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Peltier Lake and Centerville Lake TMDL Implementation Plan

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I. TMDL OVERVIEW

Peltier Lake and Centerville Lake were both listed as impaired waters by the MPCA in the 2002 303d list. The impaired use is aquatic recreation, with the stressor identified as "nutrient/ eutrophication biological indicators." The Centerville Lake watershed lies entirely within the Peltier Lake watershed. A TMDL report was completed jointly for both lakes.

Existing Loads

The combined watershed load to Peltier Lake represents approximately 38% of the total load to the lake, and internal load represents approximately 62% of the phosphorus load to the lake (Table 1). Of the phosphorus loads to Centerville Lake, the largest load is from the backflow from Peltier (46%), followed by atmospheric deposition and the watershed load, at 29% and 25% respectively.

Table 1. Volume and TP Load Source Contributions, June – September 2001

Lake	Subwatershed	Volume (ac-ft)	% Volume	TP Load (lbs)	% TP Load
Peltier	Upper Rice Creek	2927	34%	1734	14%
	Hardwood Creek	2656	31%	1926	15%
	Clearwater Creek	2087	25%	954	8%
	Centerville Lake	155	2%	20	0.2%
	Direct drainage	158	2%	93	0.7%
	Atm deposition	531	6%	43	0.3%
	Internal load	0	0%	7875	62%
Centerville	Watershed	61	10%	37	25%
	Atm deposition	542	90%	44	29%
	Peltier backflow	NA*	NA*	70	46%

*Peltier backflow was approximated in Bathtub by adjusting the diffusion coefficient, therefore volumes were not estimated.

Water Quality Standards

The TMDLs for Peltier Lake and Centerville Lake were established based on the state eutrophication standards for both lakes (Table 2). At the outset of this project an alternative water quality endpoint was proposed for Peltier Lake—80 µg/L TP. This endpoint was a natural background condition and was based on paleolimnological diatom reconstructions done by the Science Museum of Minnesota for Peltier Lake (Appendix B of the TMDL). At this time, however, a formal natural background condition is not being proposed for Peltier Lake. Thus, only the current state eutrophication standards will apply. However, information and results relating to the previously sought natural background condition will remain in the TMDL document and this implementation plan solely for reference and for possible reconsideration of an alternative endpoint in the future.

Table 2. MN Eutrophication Standards, North Central Hardwood Forests Ecoregion

Parameter	Centerville Lake: Eutrophication Standard, General	Peltier Lake: Eutrophication Standard, Shallow Lakes
TP (µg/l)	TP < 40	TP < 60
Chlorophyll-*a* (µg/l)	chl < 14	chl < 20
Secchi depth (m)	SD > 1.4	SD > 1.0

Assimilative Capacities

The assimilative capacity of each lake was estimated (Table 3) using a lake response model (Bathtub). The assimilative capacity represents the total phosphorus load that can be delivered to the lake while the lake maintains water quality standards, and is equal to the TMDL of the lake.

Table 3. Existing Loads and Assimilative Capacities

Lake	Model Scenario	Total TP Load to Lake during Growing Season (lbs)	Total Daily TP Load to Lake (lbs)	% Reduction Relative to Existing
Peltier	Existing	12,646	104	--
	Assimilative Capacity at Natural Background Condition Standard (80 µg/L)	2,597	21	79%
	Assimilative Capacity at Eutrophication Standard (60 µg/L)	1,855	15	85%
Centerville	Existing	151	1.2	--
	Assimilative Capacity at Eutrophication Standard (40 µg/L)*	95	0.8	37%

*This loading scenario accounts for Peltier Lake achieving the natural background condition standard of 80 µg/L. Centerville Lake improves due to the decreased loading from Peltier Lake backflow.

To reach the Peltier Lake assimilative capacity, load reductions for each subwatershed range from 29% to 55% for the previously proposed natural background conditions standard, and from 50% to 68% for the eutrophication standard (For Centerville Lake, the load that originates as backflow from Peltier Lake needs to be reduced by 79% (Table 5). This will be achieved if Peltier Lake reaches the natural background condition standard of 80 µg/L TP, and further reductions in the watershed will not be needed.

Table 4). The relative load reductions for each subwatershed are based on the current loading of each subwatershed; the loading goals are based on all subwatersheds having equal loading rates. Therefore, the percent load reduction for Hardwood Creek is higher than the percent load reduction for the other subwatersheds because Hardwood Creek currently has the highest loading rate.

For Centerville Lake, the load that originates as backflow from Peltier Lake needs to be reduced by 79% (Table 5). This will be achieved if Peltier Lake reaches the natural background condition standard of 80 µg/L TP, and further reductions in the watershed will not be needed.

Table 4. Peltier Lake Loading Goals by Source

Source	Existing Loading			Natural Background Conditions Standard 80 µg/L		Eutrophication Standard 60 µg/L	
	Load (lbs/growing season)	Percent Total Load	Percent Watershed Load	Load Goal (lbs/growing season)	% Reduction	Load Goal (lbs/growing season)	% Reduction
Upper Rice Creek	1734	14%	37%	950	45%	673	61%
Hardwood Creek	1926	15%	41%	862	55%	611	68%
Clearwater Creek	954	7.5%	20%	678	29%	480	50%
Direct drainage	93	0.74%	2.0%	51	45%	36	61%
Atm deposition	43	0.34%	NA	43	0%	43	0%
Internal load	7875	62%	NA	0	100%	0	100%
Centerville Lake	20	0.16%	0.42%	13	37%	12	40%

Table 5. Centerville Lake Loading Goals by Source

Source	Existing Loading		Load Goal (lbs/growing season)	% Reduction
	Load (lbs/growing season)	Percent Total Load		
Watershed	37	25%	37	0%
Atm deposition	44	29%	44	0%
Peltier backflow*	70	46%	15*	79%

*Loading goal achieved through Peltier Lake reaching the 80 µg/L goal

TMDL Allocations

The TMDL was broken down into wasteload allocations (WLAs) and load allocations (LA) for each lake (Table 6 and Table 7). The WLA includes loads that originate in areas covered by an NPDES permit. These include portions of MS4 communities that are nonagricultural and that are projected to be served by stormwater conveyances by 2020 (e.g., residential, commercial, industrial), road authorities (counties, Mn/DOT), RCWD, and other point sources. The LA includes loads that originate in non-MS4 communities (City of Columbus and May Township), portions of MS4 communities that are either agricultural or otherwise not projected to be served by stormwater conveyances in 2020, internal loading, and atmospheric deposition.

The stormwater sources (MS4, construction stormwater, and industrial stormwater) were given categorical WLAs for both Peltier Lake and Centerville Lake. The categorical WLA covers all

regulated stormwater sources; the load reductions identified by the WLAs will need to be met by this group as a whole, but individual WLAs are not specified.

The LA includes loads that originate in areas not regulated by an MS4 permit, internal loading, and atmospheric deposition. Although the load designated for each of these sources was estimated separately, they are jointly included as one overall LA.

Table 6. Peltier Lake WLAs and LAs

Permit Type	Permit Name	Permit Number	Existing TP Load (lbs/day)	Natural Background Condition, 80 µg/L		Eutrophication Standard, 60 µg/L	
				WLA (lbs/day)	% Reduction	WLA (lbs/day)	% Reduction
MS4 stormwater	Anoka County	MS400066	12.50	6.75	46%	4.78	62%
MS4 stormwater	Birchwood Village	MS400004					
MS4 stormwater	Centerville	MS400078					
MS4 stormwater	Dellwood	MS400084					
MS4 stormwater	Forest Lake	MS400262					
MS4 stormwater	Grant	MS400091					
MS4 stormwater	Hugo	MS400094					
MS4 stormwater	Lino Lakes	MS400100					
MS4 stormwater	Mahtomedi	MS400031					
MS4 stormwater	Ramsey County Public Works	MS400191					
MS4 stormwater	Washington County	MS400160					
MS4 stormwater	White Bear Lake	MS400060					
MS4 stormwater	White Bear Township	MS400163					
MS4 stormwater	Willernie	MS400061					
Construction stormwater	Various	Various					
Industrial stormwater	No current permitted sources	NA					
MS4 stormwater	MNDOT Metro District	MS400170	0.08*	0.04	46%	0.03	62%
Industrial wastewater	Forest Lake Water Treatment Plant	MNG640118	0.01	0.01	0%	0.01	0%
Industrial wastewater	St. Croix Forge	MN0069051	0.01	0.03	0%	0.03	0%
Total			*12.60*	*6.84*	*46%*	*4.86*	*61%*

*Mn/DOT's existing TP load was not independently calculated; rather, this figure is an estimate based on back-calculating from the same reduction percentage the other MS4 entities will collectively be required to meet.

Table 7. Centerville Lake WLAs and LAs

WLA or LA	Permit Type	Source/Permit Name	Permit Number	Existing Load (lbs/day)	WLA/LA (lbs/day)	% Reduction
WLA	MS4 stormwater	Anoka County	MS400066	0.24	0.21	0%
	MS4 stormwater	Centerville	MS400078			
	MS4 stormwater	Lino Lakes	MS400100			
	MS4 stormwater	Rice Creek WD	MS400193			
	Construction stormwater	Various	Various			
	Industrial stormwater	No current permitted sources	NA			
LA	NA	Non-MS4 stormwater	NA	0.090	0.090	0%
		Peltier Lake backflow		0.57	0.12	79%
		Atmospheric deposition		0.36	0.36	0%
Total:				*1.2*	*0.78*	*37%*

II. TARGET LOADS

Although the TMDL was written using a categorical approach for stormwater, the stormwater WLAs and LAs (including both regulated and non-regulated runoff) were further broken down here into target loads solely for implementation planning purposes. This was done according to the amount of upland area in each category (Table 8 and Table 9). The upland area was selected to represent the developable area in the watershed (including area already developed); it includes the total watershed area with the lake and wetland area subtracted out. Wetland areas were determined with MLCCS (Minnesota Land Cover Classification System) data; in areas where MLCCS data were not available, NWI (National Wetland Inventory) data were used.

Target loads of zero reflect MS4s that currently do not own stormwater conveyances in the watershed. In the event that these MS4s develop and maintain ownership of new conveyances in the watershed, the target load will be distributed to them from existing conveyances proportional to the area occupied by the new conveyance.

The construction and industrial stormwater percent distributions were estimated based on the percent of area within the counties in each watershed that have been covered under a construction stormwater permit over the last four years (divided by four to determine the average annual percent).

Table 8. Centerville Lake Target Stormwater Loads

Permit Name or Source	Permit Number	Regulated Sources		Non-Regulated Sources	
		lbs/growing season	lbs/day	lbs/growing season	lbs/day
Anoka County	MS400066	0.47	0.0038	0.18	0.0015
Centerville	MS400078	23.11	0.19	4.01	0.0328
Lino Lakes	MS400100	2.07	0.017	6.60	0.0541
Rice Creek WD*	MS400193	0	0	0	0
Construction and industrial stormwater, regulated	Various	0.36	0.0030	0	0

*RCWD has a target load of 0 because its MS4 jurisdiction covers ditches, which do not contain any upland (developable) area.

Table 9. Peltier Lake Target Stormwater Loads

Permit Name or Source	Permit Number	Natural Background Condition, 80 µg/L				Eutrophication Standard, 60 µg/L			
		Regulated Sources		Non-Regulated Sources		Regulated Sources		Non-Regulated Sources	
		lbs/growing season	lbs/day	lbs/growing season	lbs/day	lbs/growing season	lbs/day	lbs/growing season	lbs/day
Anoka County	MS400066	0.91	0.0075	0.11	0.0009	0.64	0.0053	0.07	0.0006
Birchwood Village	MS400004	11.71	0.096	0.54	0.004	8.30	0.068	0.39	0.003
Centerville	MS400078	43.62	0.36	2.54	0.02	30.89	0.25	1.80	0.01
Columbus	NA	0.00	0.0	316.97	2.6	0.00	0.0	224.52	1.8
Dellwood	MS400084	5.57	0.05	79.27	0.65	3.94	0.03	56.15	0.46
Forest Lake	MS400262	159.16	1.3	284.99	2.3	112.74	0.9	201.87	1.7
Grant	MS400091	11.31	0.1	250.57	2.1	8.01	0.1	177.49	1.5
Hugo	MS400094	239.90	2.0	616.03	5.0	169.93	1.4	436.36	3.6
Lino Lakes	MS400100	135.25	1.1	113.05	0.9	95.80	0.8	80.08	0.7
Mahtomedi	MS400031	76.85	0.63	6.15	0.05	54.43	0.45	4.36	0.04
May Township	NA	0.00	0.00	16.62	0.14	0.00	0.000	11.77	0.096
MNDOT Metro District	MS400170	5.12	0.042	1.15	0.009	3.63	0.030	0.82	0.007
Ramsey County Public Works	MS400191	7.47	0.061	0.63	0.005	5.29	0.043	0.45	0.004
Rice Creek WD*	MS400193	0.00	0	0.00	0	0.00	0	0.00	0
Washington County	MS400160	1.48	0.012	0.02	0.000	1.05	0.0086	0.01	0.0001
White Bear Lake	MS400060	24.31	0.20	8.00	0.07	17.22	0.14	5.67	0.05
White Bear Township	MS400163	89.95	0.74	16.28	0.13	63.71	0.52	11.53	0.09
Willernie	MS400061	4.02	0.033	0.13	0.001	2.85	0.023	0.09	0.001
Construction and industrial stormwater, regulated	Various	11.95	0.098	0.00	0.000	8.46	0.069	0.00	0.000

*RCWD has a target load of 0 because its MS4 jurisdiction covers ditches, which do not contain any upland (developable) area.

III. CONTEXT FOR ACHIEVING LOAD REDUCTIONS

Target Loads

Since a categorical stormwater WLA was established in the TMDL for all permitted stormwater sources (except MNDOT), the individual permittees will need to determine their existing contribution to the current impairment and provide an approach of how that load will be reduced in the future to meet the categorical wasteload allocation. Target loads were developed for the implementation plan (Table 8 and Table 9) to guide each MS4 in determining their portion of the WLA.

RCWD Leadership Role

The Rice Creek Watershed District (RCWD) will play a lead in planning and implementing much of the load reduction activities as well as tracking progress toward achieving the load reductions.

Documenting Progress through Adaptive Management

The TMDL report stressed the need to follow an adaptive management approach to improvements for Peltier and Centerville Lakes. Under this approach, the implementation plan includes many watershed and in-lake actions that will be measured quantitatively for load reduction success. After the result is measured, changes in the strategy will be taken to adjust and move forward. Failures are corrected and successful efforts are repeated elsewhere. This will rely on a well-defined monitoring program that is robust enough to detect small changes.

Although there is a clear need for effectiveness monitoring as management actions move forward, care should be taken when evaluating the success of each individual action. Preliminary meetings with state and local agencies have identified the need for a multi-faceted approach to implementation. In situations where several actions are taken concurrently, it will be difficult to assess the success or failure of any individual action. In addition, tools for addressing internal phosphorus loading, including tools to monitor effectiveness, are underdeveloped compared to watershed tools. This strengthens the argument for adaptive management, but also requires the use of theoretical ecology and sound literature reviews.

Actions are occurring at a very rapid pace within the RCWD and communities. The RCWD has been a leader in the metro area in developing effective watershed-based programs. It also has a long history of data collection and an active monitoring program throughout the watershed. With these qualifications, it makes sense for the RCWD to assume a key role as “aggregator” in documenting the progress that is made as implementation proceeds. The specific actions recommended for this role for RCWD include:

- Assessing the current RCWD monitoring program and adjusting it, if needed, to better detect possible changes resulting from implementation actions
- Evaluating the need for specific monitoring of BMPs installed at specific sites
- Reporting routinely (perhaps annually) on the progress made toward achieving the water quality goals for the two lakes
- Providing data input for the Implementation Work Group (see below)

Implementation Work Group
It is recommended that RCWD convene and lead an implementation work group that formalizes an approach to documenting individual MS4 responsibilities. This effort includes:

- Initiating and chairing the formation of a Peltier and Centerville Lakes TMDL Implementation Work Group
- Identifying key parties for participation in the work group
- Developing a means to assess current loading by MS4 and to prioritize areas and potential actions within MS4s to reduce loads
- Developing an appropriate tool to track load reductions by MS4 to determine progress toward achieving subwatershed load reductions
- Determining by the next MS4 permit issuance (2011) the institutional means through which TMDL implementation will occur in five-year permit cycle steps within the SWPPP framework

IV. WATERSHED/EXTERNAL LOAD

The following section identifies the background watershed implementation steps recommended to address the overall watershed load reduction. Although quantifying each element is not possible, the framework suggested above is designed to document the effects of each and proceed with adaptive management.

Peltier Lake Watershed

Implement Existing Planning and Regulatory Efforts
There are a number of regulatory efforts in place or will be in place in the future to limit the amount of nonpoint source pollution from land-disturbing and runoff-generating activities within the watershed. The following items constitute a list of action steps that are already underway in the watershed.

Hardwood Creek Biotic Impairment TMDL Implementation Plan
Hardwood Creek contributes approximately 41% of the existing watershed (external) growing season TP load to Peltier Lake; the annual TP load leaving Hardwood Creek and entering Peltier Lake is 1,926 pounds (Table 4). To reach the water quality goal for Hardwood Creek as determined in the WLA, the mean growing season TP load will need to be lowered to 611 pounds to meet a Peltier Lake goal of 60 µg/L (a 68% reduction) or 862 pounds for the background goal of 80 µg/L (a 55% reduction).

The implementation strategy of the Hardwood Creek Biotic Impairment TMDL focuses on the following implementation actions that will result in lowered TP load:

- Streambank restoration and bank stabilization at several locations along Hardwood Creek (action began with a series of projects in 2007)

- Establishment of forested riparian buffers
- Implementation of stormwater management regulations through existing RCWD Rules and volume standards (see details below)

Implementation Steps. A high priority should be placed on implementation activities within the Hardwood Creek sub-watershed through its TMDL process in order to eventually decrease TP loads to Peltier Lake. High priority monitoring of the TP load originating in Hardwood Creek should continue with a focus on post-implementation of the TMDL program. The cost of this monitoring could add $5,000 to the RCWD monitoring program. Costs for implementing the Hardwood Creek TMDL are mostly included in on-going regulatory programs that do not constitute new costs. There will likely also be additional special capital projects in the future on Hardwood Creek such as those bulleted items above. The MPCA (March 2006) estimated that restoration costs for implementation projects in the Hardwood Creek sub-watershed would cost about $4,850,000 or approximately $300 per acre of sub-watershed.

Achieving the load reductions will be the result of the three on-going implementation actions noted above, as undertaken by:

- RCWD under its rules (see later discussion) and its MS4 program for the ditch system it controls as the ditch authority
- The MS4 programs of Forest Lake, Hugo, and Lino Lakes
- The MS4 transportation programs of Mn/DOT (I-35), Washington County, and Anoka County

Participants. Those participating in implementing the Hardwood Creek TMDL results include: MPCA; RCWD; the MS4 cities of Lino Lakes, Hugo and Forest Lake; Mn/DOT; and Washington County and Anoka County (highways).

JD4 Resource Management Plan (RMP)

The JD4 Resource Management Plan covers approximately one-third of the Upper Rice Creek watershed. The Upper Rice Creek watershed, into which JD4 flows, accounts for 37% of the watershed (external) TP load to Peltier Lake, and either a 45% reduction (for the natural background condition standard) or a 61% reduction (for the state eutrophication standard) will be needed to meet the loading goals (Table 4). The main drainage area for JD4 consists of several open channel ditch branches (all in Anoka County) and tile lines (mainly in Washington County).

The RMP and the associated rule were adopted by the RCWD in 2008. The RMP addresses both ditch repair and resource management, in a coordinated fashion, to accomplish the following goals:

- Ensure landowner rights for future ditch maintenance work are respected while accounting for all ditch law obligations, including those pertaining to environmental costs
- Ensure that overall wetland functions within the planning area are maintained or enhanced when compared to existing conditions

- Ensure impaired waters goals are addressed for the downstream Peltier Lake
- Provide a mechanism for local coordination and implementation of open space plans through permanent wetland and open space protection

The guidance included in the RMP will be implemented through the adopted rule, which addresses both wetland and upland watershed runoff. Applicants are required to incorporate a variety of BMPs to meet the new standards set forth in the rule, which requires, among other things:

- Retention of the one-year event by providing at least the volume equal to the runoff from a 2.3-inch, 24-hour storm over the tributary area
- Use of infiltration BMPs for A and B soils, and bio-filtration or two-cell wetland treatment systems for C and D soils
- Adequate pre-treatment
- Volume mitigation measures reducing runoff by at least the volume from 0.5 inches of rainfall over impervious surfaces on the site
- Wetland buffers and allowable wetland bounce based on Wetland Susceptibility Class

The rules also allow for volume credits and banking for those projects that go beyond the rule requirements. It is anticipated that implementation under these rules and the RCWD general rules (see below) will result in achievement of the load reduction needed to meet the TP goal in the JD4 subwatershed for Peltier Lake at no additional cost attributable to the TMDL.

Implementation Steps. Implementation of specific BMPs are listed within the JD4 RMP, and general locations for possible BMP installations are mapped there as well. The high priority implementation program will focus on the use of upland treatment (detention, infiltration), wetland treatment systems (filtration, volume reduction through evapotranspiration, bioretention), and restoration of natural drainage systems. Monitoring of the TP load originating in JD4 should continue with a focus on post-implementation of the RMP; this should be a high priority once the sub-watershed implementation has begun. The cost of this monitoring could add $5,000 to the annual RCWD monitoring program. Although a detailed program has not yet been defined, application of the $300 per acre cost determined by MPCA would yield a total cost (4,572 acres) for the JD-4 sub-watershed of $1,371,600, in addition to the $8,140,000 recommended in the RCWD JD-4 RMP report for ditch repair and RMP implementation.

Achieving the load reduction will be the result of implementation actions undertaken by:

- RCWD under its rules (see later discussion) and its MS4 program for the ditch system it controls as the ditch authority
- The MS4 programs of Forest Lake, Hugo and Lino Lakes
- The load allocation efforts within the non-MS4 city of Columbus
- The MS4 transportation programs of Mn/DOT (I-35), Washington County, and Anoka County

Participants. Those participating in implementing the JD4 RMP implementation effort include: RCWD; the MS4 cities of Lino Lakes, Hugo, and Forest Lake; Mn/DOT; and Washington

County and Anoka County (highways). Although the city of Columbus is not an MS4 community, the preparation of a Columbus RMP would provide a regulatory vehicle through which the city could participate.

Lino Lakes Resource Management Plan

The Lino Lakes Resource Management Plan (LL RMP) is a watershed-based natural resource plan for input into the Lino Lakes Comprehensive Plan. It is based on both existing resource and full build-out conditions. The plan came about through a partnership of the Rice Creek Watershed District and the City of Lino Lakes. Ultimately the LL RMP future conditions resource assessment will test if the draft Comprehensive Plan and RCWD standards can protect resources into the future. Both are watershed-based analyses of wetlands, lakes, ditches, and the quality and quantity of water they depend on.

Portions of Lino Lakes contribute direct inflow to both Peltier and Centerville Lakes, and the Upper Rice Creek, Hardwood Creek, and Clearwater Creek watersheds. The RMP contains specific BMP and site locations for implementation of these practices. A watershed rule under development establishes a wetland preservation corridor to protect the high quality wetlands in the city, and also addresses volume control. Output from the RMP is also a key component of the Lower Rice Creek Chain of Lakes TMDL that is a companion to the Peltier and Centerville Lakes TMDL.

Implementation Steps. A draft of the LL RMP is currently out for review, with an expectation that it will be adopted by the city by the end of 2008. Implementation of the RMP will be through the programs of the city (MS4 and implementation of its comprehensive planning and land use authorities), as well as implementation of RCWD rules adopted specifically for the RMP area; this should be a high priority once the program implementation begins. Transportation MS4 programs operating within the city by Mn/DOT and Anoka County will also assist in reaching wasteload reduction goals. Select monitoring of the TP load leaving representative parts of the RMP area should be undertaken with a high priority focus on post-implementation of the RMP rules. The cost of this monitoring could add $10,000 to the annual RCWD monitoring program. This cost is higher than that for Hardwood Creek and JD4 because there are more monitoring locations required spread throughout the city. The implementation costs for the Lino Lakes RMP are included in the Upper Rice Creek, Hardwood Creek and Clearwater Creek sub-watershed and direct drainage totals to Peltier Lake cost summary in Section V.

Participants. Those expected to participate in implementing the Lino Lakes RMP include the RCWD and the city of Lino Lakes.

Rice Creek Watershed District Rules

The regulatory program of the RCWD will be a key implementation feature to yield improvement in the quality of runoff entering the Rice Creek Chain of Lakes. The current rules in effect in RCWD were adopted on February 13, 2008. Specific rules expected to contribute to water quality improvement in Peltier Lake include stormwater management (Rule C), erosion control (Rule D), wetland alteration (Rule F), and drainage systems (Rule I).

Rule C requires, among other things:

- Use of Better Site Design techniques from the MN Stormwater manual
- BMPs sized to infiltrate and/or retain the runoff volume generated within the contributing area by a two-year (2.8-inch) storm under the developed condition, or 0.8-inch for any undisturbed contributing impervious areas on the site (special provisions are made for roadways)
- Alternative compliance sequencing for sites where normal compliance is not feasible;
- Peak runoff control for the critical two- and 100-year events
- Allowable wetland bounce based on Wetland Susceptibility Class

Rule D requires, among other things:

- Erosion and sediment control plans according to RCWD criteria
- Site maintenance and inspection by the permittee, subject to District oversight

Rule F requires, among other things:

- No net loss in the quantity, quality or biological diversity of existing wetlands
- Increasing the quantity, quality and biological diversity of wetlands by restoring or enhancing diminished or drained wetlands
- A wetland functions and value assessment before and after a project
- Strict adherence to the MN WCA for any alteration of a regulated wetland and replacement credits

Collectively, these rules are expected to result in the eventual achievement of watershed runoff goals. They can be supplemented by select water quality and runoff improvement projects undertaken by public agencies, including the RCWD, and private land owners/developers.

Implementation Steps. High priority implementation of the RCWD rules will be the responsibility of the District, as assisted by the communities within its boundaries that inform potential permittees about the District's requirements. Again, quantifying water quality improvement results from the implementation of rules is not possible, but continued monitoring of water quantity and quality conditions within the District should show the long-term results as these rules take effect. There is no additional cost attributable to the TMDL to implement RCWD rules in the watershed.

Participants. Those expected to participate in implementing the new Rice Creek Watershed District rules include RCWD, all of the MS4 cities within the watershed, and any entity expecting to receive an RCWD permit for a related activity.

Related Rules and Plans

There are also other rules and plans being implemented within the area draining to Peltier Lake that should result in overall water quality improvement of the lake.

I-35E Corridor Areawide Urban Alternative Review (AUAR) – This AUAR was prepared in 2005 by the City of Lino lakes to guide development for a 4,500 acre portion of eastern Lino

Lakes bordering I-35E. This area constitutes about half of the total area of Lino Lakes, including most of the surface area of Peltier Lake. A small portion of the eastern side of the City of Centerville is also included in the AUAR. The document includes a mitigation plan that "…will become a component of the action plan to ensure that the city avoid, minimize or mitigate significant environmental impacts from development of the AUAR area." This document will be used in conjunction with the Local Comprehensive Plan and the LL RMP, as well as RCWD rules, to implement effective stormwater controls for a large portion of Lino Lakes tributary to Peltier Lake. Specific elements of the mitigation plan address ecologically sensitive resources and stormwater management. The AUAR incorporates a conservation design framework to protect surface and ground waters by purifying, filtering and infiltrating surface runoff. The stormwater component "…can be implemented on both a regional and site scale to minimize the impact of development on runoff rates and volumes, water quality, and the region's aquatic resources." BMPs such as bio-swales, wet prairies, and wetlands will be used in conjunction with more structural BMPs to effectuate water quality improvement. Implementation of the I-35E Corridor AUAR mitigation plan is required through state law. It will be done through a combination of regulatory programs including the City of Lino Lakes's MS4 and planning and land use authorities, RCWD rules and various resource regulatory programs, and therefore no additional cost attributable to the TMDL.

Environmental Assessment Worksheet (EAW) for the City of Centerville Downtown Development – This EAW was prepared in 2007 in anticipation of expected downtown improvements. The EAW contains general proposed runoff improvements that, although short on details, espouse improved runoff quality as a goal of re-development. The majority of the 37.4 acres being re-developed drain to Peltier Lake via Clearwater Creek, although a small portion also drains to Centerville Lake. Implementation of the framework laid-out in the EAW will occur under the auspices of the RCWD rules, MPCA's NPDES Construction Permit, and the city's NPDES MS4 program. The city has also received funding assistance via a 2008 BWSR grant program to help with the implementation costs of various BMPs. The city has also applied for RCWD Urban Stormwater Remediation Cost-Share funds to route downtown area runoff to a pond and park irrigation system, thus further diverting direct, untreated runoff from Centerville Lake. Improvements made in conjunction with implementing the City of Centerville Downtown Development efforts will be undertaken in accordance with city MS4 and planning and land use authorities, RCWD rules and various resource regulatory programs, and therefore no additional cost attributable to the TMDL.

MS4 Program Implementation - All of the communities within the watershed draining to Peltier and Centerville Lakes, with the exception of the City of Columbus and May Township, are NPDES MS4 communities (permitted under the Municipal Separate Storm Sewer System program). Each of these communities was required to prepare a Notice of Intent (NOI) to receive their initial permit. The NOIs go through a series of information pertaining to stormwater control programs within a community. Each community is also required to prepare a five-year SWPPP (Storm Water Pollution Prevention Program) and report on the progress of BMP implementation annually. MPCA and the RCWD can work with these communities via their SWPPPs and MS4 regulatory programs to implement the watershed improvements needed for achieving the wasteload allocation for permitted MS4 areas and load allocation for nonpoint and non-MS4

sources. SWPPPs are required to incorporate the results of any approved TMDLs within their area of jurisdiction, therefore, there is no additional cost attributable to the TMDL.

In addition to the community MS4 programs, RCWD has MS4 responsibilities for the public drainage (ditch) system it controls; Mn/DOT has MS4 responsibility for the state highway system that traverses the watershed; and Washington and Anoka Counties have responsibility for the county highway system within the watershed. All of the community, watershed district, state, and county MS4 programs will be expected to be high priority elements in the TMDL implementation plan for Peltier and Centerville Lakes. Additional costs expected to be incurred by these agencies to meet loads determined from the TMDL are not estimated at this time, but should be expected within the SWPPPs following state and federal adoption of the TMDL.

Additional Elements for the Peltier Lake Implementation Plan

There are also programs that are anticipated to assist in implementation, but which have not yet been instituted. Following are a list of programs expected to be started within the next several years. Detailed implementation actions cannot yet be stated for these non-existing programs, but descriptions are given for how implementation is expected to proceed.

Clearwater Creek TMDL

Clearwater Creek is on the 2008 303(d) list of impaired water bodies; the affected use is aquatic life, with the listed stressors as "Low Fish and Macroinvertebrate IBIs." IBI refers to the Index of Biotic (or often called Biological) Integrity. This "biotic impairment" results from stressors within the watershed or within the water body placing a threat on both the fish and macroinvertebrates (aquatic insects) within the creek. The stressors can be physical, such as high flow, high temperature or loss of suitable benthic habitat, or chemical, such as high toxic metals, low oxygen or pesticides. The stressor identification process for these two impairments has been initiated by the RCWD, with plans to complete the TMDL in the near future. A preliminary stressor identification was prepared by the RCWD in February 2008 and found that suspended solids, phosphorus, nitrogen and dissolved oxygen are likely stressors leading to the impairment. RCWD will continue to make an effort to complete this TMDL and address the water quality impairments within Clearwater Creek, which drains directly to Peltier Lake.

Clearwater Creek contributes 954 pounds of TP to Peltier Lake during the growing season (Table 4). A reduction to 480 pounds will be needed to achieve the Peltier shallow lake goal of 60 µg/L (a 50% reduction) or to 678 pounds to achieve the 80 µg/L background conditions goal (a 29% reduction).

Within the Clearwater Creek sub-watershed is Bald Eagle Lake, which is also an impaired water subject to a TMDL study. The TMDL study was initiated in 2008, with a target completion date of April 2009.

Implementation Steps. A TMDL funding proposal for the Clearwater Creek TMDL was submitted by RCWD for consideration by the MPCA,. The cost proposal submitted by RCWD for this study is $103,654 ($46,644 from RCWD and $57,010 requested from MPCA). To gain a rough estimate of potential costs that could result after the Clearwater Creek TMDL, the MPCA estimate of $300 per acre when applied to Clearwater Creek would total $8,463,300.

Participants. Those expected to be primary participants in developing a Clearwater Creek TMDL study include MPCA; RCWD; the MS4 communities of Centerville, Lino Lakes, Hugo, White Bear Township, and White Bear Lake; Mn/DOT; and Anoka and Washington Counties (highways). Several other cities in the upper Clearwater Creek watershed will also have some input.

Upper Rice Creek (minus JD4)

The JD4 RMP will lead to reduced load from one-third of the Upper Rice Creek sub-watershed. The remaining growing season TP load from the other two-thirds totals about 1,160 pounds. This will need to be reduced by 61% for the 60 µg/L shallow lake state standard, or by 45% for the 80 µg/L natural background conditions standard (Table 4).

Implementation Steps. Implementation within the Upper Rice Creek sub-watershed outside of the JD4 RMP is a high priority and will occur through the RCWD rules and local MS4 and non-MS4 runoff control programs. As with other currently unquantifiable actions, the Implementation Work Group will work on defining a monitoring scheme to track progress, which will then serve as input to refine the load targets. The cost of this high priority monitoring could add $5,000 to the annual RCWD monitoring program. The estimated cost of implementation, based on the MPCA estimate of $300 per acre for the Upper Rice Creek sub-watershed (minus the JD4 RMP area), would be $4,629,900.

Participants. Those expected to be primary participants in implementing the Upper Rice Creek improvements include RCWD; the MS4 cities of Lino Lakes, Hugo and Forest Lake; Mn/DOT; Anoka County Parks; and Washington County (highways). Although the city of Columbus is not an MS4 community, the preparation of a Columbus RMP would provide a regulatory vehicle through which the city could participate.

Howard Lake TMDL

The upper part of the Upper Rice Creek sub-watershed drains through Howard Lake. Howard Lake is on the 2008 303(d) list of impaired water bodies; the affected use is aquatic recreation and the stressor is “nutrient/eutrophication biological indicators.” In 2003, the DNR conducted fish eradication on the lake to remove rough fish. This resulted in a pronounced improvement in lake water quality and a resulting reduction in the load of phosphorus from the headwaters of Rice Creek.

Implementation Steps. RCWD submitted a request to the MPCA to undertake a TMDL study of Howard Lake during the 2008 funding cycle. The cost proposal submitted by RCWD for this study is $57,867 ($34,720 from RCWD and $23,147 requested from MPCA). Implementation costs for Howard Lake will not be developed until the TMDL study is complete. For this implementation plan, estimated costs are included within the Upper Rice Creek sub-watershed costs. Ongoing water quality monitoring of Howard Lake is recommended, as rough fish are apt to re-colonize the lake. RCWD should continue to work with MNDNR on long-term rough fish management.

Participants. Those expected to be primary participants in developing the Howard Lake TMDL study include MPCA; RCWD; MNDNR (Howard Lake is surrounded by the Lamprey Pass

Wildlife Management Area); the MS4 City of Forest Lake; Mn/DOT; and Anoka and Washington Counties (highways). Although the City of Columbus is not an MS4 community, the preparation of a Columbus RMP would provide a regulatory vehicle through which the city could participate.

Centerville Lake Watershed

Centerville Lake has a much different watershed Implementation Strategy in the TMDL report than Peltier Lake because of the difference in contributing area. The difference will also be reflected in this implementation plan. The Centerville Lake watershed is essentially the area immediately surrounding the lake, plus that amount of inflow that enters the lake from Peltier Lake during interflow events, which represents about 46% of the TP loading to Centerville Lake (Table 5).

Implementation Steps. Since the implementation steps occurring for Peltier Lake will have a significant effect on Centerville Lake via the interflow, the Centerville Lake Implementation Plan's primary component is implementing controls for Peltier Lake. Possible elimination of the interflow problem is discussed in Section VI. Beyond these two major actions, runoff controls via the RCWD Rules, MS4 programs, and Anoka County Parks park management along the west and south sides of the lake constitute the implementation plan and are estimated for this direct drainage area based on the MPCA cost of $300 per acre to be $139,800. The only additional cost would come from the interflow study noted in Section VI.

Participants. Those expected to participate in implementing improvements within the Centerville Lake watershed include RCWD; the MS4 cities of Centerville and Lino Lakes; and Anoka County Parks.

V. INTERNAL LOAD

Peltier Lake In-Lake Implementation

Introduction

The results of the load analysis (Section 5 in the TMDL report) show that about 62% of the annual load of Peltier Lake comes from internal sources. The RCWD has instituted several programs within the watershed to reduce external (watershed) loading, but clearly additional focus is needed on in-lake mechanisms.

A total (internal plus external) load reduction of over 10,000 pounds of TP will be needed to reach either of the goals (Table 3). Attention in the TMDL report focuses on substantial reductions from internal sources that are compatible with long-term reductions that can optimistically be expected for external sources. Peltier Lake is affected by complex biological processes, in part due to invasive species such as carp and curlyleaf pondweed. Therefore, determining the exact load contributed by each process (or species), and reductions achieved from management actions aimed at each process, will be difficult to quantify.

The RCWD will begin its implementation program with attention to reduction of external load as an essential first step in addressing the lake. Addressing internal load without turning off the external source is not a productive management approach.

Discussions on possible in-lake management approaches have included the DNR (Fisheries, Ecological Services, Water), MPCA, RCWD, members of the public, and the St. Paul Regional Water Services (SPRWS). Although perspectives are markedly different, all agree that the water quality focus of the TMDL program will assist each in achieving their specific lake management goals. Any successful lake management program will need to rectify program differences among stakeholders.

Implementation Context

No single management practice or approach will resolve the problem of internal loading. Any success that will be achieved will have to be obtained through a multi-faceted approach. The following implementation plan details the elements within this multi-faceted approach under the title of the "Peltier Lake In-Lake Management Program" (PLIMP). Figure 1 lays out a sample decision tree that could be followed as part of the adaptive management program once the results of the recommended actions begin to be documented. This tree contains suggested follow-up actions that could evolve from the PLIMP. Each "Implementation Steps" section contains an indication of the priority for action on a low, medium, or high scale.

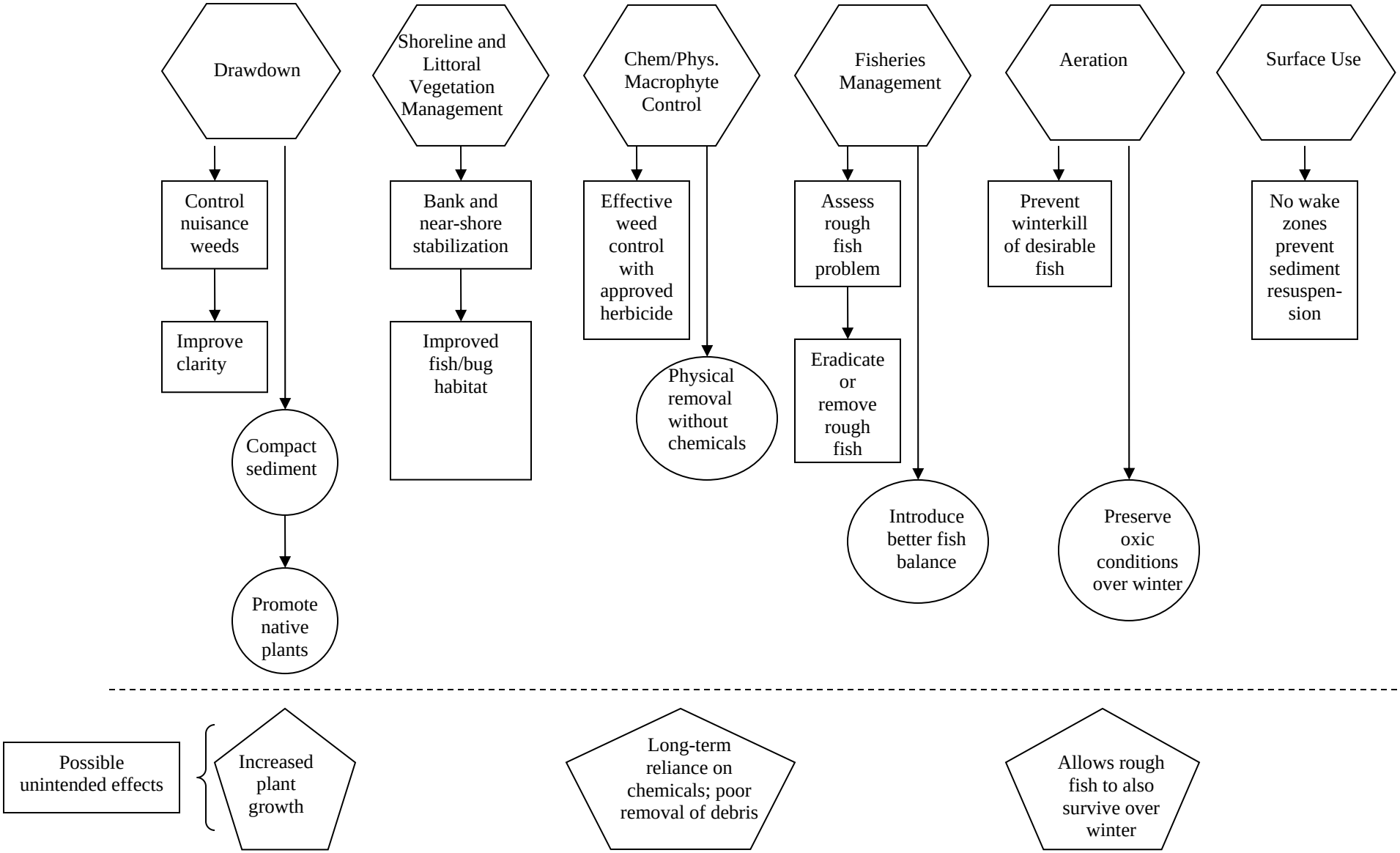

Figure 1. In-lake Management Tree

Caution will be needed to evaluate the repercussions that individual decisions made within the PLIMP have on other parts of the resource. For example, getting an immediate improvement in clarity through the control of curly-leaf pondweed could introduce the possibility of rapid growth of other macrophytes over much of the lake. Currently, the plants in the lake grow only to a depth of about six feet before they are shaded-out. With the elimination of curly-leaf pondweed, perhaps native plants would be less shaded and have room to prosper. Any such changes should be documented as part of the monitoring program below.

A package of management approaches within the PLIMP needs to be crafted to address the many aspects of the problem. **The package needs to be implemented in its entirety and monitored for effects – only then can the result be quantified and effectiveness documented.** It is a process that will take many years to accomplish within an adaptive management framework. It is recommended that primary implementation of the following recommendations be undertaken by the RCWD because of the regional importance of this lake, and that it work closely with MPCA, the DNR, Anoka County Parks, SPRWS and local interests to develop the most cost-effective strategy to implement this multi-faceted approach.

Many potential in-lake management techniques were considered for Peltier Lake. The following text describes the more favorable of these alternatives that are recommended to be part of the PLIMP.

Drawdown/Macrophyte Control

Nuisance levels of curly-leaf pondweed exist in Peltier Lake in the northern bay and along most of the shoreline to a depth of six feet (see DNR 2008 survey results in Figure 21 of the TMDL Report). Options such as mechanical harvesting and chemical control provide short-term solutions, but do not yield long-term results. A drawdown of lake levels can improve a lake's littoral vegetation through: aeration of the sediments to allow the germination of certain native plant seeds; winter freeze-out of curly-leaf pondweed turions; consolidation of the sediments to improve the sediment's ability to support rooted macrophytes; and promotion of oxygenation and consolidation of organic debris. Perhaps the most beneficial outcome of conducting this drawdown in the winter is that the curly-leaf pondweed turions (dormant vegetative propagules) in the exposed sediment are frozen and destroyed. The other noted benefits can be achieved if the drawdown continues through the following growing season (into fall).

Drawing down the level of the lake to allow for compaction of sediment and elimination of curly-leaf pondweed turions is one approach recommended for the PLIMP. Winter drawdown would begin the process with exposure of sediment and freeze-out of the turions within the exposed soil area. The DNR spring 2008 vegetation survey defined the extent of curly-leaf pondweed cover, but prior to undertaking a drawdown, a turion survey should occur to define the extent of their occurrence and assistance in defining the level of drawdown needed to effectively control them. Although summer drawdown is a possibility, the likelihood of public dissatisfaction with the disruption makes this a difficult measure to implement, although it should be part of the discussion when implementation specifics are developed.

One of the key considerations prior to developing this approach is determining the water level control authorities of the SPRWS. The utility has statutory authority established in 1885 to control the level of Peltier and Centerville Lakes, but has sold several parcels of lakeshore to

private and public owners. Whether SPRWS still maintains authority for lake level control is an important factor in any decision on drawdown because of the DNR statutory provision for getting 100% shoreline owner agreement prior to a drawdown. SPRWS periodically draws down the lake to do maintenance on its dam structure, which could possibly be combined with a longer term lake drawdown on Peltier. It is clear that there will need to be public acceptance of any attempt to lower the lake for longer than the few days it might take for dam maintenance. This will probably be easier for the winter drawdown period (November through ice-out) when there are some repercussions for ice-fishing, but otherwise a several month winter drawdown would seem to have minimal local impact. Summer drawdown (ice-out through August) will have more local repercussions because of the disruption in summer recreation activities. The trade-off for improved water quality needs to be part of the public education effort associated with any drawdown request. Because of the watershed:lake size ratio of 140:1, refilling the lake in the spring or fall should be easily accomplished; the specifics of this should be part of the pre-drawdown engineering evaluation.

The exact level of drawdown and the repeat frequency needed to assure a phosphorus reduction goal is met will need to be determined and agreed upon by all affected parties. The current depth of macrophyte growth is approximately six feet (Ray Valley, DNR SLICE program, written communication, May 2008). Drawing lake levels down six feet would assumedly eliminate the turions responsible for this growth, but there is some uncertainty about the depth to which a turion supply might exist. In addition to defining the depth of water in which curly-leaf pondweed grows, the turion survey should explore how deep within the sediment turions can be found. A six-foot drawdown would have minimal impact around the main portion of the lake, but would essentially expose the entire portion of the lake from the island northward (Figure 2). However, this northern area is abundant with curly-leaf pondweed and is therefore a primary target of the exposure approach.

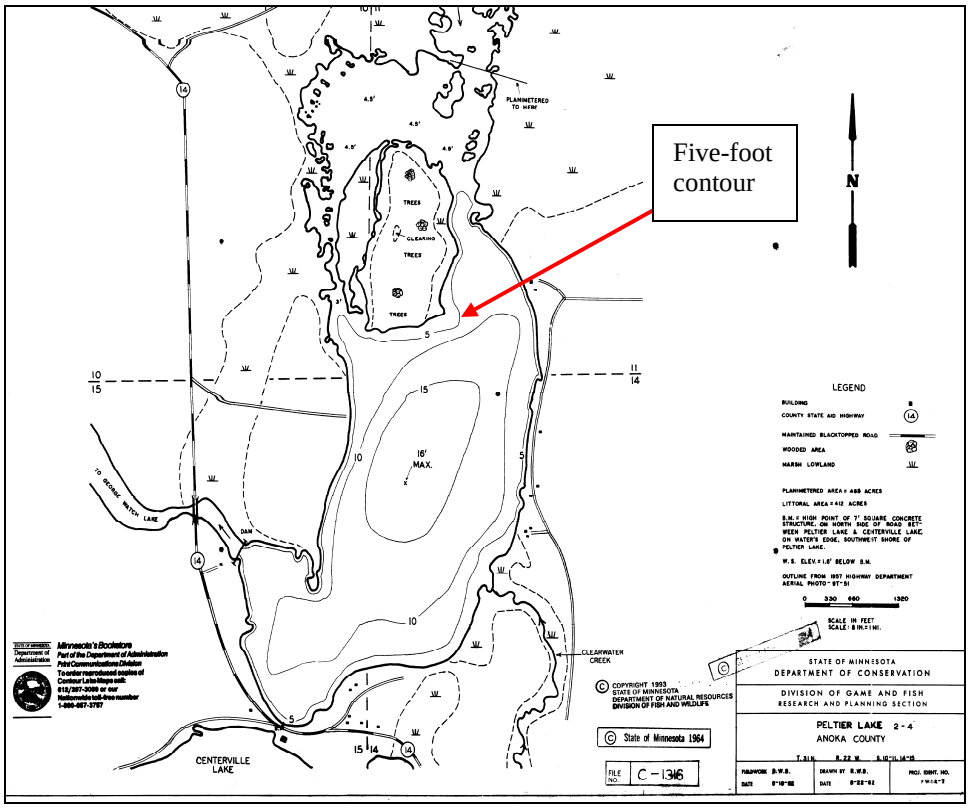

Figure 2. Bathymetry of Peltier Lake

If a drawdown were conducted and water clarity increased, increased density of Eurasian milfoil could be a secondary impact. Eurasian milfoil was present at approximately 18% of the area surveyed by DNR in its spring 2008 vegetation survey of the lake area 12-feet deep or less (Ray Valley, written communication). As previously mentioned, clearing the water could lead to proliferation of plants to greater depths than the present six feet. One of the plants that could successfully out-compete native plants would be the milfoil, thus leading to the need for another control program if the population reached a nuisance level. However, DNR and RCWD agree that Eurasian milfoil is preferable to curly-leaf pondweed from a water quality perspective, although certainly not desirable from an ecological standpoint.

Another impact of a lake drawdown could be increased susceptibility of a winter fish kill caused by dissolved oxygen depletion, although winter aeration should prevent such an event. Nevertheless, an investigation into the capabilities and operation plan of the current aerator on Peltier Lake should be included in any lake drawdown plan.

Despite concerns noted above, DNR staff has a favorable view toward lake drawdown as a viable management technique. Part of the pre-drawdown study should address the impact of passing drawn-down water through the rest of the Rice Creek Chain of Lakes, although this is not expected to be a problem during the fall drawdown.

Implementation Steps. A high priority should be placed on undertaking an engineering study of the impacts of drawing down the level of Peltier Lake during a winter season, with a potential

extension through the following growing season. The study should be initiated by the RCWD with participation in the study by DNR, SPRWS, the cities of Lino Lakes and Centerville, Anoka County Parks and lakeshore owners/stakeholders. The outcome of this study, if found to be desirable, would be a drawdown of some designated depth over the winter, with possible extension into a full summer season if deemed feasible. Related factors to study will include the continuation of aeration, downstream effects, and local recreation impact. The approximate cost of the drawdown engineering and environmental study would be $50,000, which would include the assessment of how far the drawdown should occur, how long it should last, what the shoreline and recreation impacts would be, how the release and refill of water would occur, where dredging could enhance results, and a survey of curly-leaf pondweed turions. The cost for the drawdown will be determined as part of the study.

Participants. Those expected to be primary participants in evaluating and developing the drawdown feasibility for Peltier Lake include: DNR, RCWD; the MS4 cities of Centerville and Lino Lakes; Anoka County Parks; lakeshore owners; and St. Paul Regional Water Services.

Shoreline and Littoral Vegetation Management

An ecologically healthy lake shoreline and littoral (shallow water) area is capable of filtering watershed runoff, removing both sediment and certain forms of nutrients, preventing erosion from wave action, and providing important habitat for fish, waterfowl, and invertebrates. A buffer of native shoreline vegetation should be established around the perimeter of the lake. This may be accomplished through cost-share and educational programs with shoreline property owners. Promoting native shoreline vegetation is not expected to significantly reduce phosphorus loading under the current loading scenario; however, it will improve the in-lake conditions and potentially lead to lower internal loading. Additionally, if more of the Peltier shoreline is developed in the future, an improved native shoreline vegetation will mitigate the impact of the future development. Peltier Lake has approximately four miles of shoreline, not including the island. About half of this consists of the Anoka County park land on the western side, which should be fairly stable.

The littoral (shallow zone) vegetation in lakes directly influences the lake's water quality. Without a healthy community of both emergent and submergent vegetation, zooplankton and other macroinvertebrates do not have sufficient habitat and refugia. Littoral vegetation management also can provide an energy break between waves on the water and an erosive shoreline. Re-establishment of littoral vegetation is one of the desirable outcomes of the lake drawdown recommended above. If a native seed-bank is present, this should be a cost-free result of the drawdown.

Follow-up plant management with attention to both shoreline and littoral vegetation should occur the year after a drawdown to document how both programs are succeeding.

Implementation Steps. The PLIMP should include a program that promotes establishment of both shoreline and littoral vegetation. The program is a medium priority until some of the other more immediate needs are addressed. However, it could be one that could be undertaken by existing RCWD programs and thus successfully implemented in a short time period. This program could include a cost-share element and perhaps some regulatory approaches to

allowable shoreline/littoral vegetation practices. The littoral establishment is an expected outcome of the recommended lake drawdown, so no additional cost is expected. The shoreline vegetation establishment program for the Peltier shoreline cannot be estimated with any accuracy until the extent of needed stabilization is determined. It is, therefore, recommended that a shoreline survey be undertaken and a set of restoration templates be developed and used to address categorically defined needs. The expected area of shoreline to be covered would not likely include the Anoka County park land or the island, both of which should be stable and well buffered. The cost of the shoreline survey and template development would be about $15,000.

Participants. Those expected to be primary participants in evaluating and developing the shoreline and littoral vegetation management plans for Peltier Lake include: DNR, RCWD; the MS4 cities of Centerville and Lino Lakes; Anoka County Parks; lakeshore owners; and St. Paul Regional Water Services.

Chemical and Physical Macrophyte Control.
The use of chemicals needs to be addressed in two areas. First, the use of alum to immediately sequester TP from the water column and form a floc blockage/seal on the lake bottom was discussed. There is very little favor among DNR and RCWD staff for this approach for several reasons: the shallow nature of the lake exposes the bottom sediment to wind and boat disturbance; the extent of the rough fish population capable of disturbing the floc layer is unknown, although thought by DNR to be below a problematic level; and the presence of curly-leaf pondweed and its ability to root below the floc layer and extract phosphorus negates some of the benefit.

The second area is control of nuisance macrophytes with chemical application. Any attempt to do so, for example for curly-leaf pondweed control, is a long-term, year-after-year process that will likely only succeed in controlling the population, but never eradicating it permanently. There is certainly a possibility this approach could be part of the overall management strategy for macrophyte control, but the turion control approach noted under the drawdown option above is preferred as a first approach. Some DNR staff noted the desirability of having any kind of macrophyte, even curly-leaf pondweed, as a necessary part of a healthy lake ecosystem. Although this can be true, preference is for native, non-nuisance varieties rather than non-native, nuisance plants. Part of the overall macrophyte management plan should be to manage for a native macrophyte population.

DNR also noted that Peltier Lake is classified as a Natural Environment Lake because of the large amount of public park space on the west half. One of the restrictions on Natural Environment Lakes is the prohibition of chemical treatments. Any attempt to use a chemical control approach would need a variance as part of an overall comprehensive plant management plan (preferred by DNR) or a change in the lake to a Recreational Lake category (not preferred by DNR because of the precedent it would set). DNR feels that a TMDL implementation effort would likely provide the necessary justification for a variance in the herbicide prohibition.

The use of physical or harvesting practices is also a common technique on Peltier Lake. Both private (individual) and commercial initiatives have been used. A DNR permit is required for this activity and it stipulates that all cut weeds must be removed from the lake and disposed of in upland areas away from the lake. Enforcement of this permit provision has apparently not been

strict enough to prevent private cutting and failure to remove harvested weeds from the lake by some homeowners. As part of a macrophyte control program, proper enforcement of weed harvesting permits so that cut weeds are removed from the lake must occur. Leaving cut weeds in the lake leads to biodegradation with subsequent phosphorus release and oxygen consumption, plus the spreading of invasive weeds by turions (curly-leaf pondweed) or cut stems that root upon contact with the sediment (Eurasian watermilfoil).

Implementation Steps. Selective use of both chemical and physical macrophyte control should be integrated in the PLIMP, under the strict regulatory oversight of the DNR. Chemical treatment of curly-leaf pondweed is a low priority, since it would need a variance from the DNR. Also, due to the low residence time of Peltier Lake, especially in the spring when chemical treatments are applied, the time of contact that the chemicals would have with the plants would be shortened, reducing the effectiveness of the treatment. Physical macrophyte control should be given a higher priority. Some additional costs are expected for RCWD oversight and increased DNR enforcement of existing rules. This additional cost is estimated at $10,000 per year.

Participants. Those expected to be primary participants in evaluating and developing the chemical and physical macrophyte control program for for Peltier Lake include: DNR, RCWD; the MS4 cities of Centerville and Lino Lakes; Anoka County Parks; lakeshore owners; and St. Paul Regional Water Services.

Fisheries Management

A fisheries management plan should be developed in cooperation with the Minnesota DNR that balances the fisheries and water quality goals of the lake. The fish data available for the lake show that a very good species distribution of fish currently exists in the lake (see TMDL Study). DNR actively manages the lake for game fish, most recently focusing on stocking with walleye and channel catfish. Currently a very good mix of both planktivores (zooplankton eaters) and piscivores (predatory fish eaters) exists in the lake and further alteration of populations does not appear to be needed. Further exploration of a biomanipulation or trophic cascade approach would need to have better phytoplankton and zooplankton data. There is some good zooplankton data available at RCWD and the DNR Sustaining Lakes in a Changing Environment (SLICE) sentinel lakes monitoring program hopes to collect more in 2008, but phytoplankton data are essentially non-existent and would need to be collected to better understand the plankton dynamics in the lake prior to any manipulation attempt.

The dam at the Peltier Lake outlet does not effectively serve as a fish barrier for the upstream movement of fish. DNR has reported its observation that rough fish (like carp) can jump over the dam structure to move in to Peltier Lake from downstream portions of Rice Creek when water backs up to the dam from the downstream reach. There is also nothing stopping the free movement of fish from the upper part of the watershed downward into the lake. The presence of several major tributaries and large wetlands in the upper watershed means an abundant source of fish can move freely into the lake. The potential for success of any rough fish eradication program is limited if upstream controls are not also implemented. These controls would have to include massive eradication and/or installation of many new fish barriers. The eradication, fish barrier approach has been effective for Howard Lake, but a much larger scale would be needed to protect Peltier Lake.

The rough fish population, according to the latest DNR knowledge, is dominated by bullheads, with carp and buffalo less in number. DNR does not believe that the carp population is problematic, but does not know current population numbers. The DNR SLICE program collected electrofishing data on May 27, 2008, but these data did not provide the information needed to produce a carp population estimate. Data needed to produce a carp population estimate could be gathered using other techniques, such as a mark-recapture study. As part of the overall management strategy, the rough fish component of the survey should be assessed to ascertain a true measure of the population. This survey would then be part of the database used to select among many options for rough fish control, including chemical eradication as a final option.

As part of an overall rough fish management approach, the installation of several fish barriers are proposed to prevent both the upstream and downstream migration of carp into Peltier Lake. Closing access from downstream would require a barrier downstream of the dam, since carp have been seen easily jumping over the dam when backwater from below raises the creek level at the dam. An electric barrier installation (range from $50,000-75,000) at Highway 14 is one possibility. Other non-electric (manifold) barriers could be installed (about $7,000 each) at all of the critical upstream locations where carp could enter, including upper Rice Creek, Hardwood Creek and Clearwater Creek. An evaluation of adjacent wetland controls would also be needed.

Three options exist for rough fish eradication. The first option involves the use of the chemical rotenone. The cost for rotenone ranges from $150-300 per acre (depending on the dose needed), meaning the cost for rotenone application in Peltier Lake would be between $75,000 and $150,000. A second option for fish eradication is *reverse aeration*. Because this option relies on the mixing of anoxic waters during ice-on periods, it would have the best chance for success if it were combined with a winter drawdown. Although it may have a slightly lower chance of success compared to rotenone, the significantly lower cost, combined with less anticipated resistance from the public, may make this a more feasible option for fish eradication. Because both of these options are non-selective eradication techniques, they would result in total elimination of fish in Peltier Lake. This means that DNR could start from scratch to build a desirable fish population. Because DNR Fisheries does not currently see an undesirable population mix in the lake, it would not favor this approach unless absolutely needed as part of the overall management strategy, which would include the installation of barriers to keep carp from moving back in after the eradication. A third option for rough fish eradication involves commercial harvesting. Based on past experience with this technique, DNR has concerns about the likelihood for success of this option. They also note that commercial harvesters require subsidies due to the low demand for rough fish as food. However, research at the University of Minnesota indicates that there are techniques to improve the efficiency of commercial harvesting, making it more economically viable, and giving it a greater chance of impacting the population. If this option were considered as part of an overall management strategy, it is strongly recommended that RCWD work with the University of Minnesota to ensure the greatest likelihood for success. This management action should be viewed as a reoccurring maintenance activity.

DNR believes that the best control for rough fish in Peltier Lake is a balanced mix of healthy fish with a good predator population.

Implementation Steps. Fisheries management is an integral part of the PLIMP and therefore warrants a high priority. Actions needed to build an effective fisheries management plan include: collection of more plankton base data; identifying locations for rough fish barriers; testing new techniques for producing rough fish population estimates; and consideration of both eradication and harvesting options for rough fish removal. The fisheries management study to determine actual fisheries implementation steps would cost an estimated $35,000 and would address all of the elements discussed above. Actual implementation of, for example fish barriers or rotenone application, cannot be done until this study is complete and able to define the needed implementation steps.

Participants. Those expected to be primary participants in evaluating and developing the fisheries management program for Peltier Lake include: DNR, RCWD; the MS4 cities of Centerville and Lino Lakes; Anoka County Parks; lakeshore owners; and St. Paul Regional Water Services.

Dredging

Perhaps the most assured way of eliminating in-lake phosphorus release from lake sediment is to remove the sediment from the lake. Although a very effective tool, this option is seldom used because of its high cost. A recent RCWD mechanical dredging project on Long Lake obtained bids that ranged from $7-14 per cubic yard. Hydraulic dredging was not considered as a viable option because of the higher expense and difficulty in permitting disposal sites.

Removal of select areas of sediment from Peltier, although not a top priority technique, could be done after a sediment survey to determine both nutrient content and depth of sediment. It could be part of the drawdown option to remove a certain amount of material while the water level is lowered. This would have the extra benefit of removing the turions contained within the removed sediment. No estimate of the extent of sediment removal needed is available without further field testing and full environmental evaluation.

Implementation Steps. Selective removal of nutrient enriched sediment during the period of drawdown should be considered. This would be only for a limited amount of sediment and only after nutrient content has been documented, so therefore is a low priority unless defined otherwise once the drawdown is underway. The dredging cost cannot be determined until the amount of material in need of removal is quantified and a disposal plan formalized. The cost of the study needed to identify possible dredging needs is included in the drawdown assessment previously discussed.

Participants. Those expected to be primary participants in evaluating and developing the feasibility for any dredging of Peltier Lake include: DNR, RCWD; the MS4 cities of Centerville and Lino Lakes; Anoka County Parks; lakeshore owners; and St. Paul Regional Water Services.

Aeration

Peltier Lake currently has an aerator that runs at times during the winter. The system is owned and operated by the Anoka County Parks department. DNR attributes at least some of the success in maintaining healthy species diversity to the winter aeration program. This aeration keeps the

predator population healthy over the winter, which in turn keeps the planktivores in check. Although the rough fish certainly benefit from the aeration, they would likely survive in greater percentages than the predators without it. Aeration, therefore, is also an essential part of the overall strategy. Collecting additional dissolved oxygen profiles for the lake in all seasons would assist the decision-making process in regards to future aeration; dissolved oxygen profile data are not currently available since 1990.

Implementation Steps. Operation of the Peltier Lake winter aeration system should continue based on oxygen content of the water over the winter season. DNR has identified aeration as a high priority because of its role in keeping a healthy fish population in Peltier Lake. Additional dissolved oxygen profile data collection should supplement the current limited data. Aeration activities should be coordinated with the DNR to assure minimal negative fisheries impact. The cost of aeration has been borne by the Anoka County Parks Department and is not proposed to change as a result of the TMDL program. Additional dissolved oxygen profile data could be collected for an annual cost of $10,000 for automated recording at the deepest spot in the lake, or about $5,000 for frequent visits by sampling personnel.

Participants. Those expected to be primary participants in continuing the aeration of Peltier Lake include: DNR and Anoka County Parks.

Surface Use

The northern portion of Peltier Lake has been a settling area for the upper part of the watershed and contains several feet of unconsolidated, easily disturbed sediment. This sediment is highly enriched and can result in the introduction of nutrients directly into the water column when resuspended. This part of the lake is currently under a no-wake ordinance passed by the cities of Lino Lakes and Centerville.

Implementation Steps. Control of surface water activities in the northern lake area should be continued at a high priority so that nutrient resuspension is minimized. This will be especially critical if a macrophyte rehabilitation program is able to re-introduce native vegetation in this sensitive area. There would be no additional cost to permanently extending this control.

Participants. Those expected to be primary participants in continuing the surface water use restrictions on Peltier Lake include: the Anoka County Sheriff's office, DNR, RCWD; the MS4 cities of Centerville and Lino Lakes; Anoka County Parks; and lakeshore owners.

Monitoring

As noted earlier, no single management practice or approach will resolve the problem of internal loading in Peltier Lake. A multi-faceted implementation plan through PLIMP will be needed. Unfortunately, such an approach will present difficulties when assessing the effectiveness of each of the single management strategies. For example, if both a drawdown and carp barriers are implemented, changes in water quality cannot be attributed to either of the strategies, but rather both strategies in tandem. Both DNR and RCWD recognize the importance of adaptive management practices, i.e. assessing the effectiveness of implementation steps and making the appropriate adjustments in strategy. Future assessments of the implementation strategy will need

to exhibit care in their conclusions, but a well structured monitoring plan to track changes in the quality of the lake is essential.

Peltier Lake is one of the sentinel lakes under the new DNR Sustaining Lakes in a Changing Environment (SLICE) monitoring program. Although very limited in funding, DNR intends to collect limited baseline data. The amount of data collected would be greatly enhanced through any local or RCWD assistance. Water quality data are currently collected through the Met Council's CAMP program, but only for surface samples and with no biological data.

In 2008, DNR would like to collect the following data for Peltier:

- Spring trap-netting for pike
- Spring macrophyte survey (curly-leaf pondweed focus)
- August macrophyte survey (post-curly-leaf pondweed)
- Summer trap-netting
- Spring electro-fishing
- Monthly zooplankton counts
- Chlorophyll-*a* measurements

A cursory assessment of the difference between the inflowing and outflowing TP load indicates that Peltier Lake retains about 52% of the inflowing TP load. Continued assess of this ratio should occur as part of the lake monitoring program.

Implementation Steps. Continued routine surface water data collection on Peltier Lake should be supplemented by additional bio-data and lake response data collection to document changes brought about through the PLIMP. This data collection effort is a very high priority and should be coordinated through the RCWD in conjunction with the DNR and Metropolitan Council CAMP efforts. Additional costs for the RCWD to undertake this lead monitoring role, thus supplementing its existing role, would be approximately $10,000 for field personnel and laboratory costs.

Participants. Those expected to be primary participants in monitoring of Peltier Lake include: DNR, MPCA, and RCWD.

Permitting

DNR permits will be required if some of the options are to be used. Specifically, there is a need for an aquatic plant management permit and a work in public waters permit if any dredging or drawdown were to occur.

Implementation Steps. All proper regulatory processes must be followed as a high priority as the PLIMP is implemented. This will not be any costs in addition to current regulatory costs.

Participants. Those expected to be primary participants in the type of permitting discussed above for Peltier Lake include: DNR, RCWD; the MS4 cities of Centerville and Lino Lakes; Anoka County Parks; lakeshore owners; and St. Paul Regional Water Services.

Peltier Lake In-Lake Management Plan (PLIMP) Summary

A multi-faceted in-lake nutrient control and bio-management plan has been proposed for Peltier Lake. The following approach is proposed for controlling the in-lake release of phosphorus in Peltier Lake and documenting the effects of such actions. The steps must be done in concert with external load reductions to reduce the supply of phosphorus entering the lake:

- External load reduction will be pursued by the RCWD through a mix of sub-watershed load reduction programs, various regulatory methods, and select BMP installation
- A multi-faceted approach to in-lake nutrient control will be implemented, including the following elements:
    - Macrophyte control via drawdown, soil compaction, and promotion of re-vegetation with native plants and possible chemical/physical spot control
    - Fisheries management, starting with collection of phytoplankton data, a rough fish population survey and installation of rough fish barriers as identified after the survey
    - Consideration of spot sediment removal if shown by testing to be beneficial and cost-effective
    - Maintaining the winter aeration program to keep a healthy predator population
    - Consideration of biomanipulation after plankton data are better established and when needed to adjust the desired fish population
    - Increased collection of in-lake data to reflect the changes brought about by the PLIMP

Centerville Lake In-Lake Implementation

Implementation Context

An implementation plan for Centerville Lake is less intensive than Peltier Lake because of the lesser role that internal load plays. The following elements are part of the recommended "Centerville Lake In-Lake Management Program" (CLIMP).

Mitigate Drawdown Effect from Peltier

If the drawdown of Peltier is implemented as recommended in the previous discussion, the culvert connection between the two lakes should be blocked so that water does not drain also from Centerville Lake. Emergency outflow provisions will need to be made to prevent high water from building on Centerville Lake when the outflow culvert is blocked. A water level rise on Centerville Lake in the winter of 2007-2008 with an inadvertent blockage of the culvert indicated that low water was not a problem in Centerville Lake during the cold weather season, but an analysis will be needed to assure that lake levels stay up if Peltier Lake is drawn down during the warm season.

Implementation Steps. Any efforts to discontinue or limit the flow of water from Peltier Lake into Centerville Lake should include high priority measures to protect Centerville Lake from both adversely high and low water levels. Assuming that permanent improvements to the

interconnection are not made in the short-term, the cost of regulating flow between the lakes should be minimal. The RCWD should include periodic checks of the structure as part of its routine watershed visual monitoring.

Shoreline and Littoral Vegetation Management

A buffer of native shoreline vegetation should be established around the perimeter of the lake, possibly supplemented by cost-share and educational programs with shoreline property owners. Without a healthy littoral community of both emergent and submergent vegetation, zooplankton and other macroinvertebrates do not have sufficient habitat and refugia. Littoral vegetation management also can provide an energy break between waves on the water and an erosive shoreline.

Implementation Steps. The CLIMP should include a medium priority program that promotes establishment of both shoreline and littoral vegetation. This program could include a cost-share element and perhaps some regulatory approaches to allowable shoreline and littoral vegetation practices. Contrary to Peltier Lake, Centerville Lake will not have the benefit of littoral vegetation restoration via lake drawdown. The shoreline and littoral area of Centerville Lake should be added to the Peltier Lake shoreline survey and assessed for the need for stabilization. The added cost would be about $5,000 because of the benefits of the Peltier Lake work funded under that effort.

Participants. Those expected to be primary participants in evaluating and developing the shoreline and littoral vegetation management plans for Centerville Lake include: DNR, RCWD; the MS4 cities of Centerville and Lino Lakes; Anoka County Parks; lakeshore owners; and St. Paul Regional Water Services.

Fisheries Management

The Minnesota DNR is satisfied with the current fish status in Centerville Lake and does not suggest any immediate changes. DNR believes that the aeration system has helped to establish a good predator fish population that has succeeded in keeping the rough fish population down. No further recommendations are made at this time other than continuation of the aeration system during the winter as determined by the dissolved oxygen content of the lake. Control of rough fish on Peltier Lake will also eliminate the possible contribution of these fish through the connection culvert.

Implementation Steps. The aeration system operated by the Anoka County Parks Department should continue as normal in coordination with DNR, which suggest a high priority be placed on this implementation action.

Participants. Those expected to be primary participants in evaluating and developing the fisheries management program for Centerville Lake include: DNR, RCWD; the MS4 cities of Centerville and Lino Lakes; Anoka County Parks; lakeshore owners; and St. Paul Regional Water Services

Monitoring

As noted earlier and consistent with Peltier Lake, no single management practice or approach will improve the water quality of Centerville Lake. A multi-faceted implementation through

CLIMP will be needed. Also as with the Peltier Lake situation, the complex approach will present difficulties when assessing the effectiveness of each of the single management strategies. Both DNR and RCWD recognize the importance of adaptive management practices, i.e. assessing the effectiveness of implementations and making the appropriate adjustments in strategy. Future assessments of the implementation strategy will need to exhibit care in their conclusions, but a well structured monitoring plan to track changes in the quality of the lake is essential.

Centerville Lake is not one of the selected DNR SLICE monitoring program lakes. However, data collection on Centerville Lake should be evaluated in light of the recommended CLIMP and assessed for changes in lake biological character and chemical and physical water quality.

Implementation Steps. Continued high priority routine surface water data collection on Centerville Lake should be supplemented by additional biological data and lake response data collection to document changes brought about through the CLIMP. The extent of supplemental data collection is the same as that proposed for Peltier Lake above. The added cost for the personnel and lab would be slightly less than the cost for Peltier Lake, but would be in the $7,500 range.

Participants. Those expected to be primary participants in monitoring of Centerville Lake include: DNR and RCWD.

Centerville Lake In-Lake Management Plan (CLIMP) Summary
The following approach is proposed for controlling the in-lake release of phosphorus in Centerville Lake:

- Develop a clear set of in-lake implementation objectives in coordination with the implementation strategy developed for Peltier Lake
- Establish a shoreline and littoral vegetation management program
- Continue the winter aeration program for fish management
- Determine level of collection of in-lake data to reflect the changes brought about by the CLIMP

VI. EXCHANGE BETWEEN PELTIER AND CENTERVILLE LAKES

A hydraulic connection via a 48-inch culvert exists between Centerville Lake and Peltier Lake, with flow reversal common depending on relative lake levels. Under low flow conditions, the small watershed draining to Centerville Lake generally feeds Peltier Lake. Under high flow conditions, flow from the Peltier Lake watershed fills Peltier Lake rapidly, and the flow is generally reversed, with Peltier Lake feeding Centerville Lake. This flow reversal is apparent in XP-SWMM modeling results and leads to a substantial phosphorus load from Peltier Lake flowing into Centerville Lake, estimated to be approximately 46% of the total load to Centerville Lake (Table 5). This flow exchange between the two lakes could potentially be removed or adapted such that flow could not enter Centerville Lake from Peltier Lake, thus decreasing the total load to Centerville Lake. This approach is recommended for further engineering study to

determine if it is a reasonable and feasible solution to external load reduction into Centerville Lake.

The culvert connecting the lakes has a stop-log structure that is controlled by the SPRWS. The current practice of the SPRWS is to respond to local needs for the installation or removal of stop-logs. Generally, the stop-logs are not inserted so that free-flow between the lakes can occur. However, some or all of the stop-logs can be installed to inhibit flow between the two lakes. The stop-logs are made of aluminum and do not currently seat tightly within the slots, resulting in leakage. The degree of leakage has not been quantified, but could be substantial when a high enough elevation difference exists between the lakes.

The RCWD is studying options for dealing with the stop-log structure. Clearly, the elimination of Peltier Lake inflow to Centerville Lake is desirable from a water quality standpoint. If it is determined that eliminating it or even reducing it is warranted, the following options should be evaluated from an engineering and limnological perspective:

- Do nothing – leave the structure in place as is and continue to install stop-logs as needed (this option would not require further study)
- Install the stop-logs in a semi-permanent manner by repairing the leakage, with an intent to stop most flow from Peltier Lake into Centerville Lake, but allowing higher flows from Centerville Lake to overflow the stop-logs back into Peltier Lake
- Replace the existing structure with a one-way flow gate/valve and some provision for emergency flow from Centerville Lake to Peltier Lake in the event of high water on Centerville Lake
- Block the connection (semi-permanently) and install an outlet structure on the southern side of Centerville Lake to route outflow water out of the lake and into Reshanau Lake. This block must be semi-permanent to protect the viability of routing water from Peltier Lake to Centerville Lake if needed during an SPRWS emergency

Implementation Steps: As part of the TMDL implementation plan, RCWD, in cooperation with SPRWS, should explore the means to prevent flow from Peltier Lake into Centerville Lake and develop procedures for operation of the connecting culvert. This high priority engineering evaluation would cost approximately $10,000 and could lead to further capital expenses if replacement or improvements to the interflow structure are warranted.

Participants. Those expected to be primary participants in evaluating the connection between Peltier and Centerville Lakes include: RCWD, Anoka County Highway Department; the cities of Centerville and Lino Lakes; and the St. Paul Regional Water Services.

VII. COST SUMMARY

The following summaries are based on these cost estimates:

- Engineering and environmental studies to further define implementation details - $115,000
- TMDL studies for three Impaired Waters - $217,748
- Increased RCWD activity
    - Aggregator role - $100,000 per year for five years
    - Monitoring – $47,500 per year
    - Increased oversight and regulatory enforcement - $10,000 per year split with DNR
- Sub-watershed costs
    - MPCA-based “estimated restoration costs for implementation projects” for JD4, Hardwood Creek, Clearwater Creek, Upper Rice Creek and direct drainage to Peltier and Centerville Lakes - $20,383,400
    - Ditch repairs recommended in JD4 RMP plan - $8,140,000

Table 10 summarizes the estimated costs, where available, of implementing the Peltier and Centerville Lakes TMDL program.

The following summaries are based on these cost estimates:

- Engineering and environmental studies to further define implementation details - $115,000
- TMDL studies for three Impaired Waters - $217,748
- Increased RCWD activity
    - Aggregator role - $100,000 per year for five years
    - Monitoring – $47,500 per year
    - Increased oversight and regulatory enforcement - $10,000 per year split with DNR
- Sub-watershed costs
    - MPCA-based “estimated restoration costs for implementation projects” for JD4, Hardwood Creek, Clearwater Creek, Upper Rice Creek and direct drainage to Peltier and Centerville Lakes - $20,383,400
    - Ditch repairs recommended in JD4 RMP plan - $8,140,000

Table 10. Cost Summary

Program Element	Cost	Comments
RCWD aggregator role in implementing TMDL program	Up to $50,000 per year for five years	Includes organization and leadership of the Implementation Work Group
Howard Lake TMDL Study	$57,867	Proposed to MPCA for $23,147 with additional $34,720 from RCWD
Bald Eagle Lake TMDL Study	$56,227	Proposed to MPCA for $30,925 with additional $25,302 from RCWD
Clearwater Creek TMDL Study	$103,654	Proposed to MPCA for $57,010 with additional $46,644 from RCWD
Additional monitoring of Hardwood Creek	$5,000 per year	Add to RCWD monitoring program
Additional monitoring of JD4	$5,000 per year	Add to RCWD monitoring program
Monitoring Lino Lakes RMP results	$10,000 per year	Add to RCWD monitoring program
Upper Rice Creek monitoring	$10,000 per year	Add to RCWD monitoring program
MPCA estimate (March 2006) of restoration costs for Hardwood Creek	$4,850,000	March 17, 2006 MPCA document entitled “Estimated Restoration Costs for Implementation projects – 2006 to 2008”*
JD4 RMP Area • MPCA estimate (March 2006) of restoration costs for JD4 RMP Area within upper Rice Creek sub-watershed • Ditch repair recommended in JD-4 RMP	• $1,371,600 • $8,140,000	• Based on MPCA estimate of $300 per acre of sub-watershed* • JD-4 RMP adopted by RCWD in 2008
MPCA-based (2006) estimate of restoration costs for Upper Rice Creek sub-watershed (not including Hardwood Creek or JD-4 RMP area)	$4,629,900	Based on MPCA estimate of $300 per acre of sub-watershed*
MPCA-based (2006) estimate of restoration costs for Clearwater Creek sub-watershed	$8,463,300	Based on MPCA estimate of $300 per acre of sub-watershed*
MPCA-based (2006) estimate of restoration costs for direct drainage to Peltier Lake	$748,800	Based on MPCA estimate of $300 per acre of sub-watershed*
MPCA-based (2006) estimate of restoration costs for direct drainage to Centerville Lake	$139,800	Based on MPCA estimate of $300 per acre of sub-watershed*
Engineering/environmental study of Peltier lake drawdown	$50,000	Study to assess engineering approach and environmental impact
Peltier shoreline survey and template preparation (note no implementation cost until defined by survey)	$15,000	Study to determine extent of improvements needed and preparation of repair templates
Fisheries management study of Peltier (note study only with no implementation until recommendations developed)	$35,000	Study preliminary to fish management to define extent of rough fish population and management options once that is

		known; fish barrier installation could total $100,000 if found to be needed after study, plus any costs associated with fish management
Collection of additional dissolved oxygen profile data on Peltier Lake	$5,000-10,000 per year	This would better define the oxygen conditions and need for aeration
Increased RCWD and DNR staffing for oversight and regulatory enforcement	$10,000 per year	Annual technical and regulatory oversight
RCWD assumption of lead monitoring role for Peltier Lake	$10,000 per year	Add to RCWD monitoring program
Centerville Lake shoreline survey and template preparation (note no implementation cost until defined by survey)	$5,000	Study to determine extent of improvements needed and preparation of repair templates; will use output from similar Peltier study
Supplemental bio-monitoring of Centerville Lake	$7,500 per year addition to RCWD monitoring program	Supplements routine lake monitoring
RCWD engineering feasibility study of altering Peltier/Centerville interconnection	$10,000 (study cost only)	Alter culvert for one-way flow with ability to allow two-way in emergency

* Issued as MPCA guidance “Methodology and Assumptions for TMDL Non-Point Source Pollution Restoration Planning Estimates” - Spring, 2008