake. At some point, the accumulation of the additional phosphorus and other materials into the lake along with the increasing fertility, caused the internal phosphorus cycle to 'kick in.' By the 1960s or 1970s, the condition of Lake McCarrons was probably very much like it is today. Sediment data indicate the lake's phosphorus content to be 55 ppb in 1970, approximately the contemporary level.

The contemporary phosphorus inputs to Lake McCarrons have been estimated. These are presented below (Table VI-1) for comparison with the estimated 1800 condition. These phosphorus loading values are discussed in greater detail in the following sections of the chapter. However, it is clear the amount of phosphorus entering Lake McCarrons from runoff is much greater now compared to pre-development. The point of this exercise is to illustrate this large change to provide a realistic context for the management of the lake.

Table VI-1
Historic and Contemporary Phosphorus Loads (pounds/year) to Lake McCarrons.

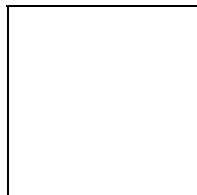
Subwatershed*	1800	1996
1	n/a	0
3	n/a	362
4	n/a	160
6	n/a	30
TOTAL	approx. 16	552

*Keyed to Figure III-1.

Urbanization and the increased impervious area certainly had the effect of increasing surface runoff and depriving groundwater recharge areas (see Figure VI-1 for groundwater gradients to Lake McCarrons). The water supply to Lake McCarrons today is more heavily weighted toward surface water and less heavily weighted toward groundwater. One concern that has been raised in recognition of this fact is that the temperature of the water supplying Lake McCarrons is warmer with a greater contribution of surface water. While this is probably true, there is no evidence that the water in Lake McCarrons is warmer as a result. Lake waters are warmed by the sun's energy rather than by dilution with the waters feeding the lake, so there is no reason to expect Lake McCarrons is warmer as a result of more surface runoff and less groundwater input. In fact, a simple calculation of the lake's heat budget indicates the lake's surface water temperatures warm at a rate of about 0.3 °F per day and groundwater takes away (cooling by dilution) about 0.018 °F per day. In other words, sun energy accounts for at least 94% of the warming of the lake.

Figure VI-1

Water Table Contours (green lines) - Groundwater Flow to Lake McCarrons.

Where can we go from here?

Obviously, there is no practical way to mimic the conditions around Lake McCarrons that occurred in 1800. Two strategic approaches are normally used to reduce lake phosphorus concentration and control algae problems in lakes. The two strategies are to 1) reduce in amount of phosphorus in runoff to the lake and 2) reduce or eliminate the impact of internally supplied phosphorus. In cases like Lake McCarrons, both are necessary to accomplish meaningful lake phosphorus reductions. To evaluate the impact of internal and external phosphorus inputs, a water and phosphorus budget must be provided as inputs to a model that is used to estimate lake phosphorus concentration.

Water and Phosphorus Budgets

Water enters Lake McCarrons from three sources - rainfall directly on the lake's surface, surface runoff and groundwater. Because rainfall patterns vary from year-to-year, the amount of water flowing into the lake varies as well. It is common to look at a 'normal' condition along with a 'wet' and 'dry' condition to evaluate the range of possible situations.

Water inputs to the lake have been evaluated for each of these conditions according to rainfall frequencies. The normal condition refers to the median annual rainfall amount and the wet and dry conditions refer to the 75th and 25th percentile conditions³. To estimate precipitation directly on the lake's surface, the annual precipitation is multiplied by the lake's surface area. Runoff has been estimated by Barr Engineering according to the P8 model (a computer simulation appropriate for this urban environment). The Metropolitan Council report in 1997 estimated groundwater inflow to Lake McCarrons as a residual to the water balance equation. The average value was $315 \times 10^3 \text{ m}^3$ for the two study years (1995 and 1996). While this is a significant volume (about 28% of the total flow in a normal year, see Table VI-2), it has minor impacts on the estimated phosphorus concentrations in Lake McCarrons (assuming a phosphorus concentration in the groundwater = 20 ppb). The groundwater inputs have been included in the phosphorus model computations⁴.

Phosphorus inputs to Lake McCarrons have also been estimated by Barr Engineering using the same P8 model for the same three hydrologic scenarios.

³ Percentiles refer to the frequency of occurrence. A 25th percentile means that one quarter of the time, there is less rainfall and the 75th percentile means that one quarter of the time there is more rainfall.

⁴ Including the groundwater inputs changes the predicted lake phosphorus concentrations by less than 4%.

The water and phosphorus inputs for the three scenarios are tabulated below along with estimates for the hypothetical 1800 condition.

Table VI-2
Water and Phosphorus Budgets for Lake McCarrons.

	1800	Present Condition (1996/97)			Units
		Dry	Normal	Wet	
Annual Precipitation	27.7	23.4	27.7	35.1	inches
Precipitation on Lake	232 (189)	195 (158)	232 (188)	294 (238)	10 ³ m ³ (acre-feet)
Watershed Runoff Volume	38 (31)	307 (249)	572 (463)	658 (533)	10 ³ m ³ (acre-feet)
Watershed Phosphorus Load	16 (35)	106 (233)	251 (552)	275 (605)	kg (pounds)

Internal Phosphorus Supply

Internal phosphorus supply refers to the recycling of phosphorus from previously deposited sediment sources being recycled back into the lake water. This is a common phenomenon in eutrophic lakes. In stratified lakes (lakes with a thermocline), the oxygen is consumed in the lower stagnant layer soon after stratification. The anoxic conditions (= zero dissolved oxygen) change the bottom chemistry in a way that promotes the release of phosphorus that had been chemically bound in the lake sediments. This phosphorus is then released into the overlying water. Because Lake McCarrons is so strongly stratified, this released phosphorus is not immediately mixed into the surface waters where it could be used by algae. When Lake McCarrons does eventually mix late in the autumn, the phosphorus that had been entrained in the bottom waters is now mixed with the entire water body. Field data show that this high level of phosphorus persists through the winter until the following spring, thus being potentially available in the lake during the season after it was first recycled. Depending on the amount of runoff that enters the lake in the spring, this residual phosphorus may either stay in the lake (dry spring period) or be flushed out (wet spring period).

The magnitude of internal phosphorus supply available for the upcoming season is estimated as the mid-May lake phosphorus concentration multiplied by the lake volume. Field data show the mid-May phosphorus concentration in Lake McCarrons dropping in wet springs and remaining elevated in dry springs. Thus, the highest observed mid-May phosphorus concentration (= 90 ppb) is used to estimate the potential magnitude of internal phosphorus input to Lake McCarrons for the upcoming summer. This value, 228 kg (502 pounds), represents the highest potentially available internal phosphorus input to be used in the lake model (see below).

Lake Phosphorus Model

A lake model is a mathematical accounting of the water and phosphorus inputs to a lake and is used to estimate lake phosphorus concentration. The model is tested by comparing its output with observed conditions. After that, the model is used to evaluate various management scenarios.

Lake models (Nürnberg 2001) have been modified to be applicable to Lake McCarrons. Lake phosphorus concentration (P) is estimated as follows (excluding and including internal phosphorus, respectively):

$$P = L_{\text{ext}} / q_s (1-R_p) \quad \text{or} \quad P = (L_{\text{ext}} + L_{\text{int}}) / q_s (1-R_p)$$

where L_{ext} is the external phosphorus load (g m^{-2}), L_{int} is the internal phosphorus load (g m^{-2}), q_s is the areal water load (m year^{-1}) and R_p is the retention coefficient estimated (Kirchner and Dillon 1975) as $16 / (16 + q_s)$.

This model can be used to evaluate the present condition of Lake McCarrons in dry, normal and wet conditions. Here, the present condition is the 1996/97 conditions as evaluated by MCES (1997) study. Using the external and internal phosphorus input data from above, the estimated phosphorus concentration for Lake McCarrons is as follows:

Table VI-3
Estimated Lake Phosphorus Concentrations With and Without Internal Phosphorus.

	Dry	Normal	Wet
W/O Internal Phosphorus	18 ppb	40 ppb	43 ppb
W/ Internal Phosphorus	56 ppb	76 ppb	78 ppb

These estimates closely match the observed range of summer average phosphorus concentrations for Lake McCarrons since 1984 - 25 to 85 ppb. The estimated phosphorus concentration of 18 ppb for dry conditions without internal phosphorus is unlikely because a greater potential for internal loading impacts are indicated in dry springs (West-Mack and Stefan 2000).

This phosphorus model is an appropriate tool to evaluate various in-lake and watershed management scenarios for controlling algae in Lake McCarrons.

Phosphorus Reduction Scenarios

Various management scenarios can be evaluated to see how the management objective of achieving a lake phosphorus concentration of 33 ppb can be attained. A quick review of the model output below clearly indicates that the management objective cannot be met by eliminating either the internal or external phosphorus sources alone:

Table VI-4
Estimated Lake Phosphorus Concentrations Without Internal or External Phosphorus.

	Dry	Normal	Wet
W/O Internal Phosphorus	18 ppb	40 ppb	43 ppb
W/O External Phosphorus	36 ppb	38 ppb	35 ppb

The only situation where the management objective may be met is during dry conditions after internal phosphorus supplies have been eliminated.

The Technical Group has agreed that an alum application is the most feasible way to eliminate internal phosphorus supplies in Lake McCarrons. Because there is very little cost savings when considering a partial alum application, it makes sense to evaluate a treatment that eliminates (as far as practical) internal phosphorus. In this case, the model can be used to evaluate various reductions in runoff phosphorus inputs. The impacts of runoff phosphorus reductions ranging from 0 to 50% and assuming internal phosphorus is reduced by 80% (Welch and Cooke 1999) are shown below:

Table VI-5
Estimated Lake Phosphorus Concentrations with Various Reductions
in External Phosphorus and Without Internal Phosphorus.

	Dry	Normal	Wet
0% Reduction	26 ppb	47 ppb	50 ppb
10% Reduction	24 ppb	43 ppb	46 ppb
20% Reduction	22 ppb	39 ppb	41 ppb
30% Reduction	20 ppb	35 ppb	37 ppb
40% Reduction	19 ppb	31 ppb	33 ppb
50% Reduction	17 ppb	27 ppb	28 ppb

According to the information in Table VI-5, a 30-40% reduction in external phosphorus supplies, in combination with eliminating internal phosphorus supplies, will meet the management objective.

Management Actions

Management actions to support the management objective should include various watershed management activities and an alum application to control internal phosphorus in Lake McCarrons.

The five-year watershed management activities that result in a watershed reduction target of 30-40% means 166-221 pounds of phosphorus per year (based on the 1996/97 conditions, Table VI-2) must be removed.

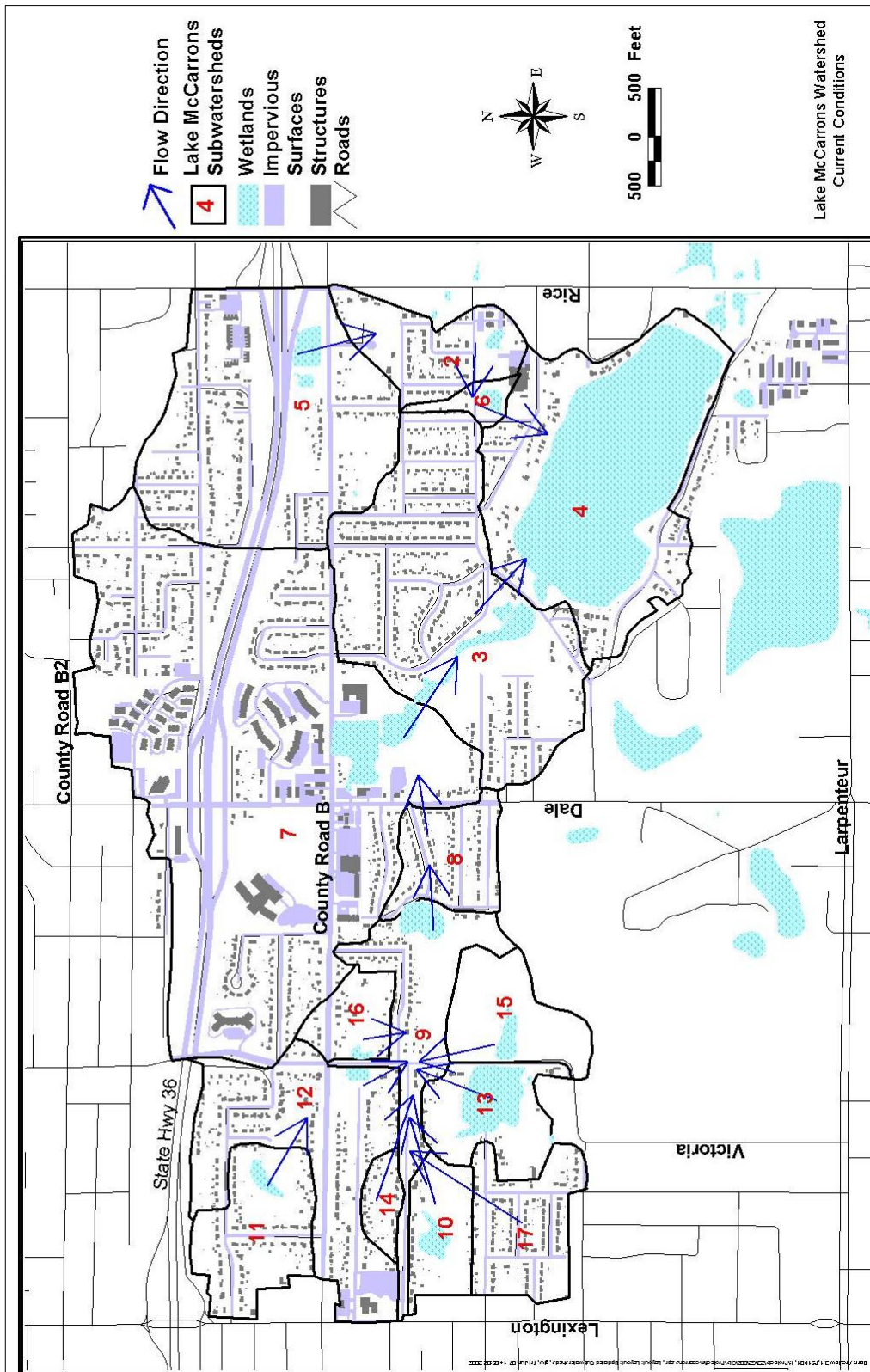
There have been recent diversions of stormwater away for Lake McCarrons which have resulted in a reduction of 101 pounds of phosphorus per year. The contemporary watershed is shown in Figure VI-2 with the corresponding phosphorus loads shown in Table VI-6.

Table VI-6
Reconciling Phosphorus Loads (pounds/year) to Lake McCarrons.

Subwatershed	1996/97	Present Condition
--------------	---------	-------------------

1	0	n/a
3	362	387
4	160	49
6	30	15
TOTAL	552	451

Figure VI-2
Lake McCarrons Watershed, Present Condition.



some areas in the Lake
s III-1 and VI-2) were
Table VI-6) and b)
a slight gain from
watershed no. 6 provides
tal impact of recent
d to 1996/97 (Table VI-

APPENDIX VI - 2

MN DNR FISHERIES - LAKE MANAGEMENT PLAN (JUNE 21, 1999)

The MN DNR fisheries management plan for Lake McCarrons contains these elements:

Long Range Goal:

To provide a fish population that will support 90 angler-hours per acre fishing pressure.

Operational Plan:

1. Annual winter fishhouse counts.
2. Population assessment in 2008; re-survey in 2003.
3. Monitor winter oxygen levels when conditions warrant.
4. Protect gamefish spawning habitat by the environmental review process.
5. Stock walleye fry at a rate of 3000 per littoral acre annually.
6. Allow private individuals with permit to stock gamefish.

Mid Range Objective:

To provide a fish population that supports 70 angler-hours per acre fishing pressure.

Potential Plan:

1. Aeration system to operate as needed (est. cost = \$32,000).
2. Fishing pier (est. cost = \$20,000).
3. Creel survey (est. cost = \$20,000).
4. Stock yearling channel catfish at a rate of 5 fish per littoral acre annually after installation of aeration system (est. cost = \$1,500).

Narrative:

- Various Surveys - list past lake surveys and assessments
- Past Management - Describes historic stocking and management activities
- Social Considerations - Provides a justification for management
- Present Limiting Factors - Small size, winterkill potential, surface use restrictions
- Survey Needs - Schedules future surveys
- Land Acquisition - None needed
- Habitat Development and Protection - Through the environmental review process
- Commercial Fishery - No value as a commercial fishery
- Stocking Plans - Walleye & channel catfish after winterkill potential eliminated, private stocking
- Evaluation Plans - Regularly scheduled test netting

APPENDIX VII - 1

DETAILS OF THE BARR ENGINEERING (1999) IMPROVEMENTS TO THE VILLA PARK PONDS

The following is excerpted from a June 10, 2002 memo from Greg Wilson of Barr Engineering to Dick Osgood of THE OSGOOD GROUP:

Narrative

Barr's assessment (Barr Engineering 1999) of the McCarrons Lake pond/wetland runoff treatment system concluded that phosphorus sorption to wetland soils is limited by reduced contact time as a result of short-circuited flow patterns. Flow through the treatment system is now highly channelized throughout and short-circuited through ponding areas. Channelization has been accompanied by channel downcutting and berm erosion during periods of high flow. This is probably because of the subsidence of peat soils used to construct the berms. Differential settlement of these soils has changed the elevations of pipes through the berms, affecting both upstream and downstream water levels. Current elevations of pipes connecting wetland cells are quite different from original levels immediately following treatment system construction. Differential settlement has also focused flood flows over the berms on one or more relatively short lengths of berm crest. Consequently, deep flow paths have eroded into the berms. In order to remedy these problems, pipes connecting wetland treatment cells must be removed, and the berms separating the cells must be reworked and augmented with timber weirs whose overflow elevations are fixed and stabilized. Doing so will create shallow areas of ponded water between all berms and, thereby, will reduce channelization and increase hydraulic residence times.

Barr recommended installation of four permeable (i.e., slotted) timber weirs to control flows between cells of the runoff treatment system. Also recommended, in addition to the timber weirs, are similarly constructed energy-dissipating baffles in front of the pipes inletting flows to wetland Cells 3 and 4. These weirs each contain four full-length transverse slots to allow passage of relatively low discharges, with the lowest elevation slot controlling the normal water level behind the berm. Details of a typical permeable timber weir include rip-rapping below the weir to armor the channel against erosion.

Timber weirs should all be attached to H-shaped steel pilings driven through peat soils into underlying mineral soils. Other construction techniques evaluated are all unable to guarantee elevation stability for the weirs. Depths of pilings will depend on the thicknesses of peat soils at each site and on analyses of the forces likely to act on system components. This will require soil borings and further final design calculations. Similarly, the exact placement of the timber weirs will require topographic survey of the areas within the runoff treatment systems and its surrounding upland areas.

Construction of the timber weirs is recommended to take place at the sites of the existing peat berms, along their downstream faces. Construction in this manner will allow the already settled berms to assist geotextile fabric barriers installed within the berms in preventing seepage under the weirs (due to piping). Low elevation slots in the timber weirs should be set so that depths of the intervening ponds range from 0 to 18 inches. Preliminary invert elevation recommendations may be subject to refinement in response to new topographic survey data.

Barr estimates that the total cost to construct the recommended improvements will be approximately \$450,000, based on the assumptions from above (see the attached spreadsheet table for an itemized estimate of the construction and operation & maintenance costs). The actual construction cost will vary, depending upon the required steel pile length and surface area of timber weir construction. The total estimated cost also includes a 25% (of the subtotal) contingency and 25% for engineering, surveying and permitting costs. Barr recommends that annual inspection be completed for each weir and control structure to observe performance following site restoration. The total annual inspection, operation and maintenance costs are estimated to be \$5,000, which includes debris removal, brushing and tree removal, as necessary. Barr also anticipates that an additional operation and maintenance cost of \$10,000 might be incurred every five years to complete sediment removal, erosion repair, riprap replacement, vegetation repair and other miscellaneous items, as necessary. Another similar project has required maintenance to maintain the slot opening sizes due to swelling of the timber.

Based on more recent information about Roseville's storm sewer system and the anticipated treatment efficiency resulting from the Villa Park wetland treatment system improvements, Barr has updated the P8 modeling that was previously done to simulate the watershed conditions observed during the Phase III monitoring program. The Phase III monitoring program revealed that there was essentially no total phosphorus removal occurring in the Villa Park wetland treatment system. The original P8 model was setup to duplicate the observed conditions in the wetland treatment system. This P8 model was updated with the new subwatershed and pond/wetland characteristics, assuming that the recommended improvements would restore ideal sedimentation conditions to the wetland treatment system. The results of the updated P8 modeling are compared to the Phase III monitoring conditions below:

	Existing Conditions w/Villa Park Improvements	Phase III Monitoring Conditions			Units
	Normal	Dry	Normal	Wet	
Annual Precipitation	27.7	23.4	27.7	35.1	inches
Watershed Runoff Volume	531 (430)	307 (249)	572 (463)	658 (533)	10 ³ m ³ (acre-feet)
Watershed Phosphorus Load	120 (263)	106 (233)	251 (552)	275 (605)	kg (pounds)

Budget Calculations and Assumptions

LAKE McCARRONS WETLAND TREATMENT SYSTEM Permeable Weir

Construction Cost Estimate (1) June 6, 2002

Item	Description	Units	Qty.	Unit Cost	Extension
1	Mobilization/Demobilization (15%)	LS	1	\$39,000.00	\$39,000.00
2	Site Preparation/Clearing/Grubbing	LS	1	\$5,000.00	\$5,000.00
3	Common Excavation	CY	900	\$10.00	\$9,000.00
4	Random Gravel	CY	300	\$20.00	\$6,000.00
5	Riprap	CY	200	\$65.00	\$13,000.00
6	Geotextile Filter Fabric	SY	2300	\$3.00	\$6,900.00
7	Steel H Piles	LF	2200	\$30.00	\$66,000.00
8	Timber-Weir Construction	SF	6300	\$20.00	\$126,000.00
9	High Flow Baffles	EA	2	\$10,000.00	\$20,000.00
10	Restoration	LS	1	\$5,000.00	\$5,000.00
Project Total					\$295,900.00
Contingency			25%		\$74,000.00
Engineering/Permitting			25%		\$74,000.00
Total					\$443,900.00

(1) Total Project includes 4 weirs (1 @ 325' long and 3 @ 235' long). Assumes 25' long H piles.

(2) High Flow Baffles include structure similar to weirs

LAKE McCARRONS WETLAND TREATMENT SYSTEM Permeable Weir

Construction Cost Estimate (1) June 6, 2002

Annual O & M

Annual Inspection (1)	\$1,500
Annual Maintenance (2)	\$3,500

Five Year O & M

General Maintenance & Repairs (3)	\$10,000
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- (1) Annual inspection includes site visit to observe each weir and control structure.
- (2) Annual O & M includes debris removal, brushing and tree removal as necessary.
- (3) Five Year O & M includes sediment removal, erosion repair, riprap replacement, vegetation repair and other misc. maintenance items, as necessary.

APPENDIX VII - 2

SUMMARY OF URBAN BEST MANAGEMENT PRACTICES (FROM BARR 2001)

This is an outline of the 40 BMPs listed in Barr (2001).

RUNOFF POLLUTION PREVENTION

Impervious Surface Reductions - Street Design • Cul-de-Sac Design • Driveway Design • Parking Lot Design • Turf Pavers, Green Rooftops

Housekeeping Techniques - Pavement Management • BMP Maintenance • Landscape Design & Maintenance • Animal Management

Construction Practices - Grading • Sequencing • Vehicle Tracking Pad

Soil Erosion Control - Mulches, Blankets & Mats • Vegetative Methods • Structural Methods

Sediment Control - Silt Fences • Inlet Protection • Temporary Sedimentation Basins/Traps • Check Dams

STORMWATER TREATMENT BMPs

Infiltration Systems - On-Lot Infiltration • Infiltration Basins • Infiltration Trenches

Filtration Systems - Bioretention Systems • Surface Sand Filters • Underground Filters • Filter Strips

Constructed Wetlands - BMPs in Series • Stormwater Wetlands • Wet Swales

Retention Systems - Wet Ponds • Wet Storage Ponds • Wet Vaults

Detention Systems - Dry Ponds • Oversize Pipes • Oil/Grit Separators • Dry Swales

Alternative Outlet Designs - Permeable Weirs • Flow Splitters • Proprietary Flow Control Devices

APPENDIX VII - 3

OUTPUTS AND ASSUMPTIONS FROM THE WATERSHED TREATMENT MODEL APPLIED TO LAKE MCCARRONS SUBWATERSHED NOS. 2, 4, 5 AND 6

The Watershed Treatment Model (Caraco 2002) was used to evaluate phosphorus load reductions from Lake McCarrons subwatershed nos. 2, 4, 5 and 6 (Management Action 3).

The Watershed Treatment Model outputs for three watershed management activities are as follows:

<u>Activity</u>	<u>Assumptions</u>	<u>Annual P Load Reduction</u>
Lawn Care Education	50% of applied fertilizer is lost 30% awareness of message 70% willingness to change behavior	11 lbs. P / 100 acres
Pet Waste Education	40% of households have dog 50% walk dog daily 60% clean up after dog 60% willing to change behavior 30 awareness of message	1 lb. P / 100 households
Impervious Surface Reduction	25% of households 'disconnect' 2000 square feet per footprint	3 lbs. P / 100 households

These reductions are applied to Lake McCarrons subwatershed no. 4 (direct drainage into the lake) and at half these rates for subwatershed nos. 2, 5 and 6 (drains through pond).

<u>Subwatershed</u>	<u>Area</u>	<u># Households</u>	----- P Reduction (lbs. per year) -----		
			<u>Lawns</u>	<u>Pets</u>	<u>Impervious Surface</u>
2	31.1 acres	86	1.7	0.4	1.3
4	59.4 acres	162	6.5	1.6	4.9
5	124.7 acres	270	6.9	1.3	4.0
6	5.9 acres	24	0.3	0.1	0.4
		TOTAL	15.4	3.4	10.6

APPENDIX VII - 4

ESTIMATED COSTS OF IMPLEMENTING WATERSHED-WIDE BMPs

Implementing best management practices (BMPs) on a watershed-wide basis is an ongoing management activity. A comprehensive education/awareness program promoting voluntary changes in attitudes and behavior as well as providing incentives for critical activities should be developed.

Developing this program can be done following the implementation of subwatershed target pollution standards (Management Action 7).

Budget

1. Develop comprehensive education/awareness program - \$13,000

Professional Services, 120 hours @ \$100 = \$ 12,000
Expenses, \$1,000

2. Implementation of comprehensive education/awareness program - \$24,800

Professional Services, 100 hours per year @ \$60 = \$6,000
Informational brochures, 10,000 @ \$0.50 = \$5,000
Postage, 10,000 @ \$0.57 = 5,700
Newspaper ads, 3 @ \$500 = \$1,500
Copy writer/graphic artist, 20 hours @ \$80 = \$1,600
Events, 1 @ \$5,000

3. Incentives - \$12,400

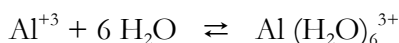
Grants & Cost Share, 10 @ \$1,000 = \$10,000
Program Administration, 40 hours @ \$60 = \$2,400

APPENDIX VII - 5

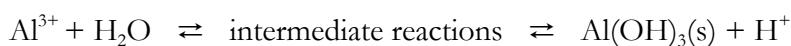
DETAILS OF THE ALUM APPLICATION

How Alum Works to Inactivate Phosphorus

Alum is applied to lake water as aluminum sulfate, or $\text{Al}_2(\text{SO}_4)_3 \cdot 14 \text{H}_2\text{O}$. As aluminum sulfate is added to water, it forms aluminum ions, which are hydrated (combined with water):



In a series of chemical hydrolysis steps, hydrogen ions are liberated, which may lower the water pH, and ultimately forms aluminum hydroxide ($\text{Al}(\text{OH})_3$), which is a solid precipitate:



The solid precipitate forms a flocculent material, referred to as a floc, that has a high capacity to adsorb phosphates. At the pH of Lake McCarrons, these reactions occur quickly and the floc is stable. Aluminum hydroxide ultimately settles to the lake bottom where it remains stable and poses no toxicity to aquatic life.

If aluminum sulfate is applied as a bulk application, the aluminum hydroxide floc coagulates quickly. Bulk applications (as is proposed for Lake McCarrons) are thus intended to form an aluminum hydroxide layer on the lake bottom, which forms an effective barrier to the release of phosphates from the lake bottom sediments. Lake phosphorus is reduced as an incidental benefit of a bulk alum application.

Dose Determination

The exact alum dose is most appropriately determined by evaluating the amount of 'mobile' phosphorus in the lake sediments (Rydin and Welch 1999; Rydin et al. 2000), which requires the collection and analysis of lake sediment samples. Because there is no data from Lake McCarrons' sediments at this time, a range of doses is estimated provided here.

Normally alum is added to the deeper waters below the normal mixing zone. For Lake McCarrons, the treatment depth is estimated to be 2 meters (about 6.5 feet) and corresponding contour area 27 hectares (about 67 acres). Here, I estimate a range of alum doses using 30 g Al / m^2 as the low dose (Welch and Cooke 1999) and 100 g Al / m^2 as the high dose (Rydin and Welch 1999). These doses are estimated:

Low Dose	30 g Al / m^2 applied to 27 ha = 8,100 kg Al 8,100 kg Al = 17,800 lbs Al = 36,400 gallons alum
High Dose	100 g Al / m^2 applied to 27 ha = 27,000 kg Al 27,000 kg Al = 59,000 lbs Al = 121,000 gallons alum

The appropriate dose for Lake McCarrons is likely within the range noted above.

Budget

1. Alum Dose Determination - \$ 4,500

Professional Services, 20 hours @ \$100 = \$ 2,000
Lab Services & Expenses, \$2,500

2. Permits and Regulatory Review - \$ 4,000

Professional Services, 40 hours @ \$100 = \$4,000

3. Alum Application - \$31,000 - \$103,000

Cost of alum as delivered and applied, estimated at \$0.85 per gallon

Low: 36,400 gallons @ \$0.85 = \$30,940
High: 121,000 gallons @ \$0.85 = \$102,850