Lake Vegetation Management Plan
Green Lake, Kandiyohi County
2009 to 2014

Draft Plan 12 June 2008 provided by Chip Welling, MnDNR; revisions developed, Kandiyohi County September, 2008, by GLPOA Lake Management Committee and Lake residents – GLPOA Committee Chair Greg Roverud, President Kelly Terwisscha, Executive Sec'y Terry Frazee, Jill Nelson, Lachlan Smith, Ralph Jansen, Gary Broman; Residents Bill Latham, Ann Latham.

☒ **Variance Requested by Cooperator**

☒ **Variance Approved (see Section VI)**

Purpose of this Lake Vegetation Management Plan

The purpose of development of this Lake Vegetation Management Plan is to provide a summary of the water quality and vegetation of Green Lake, a description of problems to be addressed, and goals for management. Also included in the plan is a description of the involvement of the public in development of the plan, conditions to be included in permits to be issued to allow control, and signatures of representatives of organizations that developed the plan.

Section I: Lake Information

Name: Green **County**: Kandiyohi **DOW Number**: 34.0079

Fisheries Area: Spicer; MnDNR Region 4 **Surface Acres**: 5,406 **Littoral Acres**: 2,054

Classification: ☐ Natural Environment ☐ Recreational Development ☒ General Development

Cooperator(s): Green Lake Property Owners Association (GLPOA), MnDNR – Fisheries, MnDNR – Ecological Resources, Invasive Species Program, Middle Fork Crow River Watershed District, Kandiyohi County.

Section II: Water Quality and Plant Community

A. Water Quality

Average readings GL-1: NW side of lake			
Year	TP	Secchi	Chlor-a
	(mg/L)	(ft)	(µg/L)
2004	0.014	13.2	3.8
2005	0.017	12.8	3
2006	0.014	12.8	3
2007	0.018	10	8
2008	0.016	13.5	4.9
2009	0.019	13.2	5.5

Average readings GL-2: SE side of lake			
Year	TP	Secchi	Chlor-a
	(mg/L)	(ft)	(µg/L)
2004	0.014	13.1	4
2005	0.016	12.3	3
2006	0.015	12.5	3
2007	0.017	10.8	7
2008	0.010	13.7	5

Provided by MFCRWD

The MN Pollution Control website lists Green Lake as mesotrophic, based on phosphorus, chlorophyll a, and secchi depth data.

http://www.pca.state.mn.us/water/clmp/lkwqReadFull.cfm?lakeid=34-0079

Green Lake water quality concerns are addressed with the goal of protection and improvement to maintain mesotrophic standards for the lake. The Green Lake Sanitary Sewer and Water District was formed in conjunction with Kandiyohi County, and a public sewer system and treatment plant was completed in 2000-2001. Central sewer now serves the Cities of New London and Spicer and all 1st tier properties on Green Lake.

A Clean Water Partnership (CWP) Phase I Study of Upper Middle Fork, including Green Lake, was completed in 2002. The Middle Fork Crow River Watershed District (MFCRWD) was formed and approved in 2005: both the CWP Phase I and the MFCRWD Management Plan (2007-2017) list, as priority issues and recommendations for Green Lake, Erosion and Sediment Control, Invasive Aquatic Species (Eurasian Watermilfoil) control, Shoreland Management and Stormwater Management. (MFCRWD Mgt. Plan, Ch. 3 Pg. 12)

Water quality monitoring and vegetation monitoring have been done consistently over the past 10 years by GLPOA volunteers and MnDNR personnel. Water monitoring for secchi, phosphorus and chlorophyll-a is conducted by GLPOA volunteers in conjunction with MFCRWD for lab results and documentation into MPCA files.

B. Plant Community

During July 2008, DNR staff surveyed the aquatic plants in Green Lake. This involved assessments of the vegetation along 50 transects located perpendicular to shore around the periphery of the lake. Similar surveys were conducted during 1994, 2003, and 2007. Eurasian watermilfoil hereafter called "milfoil" was observed in 20% of transects surveyed and mean abundance was 11.3% in 2008 (Table 1). This is an increase by comparison with 2003, when the frequency of milfoil was 4%.

Table 1. Percent frequencies of occurrence of Eurasian watermilfoil and some of the more commonly encountered native submersed plants in Green Lake, Kandiyohi County observed during surveys by the MnDNR. This involved assessments of the vegetation along 50 transects located perpendicular to shore around the periphery of the lake. Also included are selected results from 1994, 2003, and 2007.

Lake Vegetation Management Plan

Green Lake, Kandiyohi County

		Non-vascular plants		Pondweeds					
	Eurasian watermilfoil	muskgrass	stonewort	Variable-leaf	Clasping-leaf	Sago	Bushy	Number of species	Maximum depth (feet)
1994	0	92	25	23	19	21	17	15	35
2003	4	96	32	34	16	34	16	20	30
2007	16	94	22	4	38	16	32	17	40
2008	20	98	50		14	16	8	25	40

Among native plants, muskgrass was the most commonly observed plant with frequencies of 92-98% (Table 1). Muskgrass actually is an advanced, multi-cellular form of algae. It grows entirely below the water surface, and dense growth may cover large areas on the lake bottom. Like muskgrass, stonewort is an advanced form of algae. The frequencies of the four most commonly encountered native pondweeds varied from year to year. The numbers of species of submersed plants observed during surveys varied from 15 to 25, which is a high number when compared to many other lakes. Also, the maximum depth at which submersed plants were observed is high, ranging from 30 to 40 feet. These characteristics of the vegetation of Green Lake are what one generally would expect to see in a lake with high water clarity. Historical average water clarity is 10.8 feet and the average for 2007 was 11.5 feet.

Spicer Fisheries, Lake Management Plan dated 2003, and lake residents, have reported a perceived increase in filamentous algae (including chara algae or muskgrass) in areas of gravel rubble and firm sand. Chara has increased growth at stormwater inlets as well. This may be an indication of increased sediment deposits in the lake bed.

Two stands of bulrushes exist in littoral areas of Green Lake: at the Outlet of the Middle Fork (east end) and on the south side east of the Spicer Castle. These are highly prized and are

protected by MnDNR. As of 2008 Eurasian watermilfoil has not been identified within the bulrush stands. In 2009, Eurasian watermilfoil has been found near these bulrushes on the east end.

C. History of Eurasian watermilfoil in Green Lake

Milfoil was first discovered in Green Lake in 2000. Shortly thereafter, the plant was observed by the MnDNR in about 15 acres of the lake. Initially, the MnDNR attempted to eradicate EWM using aggressive herbicide treatments; however, the treatments did not entirely eliminate EWM and the invasive plant spread within the lake basin. In recent years, the GLPOA and MnDNR have undertaken aggressive management of milfoil in Green Lake (See Appendix 1).

Section III: Public Input Process

Green Lake is a valuable asset to the community and the region. The development of this LVMP incorporates comments from a variety of stakeholders including residents of the area, the Green Lake Property Owners Association, the Middle Fork Crow River Watershed District and Kandiyohi County.

The GLPOA has in previous years worked with MnDNR Fisheries to formulate a lake vegetation management plan. This resulted because of the discussion between Spicer Fisheries and the GLPOA about the imminent spread of milfoil. Several conversations, meetings, and walk-in appointments were held between the MnDNR and GLPOA. Nothing formal has been written until this document.

The following information was provided by Terry Frazee, GLPOA Executive Secretary on August 20, 2008:

The association has a membership of 66% of property owners on Green Lake. They hold six Board meetings per year, mail six newsletters per year, and participate in water quality monitoring and events. In 2007, 682 lakeshore owners and associate members and 19 businesses received

newsletters. In 2007, the association held 6 Board of Directors meetings and 1 General Membership Meeting. Board members Chair several Committees, including Lake Management, Education, Zoning Variance and Taxation, Fisheries, and MnDNR/Water Monitoring, which meet as needed. The Lake Management Committee is responsible for development and implementation of the Eurasian watermilfoil Control Program subject to approval by the Board. In 2007/2008, major events included: Special Meetings – Taxation/Valuation, Phosphate Free Fertilizer, MnDNR Fisheries Stocking Plan, Loons, MnDNR Boat Access Expansion, Sewer and Water and Lake Management.

In 2007 Representatives of GLPOA and Middle Fork Crow River Watershed District provided information summaries and testified at Legislative Sessions for the Pilot Project to Control Eurasian Watermilfoil in Green Lake. The Bills were sponsored by Senator Joe Gimse and Representative Al Juhnke. In 2007, the Minnesota House of Representatives carried the bill but the Minnesota Senate did not, so therefore it did not pass.

In 2008 GLPOA contracted with Dick Osgood, Osgood Lake Management Consulting, who prepared and presented an application to LCCMR for funding the Pilot Project to Control Eurasian Watermilfoil in Green Lake. In 2008, the GLPOA did not receive funding through LCCMR.

Section IV: Problems to be Addressed in this Plan

Interference with use of the lake caused by Eurasian watermilfoil (EWM).

1. Invasion of EWM into native plant stands, resulting in replacement of native plants by EWM.

2. Risk of spread of Eurasian watermilfoil from Green Lake to other lakes.

Section V: Goals for Management of Aquatic Plants

Goal 1. Maintain a healthy ecosystem dominated by native plant species in Green Lake.

Action a. Maintain a current assessment of the distribution and abundance of Eurasian watermilfoil in Green Lake.

Action b. Aggressively control identified Eurasian watermilfoil sites to prevent displacement of native plants and reduce spread of Eurasian watermilfoil in Green Lake.

Action c. Ensure that Eurasian watermilfoil removal efforts do not harm native plants.

Goal 2. Maintain opportunities for use of Green Lake.

Action a. Reduce interference with use of the lake caused by Eurasian watermilfoil. Currently, recreational use has not been affected by milfoil and boaters are able to navigate around infested areas.

Section VI: Operational Treatment Plan

The control of milfoil that the GLPOA proposed to do differs from most proposals for control of aquatic plants in Minnesota. In Minnesota, control of aquatic plants usually is proposed to enable the applicant to gain access to the lake from the lakeshore property that they own. Offshore removal of aquatic vegetation is generally permitted when dense stands cover substantial portions of a lake and prevent riparian landowners or the general public from gaining access to large areas of the lake.

In the case of the GLPOA proposal to control milfoil in Green Lake where the vegetation is predominantly milfoil, which does not interfere with access, the MnDNR will allow chemical treatment by a local cooperator such as the GLPOA. It is expected that the local cooperator will cover the expense of control. Sites with milfoil proposed for treatment would be identified by a local cooperator, delineated with GPS, and described in an application to be submitted to the MnDNR for review. The MnDNR recommends that a GPS used for vegetation surveys be a Garmin brand unit that is set to the projected UTM NAD83 Zone 15. The composition of the vegetation in areas proposed for treatment would be verified by MnDNR inspection. It is required that herbicides that provide selective control of milfoil be used to protect native vegetation.

Goal 1

Action a. Monitor the distribution and abundance of Eurasian watermilfoil.

Task 1. MnDNR and GLPOA will develop a mutually agreed upon GPS technology and methodology for identification of milfoil locations. GLPOA will conduct spring and fall surveys annually to identify EWM locations and monitor its spread. Surveys will be completed utilizing surface and/or underwater observation. Landowners and lake users will be asked to report observations which will be collected and recorded by GLPOA. Collected data will be kept in a GPS format compatible with MnDNR GPS and GIS protocols.

Task 2. The MnDNR will continue to provide technical assistance to the GLPOA in its efforts to monitor the distribution and abundance of milfoil by periodic inspections or surveys of Green Lake, including mapping of sites.

Action b. Aggressively control Eurasian watermilfoil

DNR APM Permit Application:

Task 1. GLPOA will prepare and submit a permit application annually by April 1 of each year to the MnDNR Fisheries office in New Ulm. Inspection of sites proposed for treatment to control milfoil will be conducted by the MnDNR prior to issuing a permit. If new infestations are discovered that were not included in the original permit, then additional treatments may take place under an amended permit. Proposed additional treatments will require inspection by MnDNR staff as work schedules permit and the issuance of an amended permit will be provided before treatments can be conducted. GPS coordinates of the proposed nearshore (within 150 feet of shoreline) and offshore (greater than 150 feet from shore) Eurasian watermilfoil treatment areas, in a format compatible with MnDNR GPS, will be submitted by GLPOA.

Task 2. Dated signatures of approval from all landowners whose shorelines will be treated must be obtained by GLPOA and provided to the MnDNR with an application for a permit to allow control of milfoil in near shore areas (M.R. 6280.0450, Subp. 1a.). These areas may include Indian Beach Harbor and City of Spicer, and also for areas where milfoil may develop within 150 feet of either public or private shoreline. Signatures of approval will be supplied to MnDNR with the permit application or at least 10 working days prior to proposed treatment date and will be required annually. Treatment of milfoil may exceed 100 shoreline feet per landowner where native plants are not impacted (M.R. 6280.0350, Subp. 1a., C).

Task 3. Treatment for the control of milfoil is allowed during the spring and fall treatments may be granted according to Aquatic Plant Management rules and a variance granted by the commissioner (M.R. 6280.0250, Subp. 4). If milfoil is not found within previously infested sites or in previously treated sites, then treatment will not be allowed. Spring treatments will be completed after June inspections through July 15. Fall treatments will be conducted after late summer surveys (August surveys).

Task 4. The MnDNR Fisheries Office in New Ulm will be responsible for permit issuance for herbicide and/or hand removal control of milfoil. One permit will be issued for the control of aquatic invasive species, but may be amended. Refer to #1 above, with specific treatment areas in GPS format.

Task 5. Control of milfoil in 'Commons Areas' (>150' from shore) and near shore areas with landowner permission (<150'from shore)

☒ **Herbicide Control:**

Product(s): 2,4-D or triclopyr; or any other MnDNR Approved Herbicides selective for the control of milfoil

Rate of Application: Up to the maximum rate on the label for the product to be applied

Timing of Application: Spring and late summer/fall applications

☒ **Hand Removal by Divers:**

Volunteer and/or Approved Contractor

In Permitted Areas: according to Section VI B. 6

Task 6. Hand removal of milfoil by divers: If the MnDNR receives a proposal to use divers to remove milfoil from offshore areas of Green Lake, then the MnDNR will have general considerations for any diving project that may be permitted. While removing milfoil from the lake is a satisfactory outcome, we need to ensure that there is no inadvertent damage to or removal of native submersed vegetation. Therefore, permit conditions may include some or all of the following:

1) Removal will only be permitted in areas confirmed with spring or late summer inspection by MnDNR staff to have milfoil, and included on a permit. A map and waypoints will be included with the permit.
2) Only a licensed harvester may remove milfoil in any areas where native vegetation coexists with the milfoil.
3) If volunteer divers are used, they may only remove milfoil in areas identified by the MnDNR to be monocultures of milfoil. They must demonstrate the ability to navigate to GPS locations provided by the MnDNR and to identify milfoil.
4) New volunteer divers will be required to attend a short workshop by MnDNR staff to discuss identification of milfoil and the permit conditions prior to removing EWM. This workshop will be scheduled and conducted annually.
5) MnDNR staff may observe dive operations to ensure no damage to native vegetation occurs.

MnDNR Permit No. 08F-4106 (and amended Permit dated July 9, 2008) included "And/or hand removal of Eurasian watermilfoil."

C. Variance Approval

Variance: None required.

Section VII: Funding

A. Green Lake Property Owners Association (GLPOA) will be responsible for obtaining the necessary funds for control of milfoil in Green Lake.
The GLPOA may apply to the MnDNR for State of Minnesota reimbursement of eligible costs for the milfoil control.

B. If areas of dense and matted milfoil develop in 'public-use' areas of the lake such as sites adjacent to public water accesses or off-shore from developed shoreline, then the lake will be eligible for a grant from the MnDNR to support control of milfoil in these areas.

C. Funding provided by GLPOA may include grants from Middle Fork Crow River Watershed District, Kandiyohi County and the State of Minnesota.

Lake Vegetation Management Plan

Green Lake, Kandiyohi County

Section XIII: Signatures

This Lake Vegetation Management Plan is in effect for 5 years from date of Regional Fisheries approval.

It may be necessary to make minor adjustments to this Plan in any one year. This may be done by mutual agreement.

This 5 year Plan, 2009 – 2014, may be reviewed on the request of either party and may be renewed by mutual agreement.

DNR Approval

Submitted By: Chip Welling[1] and Joe Eisterhold[2]

Title: [1]Aquatic Invasive Species Management Coordinator and [2]Invasive Species Specialist

Date: 09 September 2009

B— Geis 10/4/2009
Area Fisheries Supervisor Date

Jack Lauer 11/5/2009
Regional Fisheries Approval Date

John Schladweiler 11-5-2009
Regional Ecological Services Approval Date

I affirm that I am an authorized representative of the Green Lake Property Owners Association and acknowledge our participation in the development and implementation of this lake vegetation management plan.

Kelly Drewiske, President 9/24/2009
Green Lake Property Owners Association, Name & Title Date

Reports cited

Ecological Resources (Formerly Ecological Services) selected Records: Map of EWM, 2000; APM Permits, 2001; Report of survey, Wendy Crowell, Aug. 2001

Letter dated July 25, 2002, Spicer Fisheries

McComas, S., and D. Osgood. 2001, 2003. The potential nuisance growth of Eurasian watermilfoil based on lake soil fertility for Green Lake, Kandiyohi County, Minnesota. Unpublished report prepared for the Green Lake Association and Kandiyohi County by Blue Water Science, 550 So. Snelling Ave., Saint Paul, MN 55116.

Middle Fork Crow River Watershed District Mgmt Plan. 2007. Ch.3, P.12.

MnDNR Spicer Fisheries Lake Management Plan. 2003, pp. 2,3.

MnDNR Spicer Fisheries Standard Lake Survey Report, Draft, 7/28/2008

Spilseth Diver Report. 2008

Welling, C., B. Gilbertson, and J. Bacigalupi. 2007. Green Lake, Kandiyohi County, Minnesota: Distribution and abundance of submersed vegetation and Eurasian watermilfoil, and possible approaches to management of Eurasian watermilfoil. Unpublished report prepared by the Minnesota Department of Natural Resources, 500 Lafayette Rd. Saint Paul, MN 55155 (18 January).

References

Bay Lake Aquatic Vegetation Management Plan. 2004. Unpublished report prepared by the Minnesota Department of Natural Resources, Brainerd, MN

Lake Alexander Aquatic Plant Management Plan 2006-2011. Unpublished report prepared by the Minnesota Department of Natural Resources, Brainerd, MN

Appendices

Appendix 1. History of Eurasian watermilfoil and the management of this invasive species in Green Lake.

Appendix 2. [map] Enumeration of offshore Eurasian watermilfoil, June-July 2007.

Appendix 3. [map] Enumeration of offshore Eurasian watermilfoil, June-October 2008.

Appendix 4. Sketches of treatment areas in 2001 and additional supporting documents provided by GLPOA.

Appendix 5. Report of Diver Removal of Eurasian Watermilfoil in 2008.

Appendix 6. [map] Enumeration of sites and total area permitted from June-September 2009.

Appendix 1. History of Eurasian watermilfoil and the management of this invasive species in Green Lake.

According to MnDNR Ecological Resources records, Chemical treatment (2,4-D) was applied late August, 2000, to identified sites. Treatment was again applied to these sites in July 2001. In August of 2001 an area of approximately 14.5 acres was surveyed by DNR and herbicide applied early September 2001 (DNR Records – APM Permits, Report by W. Crowell). After 2001 DNR discontinued the high intensity management designation/program of milfoil control for Green Lake.

Spicer Fisheries (Bruce Gilbertson) and Kandiyohi County Environmental Services (Jeff Bredberg) viewed the treatment sites in July, 2002, and reported to the Green Lake Property Owners Association in a letter dated July 25, 2002: "We found no milfoil at sites identified in the past two years as having abundant growths." And, "Several native aquatic plant species were identified at each of these sites." However, a stand was surveyed north of the fishing pier in Lion's Park about 15'X30' and was left untreated (Gilbertson, 2002). It could be concluded that the three consecutive chemical treatments by DNR did contribute to the decline of about 15 acres of milfoil in Green Lake.

In 2006, the DNR received reports of milfoil fragments seen floating around the lake and growing concern among users of the lake that milfoil was spreading in Green Lake. During that year, several new stands of milfoil were observed, especially in the 5' to 15' depth zone of the lake. Though the total acreage of milfoil remained around three acres and sites with milfoil observed in 2006 were not an unavoidable hindrance to navigation, there was concern that the sites might increase in size or increase the potential for establishing new stands in the lake. This led to a meeting with concerned groups and individuals in October, when representatives of the Green Lake Property Owners Association (GLPOA), Middle Fork Crow River Watershed District, and the DNR toured parts of Green Lake to examine the distribution and abundance of milfoil. This effort was not a thorough or exhaustive inventory of all milfoil

growing in Green Lake. We were fortunate that on the day of the tour there was plenty of sunshine and almost no wind, so visibility of milfoil in the lake was good.

In June of 2007 New Ulm and Spicer Fisheries personnel surveyed Eurasian Watermilfoil in Green Lake and created a map of GPS waypoints of milfoil locations. Actively growing milfoil stands were identified in peripheral littoral areas around the entire lake plus three sites on lakeward bars (June 27, 2007, Amended sites Map, DNR Fisheries). The June 27, 2007 survey is the most thorough survey completed to date, and the GPS waypoints became the basis for the APM Permit application of GLPOA to apply herbicides to milfoil sites in 2007.

The DNR subsequently produced an assessment of the status of milfoil and native plants in Green Lake along with possible approaches to management of milfoil (Welling et al. 2007). In the assessment, the DNR described environmental conditions in Green Lake, particularly the low fertility of the lake bottom, which appear to limit the growth of submersed plants in general and milfoil in particular. A survey of sediment characteristics by McComas and Osgood (2001) to determine the potential for abundant or "nuisance" growth of milfoil found that levels of exchangeable nitrogen were generally low. As a result, they estimated that a small portion, approximately 40 acres, of Green Lake had high potential for producing heavy growth of milfoil.

Since the 2001 McComas and Osgood evaluation at least 2 changes have occurred: in 2000 and 2005 several stormwater inlets from increased impervious surface and curb and gutter have been added by highway projects that discharge stormwater directly into Green Lake. In addition, the 2007 survey of milfoil at 53 sites identified new stands of milfoil at or near all of the sites predicted as "potential" in 2001.

Nevertheless, growth of substantial stands of Eurasian watermilfoil has also occurred on at least two rock bars, well lakeward from periphery littoral area, since 2004: the milfoil sites are Hultgren's Bar and south and east of Lone Tree Bar. Historically these are mid-lake areas of large rocks and rubble that have supported little or no vegetation. The Lone Tree site has developed

into approximately one/half acre by 2008, with smaller growth patches growing intermittently in rock formations considerably off shore.

DNR staff suspect that submersed plants on Green Lake may be gradually becoming more abundant in depths of eight to 20 feet, which is where the identified milfoil is growing. One cannot rule out the possibility that Green Lake may have become sufficiently fertile to support further increases in milfoil in certain areas. Future assessments of the fertility of the lake bottom where milfoil is growing may be informative.

In addition, it has been observed that many of the larger stands of milfoil are located near storm-water inlets, which supply sediment and nutrient for aquatic plant growth. Watershed initiatives that reduce the amounts of sediment and nutrients entering Green Lake, including restoration of the shore impact zone to create a buffer between the lake and developed areas, will help to limit the future abundance of milfoil and should be pursued where possible.

In a report of January 2007, the DNR also advised people who would manage milfoil that in the specific case of Green Lake, there are some concerns about potential for control in certain situations in which the milfoil grows (Welling et al. 2007). Stands of milfoil are often found in offshore areas beyond the normal areas that lakeshore homeowners may treat with a permit. For example, some of the areas with dense milfoil have narrow bands, perhaps ten to fifteen feet wide, of the plant growing in depths of 7 to 15 feet. These bands are located well off shore at the edge of the littoral shelf immediately adjacent to a steep slope leading to much deeper water. If one were to treat such a band or isolated stands of milfoil with herbicide, there are concerns about potential dilution of herbicide due to movement of water through the area, which could carry the herbicide away from the milfoil plants. Such movement of water might be caused by winds, which are often strong on Green Lake. However effective the control may be in any one area, it is expected that milfoil will reestablish itself after treatment. As a result, control will likely need to be repeated in the future.

During June 2007, the DNR received an application from the GLPOA for a permit to control milfoil by treatment with herbicide. Subsequently, DNR staff searched offshore areas of the lake and located milfoil in 53 sites, which comprised an area of about three acres in Green Lake. These sites were treated with herbicide by a contractor working for the GLPOA. During mid-September, DNR staff conducted a post-treatment inspection of these sites. Most of them appeared to be virtually the same as when they were located by DNR staff prior to treatment with herbicides in July.

A re-survey in late June 2008 indicated that milfoil was reduced in some sites and that native vegetation had replaced some milfoil. Milfoil had replaced native vegetation in at least one site, where 'mixed' (native and milfoil) vegetation occurred in 2007. Some sites were permitted for treatment in 2008. In some sites increased growth was documented. New infestations were identified by lake users on North Shore and Lone Tree Bar (see map, July 2008). A total of 4+ acres (11 of the milfoil sites), including Indian Beach Harbor and near shore at Lion's Park, were permitted for herbicide treatment by DNR in 2008. On July 22, 2008, seven volunteer divers completed a required DNR workshop at the Fisheries office in Spicer. Subsequently, volunteer divers did remove milfoil plants in a permitted site (Spilseth, 2008 – Appendix 5).

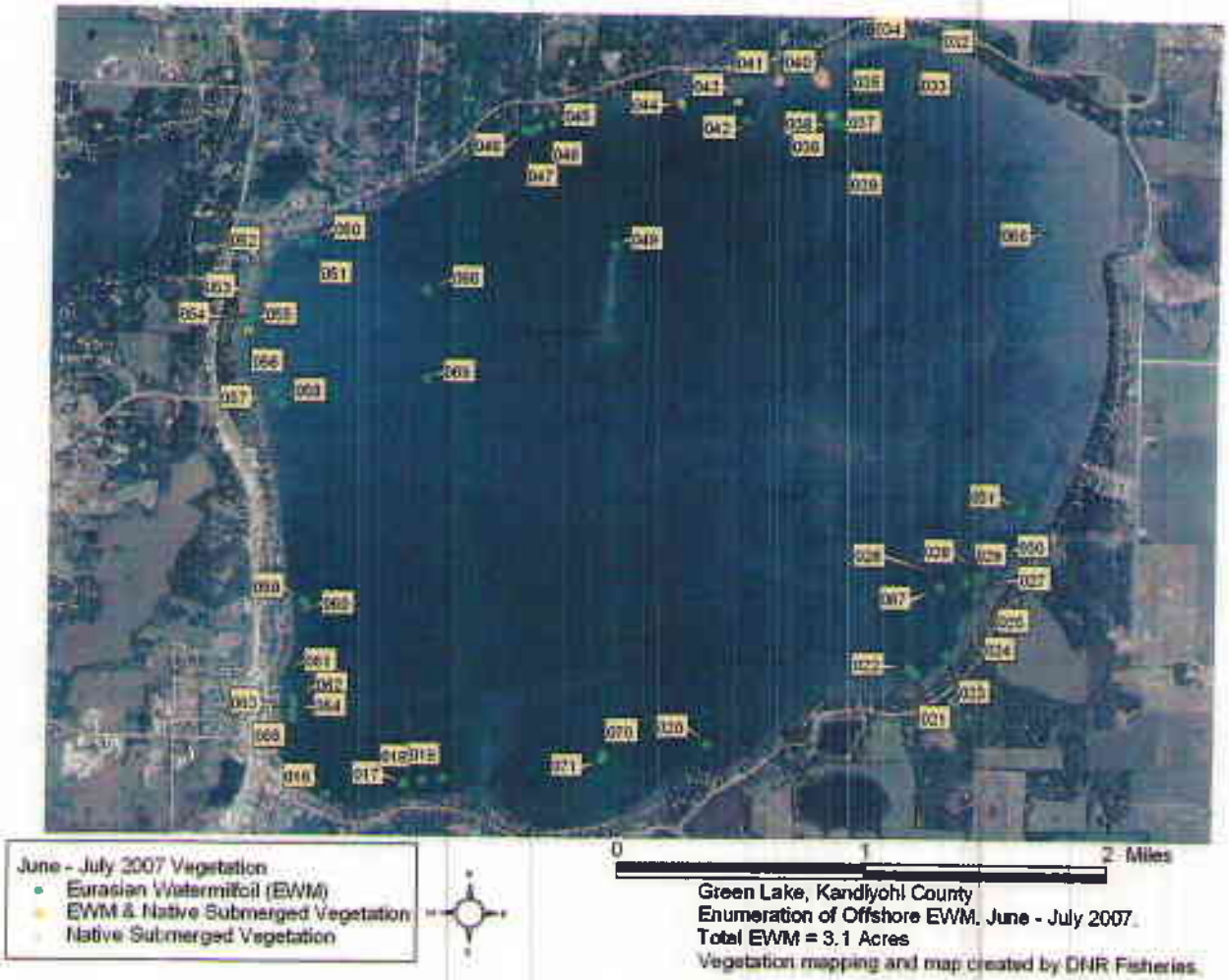
The 2008 MnDNR Standard Lake Survey Report for Green Lake includes the Abundance of Aquatic Plants (In Transects), Frequency of Occurrence (%) and Mean Abundance (%) of 27 species. In 2008 Eurasian watermilfoil was found to increase from 16% to 20% frequency of occurrence in one year.

YEAR	Frequency of Occurrence (%)	Mean Abundance (%)
1995	0	0
2002	Occasional *	
2004	4	1.3
2007	16	5.3
2008	20	11.3

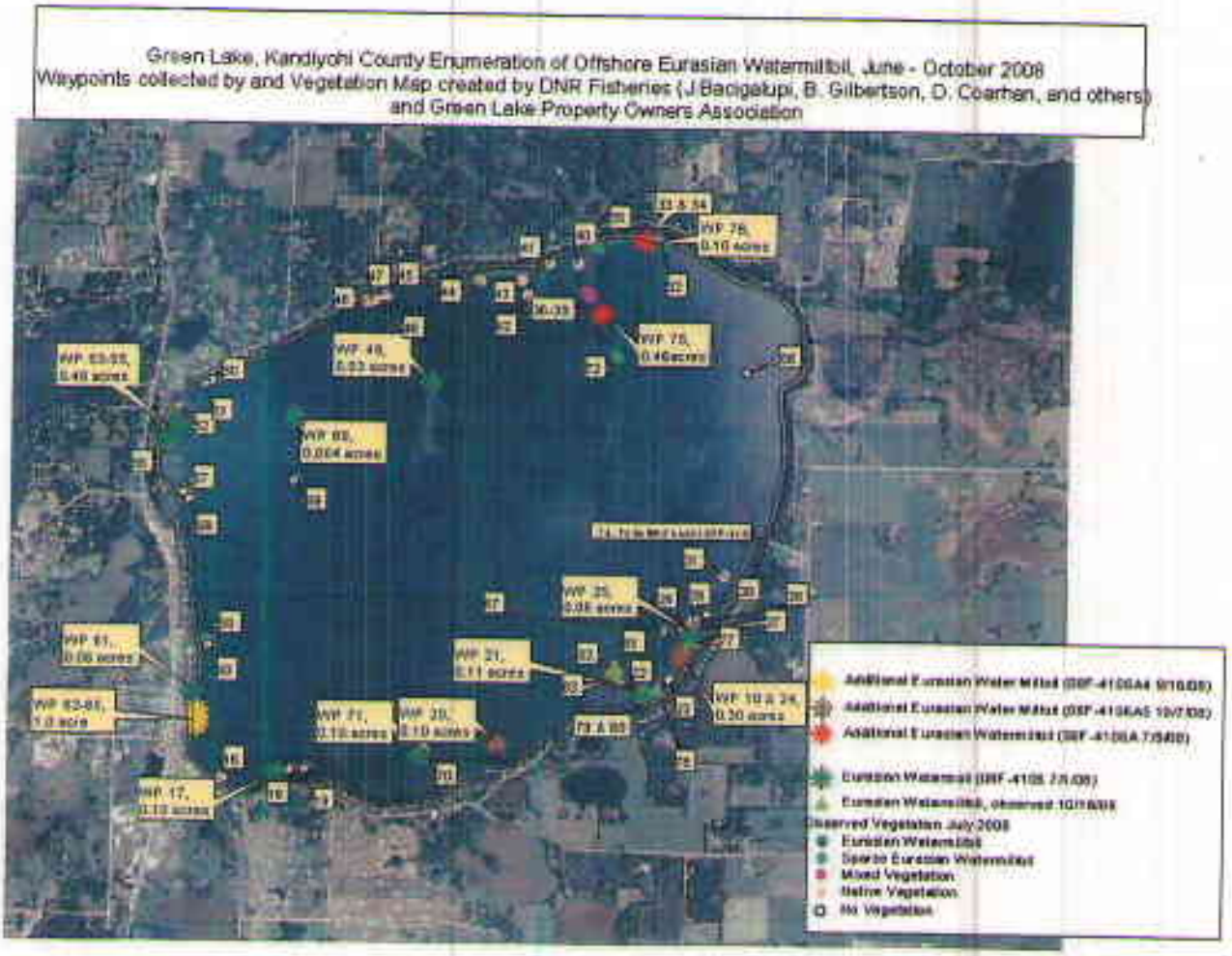
* from McComas and Osgood 2003

By rank, in 2008 Eurasian watermilfoil is the 4th most abundant aquatic vegetation species in Green Lake; only Muskgrass group (including chara algae) 93.3%, Stonewort group 29.3% and watermoss group 12.7% are more abundant than milfoil. In 2004 there were 14 species more abundant than milfoil.

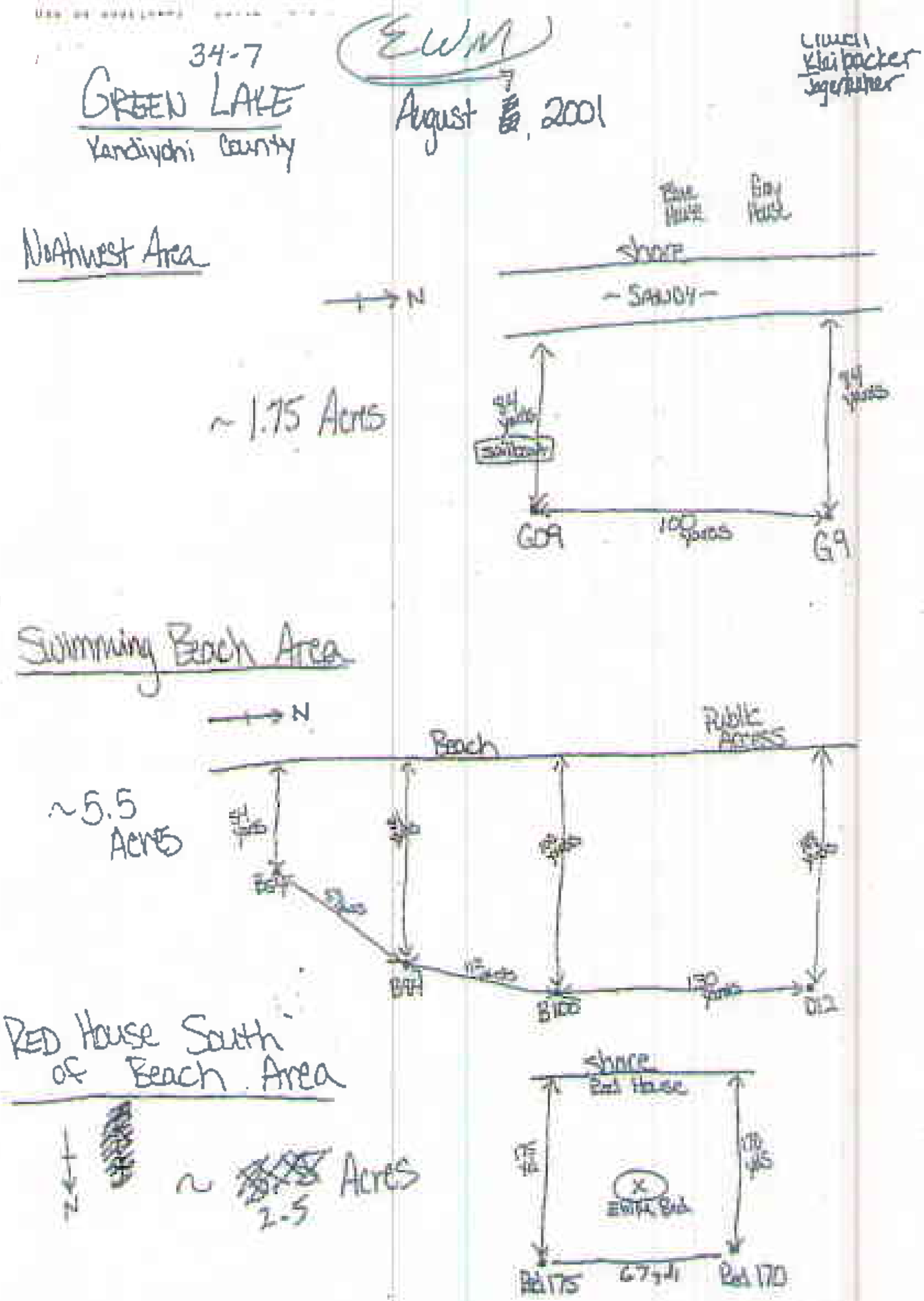
Appendix 2. Enumeration of offshore Eurasian watermilfoil, June-July 2007.



Appendix 3. Enumeration of offshore Eurasian watermilfoil, June-October 2008.



Appendix 4. Sketches of treatment areas in 2001 and additional supporting documents provided by GLPOA.



NA-0134Sep 6 2001 3:17PM MN DNR NEW ULM 507 359 6018 No.8659 P

DEPARTMENT OF MINNESOTA NATURAL RESOURCES

Permit Number
01F-4078A

AMENDED

PERMIT TO DESTROY OR CONTROL AQUATIC VEGETATION OR ORGANISMS

The Commissioner of Natural Resources, pursuant to authority vested by law, hereby grants this permit to the person whose name appears below, for the purpose specified, dates inclusive as shown, in the manner and under the conditions hereinafter set forth:

Permittee's Name	Telephone Number
MN DNR Exotic Species Program - ~~Nicole Hansel-Welch~~ Chip Welling	651-297-8021
Address (No. & Street, RFD, Box No., City, State, Zip Code)	FAX: 651-296-1811
DNR Eurasian Watermilfoil Program; Box 25, 500 Lafayette Rd; St. Paul MN 55155	
Type of Control	
Chemical control of Eurasian Watermilfoil.	

INCLUSIVE DATES OF PERMIT:

FROM	TO
September 6 ~~July 10~~, 2001	September ~~1~~ 14, 2001

THIS PERMIT APPLIES ONLY TO THE WATER AREA DESCRIBED AS FOLLOWS:

Name of Lake	County	Township	Range	Section
Green	Kandiyohi	120	34	2, 3

Extending ___ feet along shore and having a maximum width of ___ feet and/or to entire lake of ~~2.6~~ 12 acres

Location of Treatment Area: Five areas for a total treatment of 12 acres, as indicated on map submitted with application.

Means and Methods to be used:

Treatment with Navigate (2,4-d) to be applied according to label directions for control of submerged vegetation by Midwest Aqua Care Inc.; 10001 Great Plains Blvd., Chaska MN 55318. Warning signs to be posted in accordance with water use restrictions. It is the permittee's responsibility to notify the Regional Fisheries Office 48 hours prior to treatment.

THE PERMITTEE OR HIS AGENT SHALL GIVE NOTICE OF THE PROPOSED DATE OF THE TREATMENT TO THE FOLLOWING PERSONS WHICH SHALL BE RECEIVED BEFORE BEGINNING ANY WORK HEREUNDER. FAILURE TO GIVE NOTIFICATION PRIOR TO BEGINNING WORK SHALL BE GROUNDS FOR REVOCATION OF ANY PERMIT OR REFUSAL TO RENEW THE SAME.

Region 4 Fisheries	Fax Number	Telephone Number
Brenda Black	507-359-6018	507-359-6088

The Minnesota Department of Natural Resources does not vouch for the effectiveness of any aquatic nuisance control method or operation nor does it stand as arbiter to determine whether or not any such method or operation has been satisfactory.

This permit is permissive only and no liability shall be incurred by the State or by any of its officers, agents or employees by reason of the issuance of it or by reason of acts or operations of the permittee. The permittee shall be solely responsible for any damage or injury to persons, domestic or wild animals, waters, or property, real or personal of any kind, resulting from the permittee's acts or operations, and at all times the state of Minnesota, its officers, agents, and employees, shall be held harmless from any liability for such damage or injury.

Authorized Signature for Commissioner	Date
Susan L. Welling for BB	9-06-01

Distribution Of Copies Spicer Area Fisheries; Regional Fisheries; Enforcement; Midwest Aqua Care Inc

AUG-08-2001(WED) 12:43 E C O (FAX)651 296 1811 P.001

Transaction Report

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State of Minnesota
Department of Natural Resources
Facsimile Transmittal Coversheet

Date Sent
August 8, 2001

# of pages including this
3

TO: Mike Roe, Water Patrol — Fax Number: 320- 231-6289

Bruce Gilbertson, Spicer Area Fisheries — Fax Number: 320-796-6282

FROM: Wendy Crowell
Telephone Number: 651-282-2508

E-mail - wendy.crowell@dnr.state.mn.us

I surveyed Green Lake in Kandiyohi County (DOW 34 - 79) yesterday with two interns, Megan Kleibacker and Andy Jagerlehner and found Eurasian watermilfoil in three areas. We found milfoil in the areas which were treated earlier this summer, as well as milfoil in front of the red house which was treated last summer. The area by the beach has become larger since the treatment. Milfoil is now on both sides of the beach and out past the public water access. It is likely that this milfoil occurred there earlier this summer, but at such a low density that we couldn't find it at that time. I have attached a map showing where I found milfoil in the lake, as well as drawings of the individual areas. We marked the northwest area and the swimming beach area with milfoil buoys, but did not mark the area by the red house with buoys. The area by the red house is small and is pretty far away from shore, and it seemed likely that the buoys would drift by the time it was time to treat. The location of each area are marked using gps coordinates, and so we will be able to easily mark the spot by the red house when it is time to treat this milfoil. In total we found about 10 acres of milfoil in Green Lake. I would like to wait a few weeks before treating these areas again. It works best to treat milfoil when it is actively growing and milfoil does not grow well when it is very hot. I believe that if we wait a few weeks before treating these areas again we will get better control of the milfoil.

If you have any questions just give me a call.

Thanks,

Wendy Crowell

To: Green Lake Property Owner's Association
C/o Terry Pearce

July 25, 2002

I wanted to inform GLPOA members of some DNR activities related to Green Lake this summer.

First, there has been a change in direction in the Eurasian watermilfoil (EWM) program from what has taken place in Minnesota over the last 15 years. DNR Ecological Services has decided that with the limited funds available for EWM control and the lack of success in eradicating this aquatic exotic plant anywhere in the state, a shift in the program was necessary. The shift is from eradication to management of the plant. Beginning this year DNR will provide grants for lakes dealing with EWM to control the plant where it is matted and creating a nuisance to common navigation areas, access sites, etc. Kandiyohi County will apply for DNR grant money for both Green Lake and Norway Lake to hire a contractor to develop an EWM Plan for each lake. Aquatic vegetation permits may be issued to individuals who wish to treat EWM where it interferes with swimming or boating access at their lakeshore residences.

On July 23, 2002 Jeff Bredberg of Kandiyohi County Environmental Services and I conducted a boat survey of Green Lake and Norway Lake to find areas with EWM, looking especially for matted stands. The results were encouraging at this time. We found no EWM at sites identified in the past two years as having abundant growths. None was found by the swim beach, Spicer boat access, Little Melvin's, Coulter access, or at Little Morgandale resort. Several native aquatic plant species were identified at each of these sites. One small stand was found north of the fishing pier in Lion's Park. It was about 15 feet by 30 feet in size, with some scattered plants surrounding it. The reason for the sharp decline of EWM in Green Lake is not known. Because it was not sampled at the various sites does not mean it is not present at all, but probably at very low abundance. For now, we are not recommending any treatment at the Coulter or swim beach. Chemical treatment in these areas could create disturbances that would allow EWM to re-establish itself. There will be continued monitoring for the plant.

Another item of interest is that Fisheries is conducting its annual fish survey of Green Lake in July. Depending on the results of the netting, coupled with historical netting information, a decision will be made regarding the experimental regulations on Green Lake. We may continue with existing regulations or possibly drop them. If a decision is made to drop the regulations, signs will be posted on the lake for the next 90 days to notify interested people. A meeting would then be held in early November. The late date for holding public input meetings is due to posting requirements and the fact that we had not anticipated making changes prior to this time. A decision about regulation direction will not be made until after this newsletter goes to print.

Skip Wright (DNR Waters) and I, are continuing our participation in the Water Quality Advisory Committee, along with representatives from other interested parties including GLPOA. The purpose of the committee is not to determine the best Highway 23 route, but to do our best to see that the highway project has as little negative impact as possible

on water quality of Green Lake and other area lakes. The committee work is expected to continue until September 2002. Placement and sizing of storm water ponds to treat runoff is an important tool for protecting lake water quality from urban runoff. A Maintenance Plan to keep the ponds working as designed, and an Erosion Control Plan for the construction phase of the highway are also important components that are to be developed by MDOT with committee assistance.

Sincerely,
Bruce Gilbertson, Area Fisheries Supervisor

Subwatershed #6 - Green Lake

Area: 16,376 ac

Minor Subwatersheds:

1804100 (9,093 ac)
1804101 (576 ac)
1804102 (923 ac)
1804103 (1,637 ac)
1804104 (2,858 ac)
1804105 (223 ac)
1804106 (1,066 ac)

Land Use Characteristic	Subwatershed		
	Total	Percent	Ranking
Agriculture	3,253 ac	20%	9
Urban/Developed	1,754 ac	11%	3
Water	6,221 ac	38%	1
Wetlands	7,486 ac	46%	1
Restorable Wetlands	627 ac	4%	6
Erodible Land (HEL/PHEL)	4,975 ac	30%	2
Public Drainage Ditches	0 mi	--	9
Feedlots	5	--	10

Surface Water Resources:

Middle Fork of the Crow River
Green Lake
Elkhorn Lake

Local Governmental Units:

Cities: Spicer
Counties: Kandiyohi
Townships: Green Lake, Harrison, Irving, and New London

Priority Issues and Recommendations:

- ***Erosion and Sediment Control.*** Many of the soils of the subwatershed are classified as erodible. The District should reduce erosion and sedimentation in agricultural, shoreland, and urban areas through the implementation of BMPs and regulations, including the adoption of rules relating to new land development and public construction projects.
- ***Invasive Aquatic Species.*** Green Lake is infested with Eurasian watermilfoil and curlyleaf pondweed. The District should work with the DNR, lake associations, and other stakeholders to identify and implement specific management strategies to control the spread of these and other invasive aquatic species.
- ***Lake Management.*** There are vast surface water resources in the subwatershed including Elkhorn and Green Lakes. The District should cooperatively work with all stakeholders to actively manage these lakes to protect and improve their water quality.
- ***Shoreland Management.*** The shoreland areas of the subwatershed have been highly altered by development. The District should minimize the impact of development within these areas through the implementation of BMPs and promotion of the DNR's new alternative shoreland standards.
- ***Stormwater Management.*** The New London-Spicer Area is experiencing intense development pressure. The District should cooperatively work with the Cities and County to increase stormwater management within the subwatershed through the implementation of BMPs and regulations.
- ***Wellhead Protection.*** The Green Lake Sanitary Sewer and Water District (GLSSWD) serves many areas in the subwatershed, including the City of Spicer. The District should cooperatively work with the GLSSWD to prepare and implement a Wellhead Protection Plan.
- ***Wetland Preservation.*** There are many wetlands in the subwatershed. The District should preserve these areas through the implementation of existing Federal and State wetland regulations and the promotion of conservation easement programs.

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assessment showed that smallmouth bass are currently exceeding long-range management goals; yellow perch, bluegill and northern pike are meeting LMP goals and walleye are below LMP goals for fish 10"+.

2003

Green Lake is in DNR Lake Class 22 and historically has shown higher walleye, bluegill, rock bass and smallmouth bass (since mid-1990's) catches than most other class 22 lakes in Minnesota. Generally, yellow perch, white sucker, tullibee, black bullhead and carp catches are similar to most other class 22 lakes. Black crappie, northern pike, yellow/brown bullhead catches are generally lower than most other class 22 lakes in Minnesota.

Creel survey's were conducted on Green Lake in the early 1980's, 1995-96 and 1996-97, 2001. Angling pressure during the openwater season has varied from 217 hours/day (2001) to 736 hours/day (1982). Walleye harvest rates have varied from 0.23/hr. (1995) to 0.07/hr. (1981, creel shortened due to labor strike). Smallmouth bass were the the most frequently caught species during the 2001 creel survey (11,169 caught). It took an average of 115 angler-hours to catch a smallmouth bass at least 17 inches long in 1995 compared to only 11 angler-hours during 2001. Black crappie harvest estimates were much higher during the early 1980's (17-70/day) than in 1995 (0.1/day) and 2001 (0). Catch rates of northern pike 28" and larger increased from 0.003 angler/hour in 1995 to 0.011/angler-hour in 2001. Sizes of northern pike caught/harvested by angler increased substantially in the 2001 creel.

With the exception of northern pike, growth rates for most primary/secondary species in Green Lake show below average growth rates compared to other Spicer Area lakes. Northern pike growth rates are average compared to other area lakes and appear to have increased in recent years.

Social Considerations

- Green Lake is an integral part of the local and surrounding communities because of it's recreational and economic significance. The preservation and enhancement of quality fishing/recreation and habitat is vitally important to the city of Spicer and Kandiyohi county, area businesses, local residents, and to the many in-state and out-state visitors to Green Lake.
- The recent reduction in walleye catch rates compared to the mid-to-late 1990's (also survey gillnet catches through 2002) has caused concern about walleye management. This has led to intense scrutiny and debate concerning the experimental regulations on bass (most notably smallmouth bass) and, to a lesser extent, northern pike.
- Eurasian watermilfoil was discovered in Green Lake in 2000. Treatments by Ecological Services did not eradicate the plant. Nuisance conditions are not expected to occur in Green Lake (firm substrates, windswept, deep); however, transport downstream to Lake Calhoun and to other area lakes where conditions are more likely to create nuisance growths is a concern.
- Currently, there are 4-5 permitted fishing tournaments on Green Lake annually and various weekday walleye leagues. The Little Crow Anglers annually sponsors a walleye tournament (24th annual in 2001, currently a 2-day event) which attracts between 50-100 boats. Other larger walleye tournaments have also occurred on Green Lake in recent years (e.g., World Walleye Association, Minnesota Walleye Trail).
- Maintenance of water quality is a major concern for Green Lake for several reasons; rapid development in the immediate (2nd and 3rd tier lakeshore development) and entire watershed, major area road expansion project (i.e., Highway 23 Project), primarily agricultural watershed, etc. Concern for protection of Green Lake water quality was the impetus for the Middle Fork of the Crow River Watershed Study which is an ongoing cooperative effort (Green Lake Water Quality Committee along with various state, federal and county agencies). All residents around Green Lake are now connected to a centralized sewage system (Green Lake Sanitary Sewer District).
- Carp periodically congregate at various inlets in the spring.
- Water-use conflicts, especially nearshore, have increased in recent years.
- Although historical water quality parameters (water clarity, nutrient concentrations, etc.) do not suggest a deterioration in water quality; residents/anglers report an increase in filamentous/attached algae, sedimentation

CC: Area, Regional and St. Paul Fisheries Offices
Green Lake Management Plan Update – May 2003
Questions or Comments Contact – Spicer Area Fisheries (320) 796-2161

Lake Vegetation Management Plan

Green Lake, Kandiyohi County

and submersed vegetation abundance.

Present Limiting Factors

2003

- Supplemental walleye fingerling "contingent" stockings (also possibly periodic fry stockings) may be needed to reach and maintain lake management survey goals for walleye.
- The negative effects of reported increases in sedimentation and filamentous/attached algae on walleye egg survival may be a possible limiting factor.
- The amount of emergent vegetation abundance (e.g., bulrush) has gradually been reduced to minimal coverages, primarily due to human impacts.
- Periodic summerkill of tullibee occurs during summertime hot, calm weather patterns. In addition, condition of larger northern pike may be reduced during extended hot, calm conditions (i.e., stable thermocline, anoxic hypolimnion).
- The black crappie population is near non-existant compared to levels recorded in the early-mid 1980's. Historically, shoreline seining has sampled black crappie young-of-year/yearlings in any abundance only once (1978).

Survey Needs

- Utilize GPS (sampling locations, aquatic vegetation/substrate mapping, etc.) and GIS technology (e.g., watershed analysis) to enhance future surveys.
- Spring electrofishing, iceout northern pike trapping and creel survey's are needed in 2004 and 2005 to complete data collection for research evaluation purposes.
- More frequent aquatic vegetation survey work is needed to assess aquatic vegetation abundance and distribution and to assess the status of Eurasian watermilfoil.
- After the experimental regulation creel survey's (2004, 2005), periodic creel survey's (e.g., once every 5 years) will be needed to evaluate lake management plan goals.

Land Acquisition

- The acquisition of the strip of land adjacent to the outlet would increase the protection level of the largest and most important stand of bulrush in Green Lake. No other land acquisition proposals are currently anticipated.

Habitat Development and Protection

- In addition to various state, federal and county agencies, the Green Lake Property Owner's (Water Quality Committee) have been active in the Middle Fork of the Crow River Watershed Study and in promoting best management practices for riparian landowner's. Pursuit of continued funding/projects within the entire watershed is needed.
- Because of substrate and morphologic factors, emergent vegetation expansion is not likely to succeed. Protection and expansion of existing stands (outlet and Spicer Castle stands) is a priority as is continued promotion of riparian buffer plantings.
- Continued protection of existing submerged vegetation through the APM process needs to continue. Although the amount of submerged vegetation appears to have increased, coverage is still limited. Moderate amounts of submerged vegetation is important to a well balanced multi-species fishery in Green Lake and in meeting LMP goals.
- The entire shoreline of Green Lake has been developed for many years. Within the past 10-20 years, the sizes of the homes and the development of condominiums/townhouses has increased substantially as has 2nd and 3rd tier development. The largest 'private' resort on Green Lake, Indian Beach Resort, was sold recently and is in the process of a new residential development. Aside from County Park #5, there are no "fishing" resorts left on Green Lake.

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Green Lake Management Plan Update – May 2003
Questions or Comments, Contact - Spicer Area Fisheries (320) 796-5161

STANDARD LAKE SURVEY REPORT
RE-SURVEY DATED 07/28/2008 FOR DOW NUMBER 34-0079-00

DRAFT

Water Level History (Continued)

Normal Water Level: N/A

Average Annual Fluctuations: N/A
Source of Fluctuation Data: N/A

Highest Recorded Water Level: N/A
Source of Highest Level Data: N/A

Lowest Recorded Water Level: N/A
Source of Lowest Level Data: N/A

History of Water Level: Reading represents a number on the gauge

Station ID	Date	Level	Reading (Feet)
GA - 1	08/12/2008	Low	4.12

Aquatic Vegetation And Shoalwater Substrates

Abundance Of Aquatic Plants (In Transects)

Number of Transects: 50
Maximum Depth of Aquatic Vegetation Sample (Feet): 40.0
Date(s) of Field Work: 08/28/2007

Common Name	Type	Frequency of Occurrence (%)	Abundance Rating	Mean Abundance (%)
Bladderwort Group	Submergent	8	Rare	6.3
Bushy Pondweed	Submergent	8	Rare	6.3
Canada Waterweed	Submergent	2	Rare	1.0
Cattail Group	Emergent	2	Rare	5.0
Clasping-leaf Pondweed	Submergent	14	Rare	5.7
Coontail / Common hornwort	Submergent	6	Rare	2.7
Curly-leaf Pondweed	Submergent	12	Rare	3.0
Eurasian milfoil	Submergent	20	Rare	11.3
Filamentous algae	-	4	Rare	2.0
Flat-stem Pondweed	Submergent	4	Rare	1.3
Floating-leaf Pondweed	Floating-leaf	2	Rare	0.3
Fries' Pondweed	Submergent	2	Rare	0.3
Hardstem Bulrush	Emergent	4	Rare	6.7
Marestail	Submergent	2	Rare	0.7
Muskgrass Group	-	98	Abundant	93.3
Narrow-leaf Pondweed Group	Submergent	4	Rare	1.3
Needlerush Group	Emergent	8	Rare	6.7
Northern Milfoil	Submergent	4	Rare	1.7
Reed Canary Grass	Terrestrial	4	Rare	1.3
River Pondweed	Submergent	20	Rare	9.0
Robbins'Pondweed	Submergent	2	Rare	0.3
Sago Pondweed	Submergent	16	Rare	5.0
Stonewort Group	-	50	Rare	29.3
Swamp Milkweed	Terrestrial	2	Rare	0.3
Water (wild) Celery	Submergent	4	Rare	1.3
Water Moss Group	-	14	Rare	12.7
White Water Buttercup Group	Submergent	2	Rare	0.3

(Floating-Leaf and wetland species may be tallied with emergent species)

Shoalwater Substrates (In Transects)

Appendix 5. Report of Diver Removal of Eurasian Watermilfoil in 2008 from Green Lake Newsletter.

In our battle against the spread of Eurasian milfoil the association has been aware of the method of hand removal which is labor intensive but an effective control measure. Unfortunately, the hiring of professional eradicators which involves trained industrial divers is quite expensive. Some concerned "North Siders" who are divers decided to investigate the possibility of diving and pulling using our own or rented equipment. The DNR 2008 milfoil control permit for Green Lake included hand removal of plants at identified sites, and with the help of Ann Latham the DNR required training of volunteer divers took place July 22. We were told that our group would be the first volunteer scuba extraction team that they knew of in the state.

We received training, and actually a fair amount of encouragement from D.N.R. representative Jacquelyn Bacigalupi. The training agenda included identification of the weed so desirable water plants would not be pulled and the nature of the weed with precautions to keep the particles from spreading. Global position maps of the permitted spots were distributed.

With tank sets rented from St. Cloud, a neighborhood paddle boat which was commandeered, and lots of sun screen applied, we ventured off-shore. The divers were armed with spades to dig the roots and found the footing to be tough. As the rooted plant was brought to the surface the harvesters loaded the weed on board and used the pool skimmer to capture any stray particles. We worked over four days and went through four tanks of air. The work was slower than we'd hoped and our methods could be improved but we learned a few things that might help others if they are interested in attempting this method. We would all be willing to spend some more time pulling if the equipment was more accessible.

If you are diver, you know it is always fun to explore the undersurface world. The diving was interesting and we all felt it was very satisfying to be able to yank those ugly things out of the lake! If you know some interested divers or have some ideas about how to use this method we'd like to hear from you. Our permit does require that pullers participate in a brief training before beginning the process. That can be arranged by contacting Pauline Spilseth at 295-1173.

Appendix 6. Enumeration of sites and total area permitted from June-September 2009.