Grant

June 2021

Vadnais Lake Area Watershed Management Organization Nine Key Element Document for Birch, Tamarack, and Wilkinson Lakes

This document provides a summary of the EPA's nine key elements information for Birch, Tamarack, and Wilkinson Lakes.

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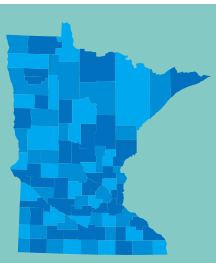

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Executive summary

The Vadnais Lake Area Water Management Organization's (VLAWMO) mission is "to protect and enhance the water and natural resources within the watershed through water quality monitoring, education and outreach projects, wetland protection, and water quality enhancement projects and programs." (VLAWMO, 2020, p. 6). This NKE document is meant to rely mostly on the existing VLAWMO plans and studies and bridge them together into a single document to demonstrate meeting the nine elements of watershed based planning.

The VLAWMO has a long history of working with its member cities, watershed citizens, and many other partners in protecting and enhancing the water resources within the watershed. The VLAWMO was formed in 1983 using a Joint Powers Agreement (JPA) under the authority of Minn. Stat. chs. 471.59 and 103B.201.

The watershed encompasses the City of North Oaks, along with portion of the Cities of White Bear Lake, Gem Lake, Vadnais Heights, Lino Lakes, and White Bear Township, and includes 17 lakes, 1 creek, and over 1,000 wetlands.

The history of watershed planning for VLAWMO extends back to water management planning required for watershed management organizations in the seven-county Twin Cities metropolitan area by the Minnesota Legislature in 1987. Water management organizations are required to develop a Plan at least every 10 years under Minn. Stat. ch. 103B.231 and Minn. R. ch. 8410. The plans must contain information which describes the natural resources within the watershed, establish measurable goals that address priority issues, devise and implement strategies to reach the goals, and a procedure to evaluate progress. The preferred approach by the locals for planning is to include what can be reasonably accomplished in 10 years.

The VLAWMO Comprehensive Watershed Management Plan (Plan) is the fourth generation of their Plan and describes how VLAWMO will manage activities in the watershed from the years 2017 through 2026. The Plan describes the natural resources and core activities of the watershed, the issues and goals that VLAWMO will focus on for the next ten years, and the implementation strategies and subwatershed activities that will be utilized to meet those goals. The VLAWMO has also conducted specific studies, including retrofit analysis and sustained lake management plans, for Wilkinson, Birch, and Tamarack Lakes.

Development of a nine key element (NKE) plan in conjunction with the existing Plan presented a complex challenge to mesh all of the varied programmatic requirements. Water and watershed plans in Minnesota are generally developed on a 10-year timeline with specific activities and projects that will be reasonably achieved within the current funding and capacity of the watersheds. The EPA requires that the 10-year timeline identify and adaptively work to implement activities and projects that will be required to meet the reductions needed to meet water quality standards. Part of the NKE plan is to work to identify and adaptively implement means to achieve these goals.

The Plan, along with individual Sustainable Lake Management Plans (SLMP), use an adaptive management approach. The Plan and SLMPs, Ramsey County retrofit reports, and feasibility studies, combined with the documentation described in this memorandum, fully provide the NKEs identified by EPA as critical in a watershed plan for achieving improvements in water quality for the three lakes. This NKE document summarizes the details required to meet the NKEs and the VLAWMO planning processes.

The NKE plan (in collaboration with VLAWMO's other reports and documentation) is addressing all pollutants, sources and solutions in the watershed. For the purposes of the Section 319 grant program, only practices and activities eligible for funding under the EPA 2014 Section 319 program guidance and Minnesota's Nonpoint Source Pollution Program Management Plan (NPSPPMP) are eligible for Section 319 funding. All match activities must be eligible for Section 319 funding, except where noted in the NPSPPMP.

While it may not appear to be a significant difference, in practice it becomes difficult to mesh the Watershed's requirements under State statute for watershed planning with the NKE. It is the goal of the VLAWMO and the MPCA to successfully marry these two approaches by focusing on Birch, Tamarack, and Wilkinson subwatersheds within the Vadnais Lake HUC12. It is the desire and intent of the WMO to achieve the measurable outputs described in this document and the spreadsheet. However, achievement is highly dependent on partner interest, opportunity, funding, schedule and capacity.

In preparation for this grant program, the VLAWMO and partners conducted specific feasibility studies focused on the Wilkinson subwatershed to further identify and design projects that would be pursued. The VLAWMO engineers conducted additional analysis in the Wilkinson subwatershed during 2020 in preparation for this grant program to further analyze the feasibility of achieving goals specified in the Plan. Small, disconnected projects are unlikely to make a difference to water quality in the lake. A large, connected network of projects is necessary in this largely developed area with substantial habitat buffers and designated protected areas. Working with the major landowner in the area, the North Oaks Company (NOC), is crucial to make measurable differences and work to achieve the goals set out in the Plan. To build the framework for these projects, an additional feasibility study was undertaken by North Oaks Company in late 2020, in collaboration with VLAWMO, to identify large, connected projects focused on NOC-owned land. The large, connected projects have been identified and designed by Barr Engineering as part of this feasibility study. Results of that work are recently available (Dec. 2020), and development for a phasing plan for those projects is currently underway. This connected suite of projects, forming a stormwater spine, is intended to be a major focus for project implementation for at least the initial grant rounds.

Water quality condition summary

The Plan and SLMPs are extensive plans that are actively used by the VLAWMO. These documents include specific plans for each lake and subwatershed. Birch Lake is assessed as not being impaired and should be managed for protection. Tamarack and Wilkinson Lakes are listed as impaired for eutrophication (high concentrations of phosphorus) (Table 1). A TMDL was completed for Wilkinson Lake in 2014. A TMDL is scheduled for Tamarack Lake in 2024.

Table 1. Impairment status and needed reductions for Birch, Tamarack, and Wilkinson Lakes.

Waterbody	Impairment	Action	Reduction (lbs/yr)	% reduction
Wilkinson Lake	Nutrient impairment	Restore	544.9	63
Birch Lake	No impairment	Protect	25	6
Tamarack Lake	Nutrient impairment	Restore	~40	8

Birch and Tamarack Lakes are upstream of Wilkinson Lake. Wilkinson Lake outlets to Deep Lake and the rest of the Vadnais Chain of Lakes. Gilfillan and Black Lakes are also located in the Wilkinson Lake subwatershed, but are not included as part of the NKE focus at this time. Gilfillan Lake is listed as impaired for nutrients, but it is a land-locked basin that does not have an outflow that will affect Wilkinson Lake. Black Lake is a very small lake that is surrounded by thick wetland vegetation and is not impaired. As such, VLAWMO will address the management of Birch, Tamarack, and Wilkinson in the NKE document for the Section 319 Small Watershed Focus Program and continue management of Gilfillan and Black Lakes through the VLAWMO Plan and the individual SLMPs.

The shallow lake eutrophication criteria for the North Central Hardwood Forest ecoregion are for summer average concentrations to be less than 60 µg/L for total phosphorus (TP) and 20 µg/L for Chl-a and Secchi transparency to be greater than 1 meter. These criteria apply to Wilkinson, Birch, and Tamarack Lakes. Table 2 provides the summary of the water quality data for the three lakes. A more detailed graph and trends over time is shown in the specific subwatershed sections of this document for each lake.

Table 2. Summary of water quality data from 2000-2019, for Wilkinson, Birch, and Tamarack Lakes

Lake	TP (µg/L)	Chl A (mg/m^3)	Secchi (m)	Chloride (mg/l) (2011-2019)
Water quality standards	<60	<20	>1	230
Birch Lake	30	5	2.2	93
Tamarack Lake (500)	143	70	.5	38
Wilkinson Lake 1100 acres	126	22	1.3	56

Implementation strategies

The implementation strategies, schedules, goals, milestones, and measurement criteria are described in the following tables for each of the Lakesheds. The estimated reductions will meet the estimated needed reduction to either restore (Tamarack and Wilkinson Lakes) or improve the trend for protection (Birch Lake). These tables are intended to illustrate meeting of Elements b., c., f., g., and h. Note: It is the desire and intent of the WMO to achieve the measurable outputs listed below. However, achievement is highly dependent on partner interest, opportunity, funding, schedule and capacity.

Table 3. Wilkinson Lake implementation activity, measure, assessment, status, schedule, and estimated load reductions

Implementation Activity	Goal	Milestone	Assessment	2021-2023	2024-2026	2027-2029	2030-2032	Estimated Load Reduction (P) lbs/yr	Estimated Load Reduction (TSS) lbs/yr
Current projects underway/ongoing									
Ongoing biweekly monitoring and reporting (May-Sept)	Gain an understanding of water quality conditions and trends for Wilkinson Lake	EQuIS/MPCA reporting completed on time annually; Annual monitoring report included on website and provided to BWSR	# data entered in EQuIS annually # annual reports filed with BWSR/MPCA # reports posted on website	X	X	X	X		
Digital communications and social media outreach	Develop meaningful relationships with community and further their understanding of water quality	Page views per year, new page likes per year, email opens per year	# website views annually # social media page likes annually # email opens/yr	X	X	X	X		
Large BMP (stormwater spine) in development with North Oaks Company and Barr Engineering Step 1: Completion of feasibility and stakeholder input for proposed regional project	Reduce phosphorus loading from the watershed and decreasing TP and TSS concentrations in Wilkinson Lake	Feasibility study completed Input from stakeholders gathered, understood and used to inform the study	# stakeholders participated Feasibility study	X					
Invasive species control efforts: Purple loosestrife	Establish appropriate native plants and mitigate the presence of invasive species	Invasive species extent documented and reduced, Purple loosestrife mapped, analysis/comparison of maps	# acres of purple loosestrife reduced # beetles introduced # maps	X	X				

Implementation Activity	Goal	Milestone	Assessment	2021-2023	2024-2026	2027-2029	2030-2032	Estimated Load Reduction (P) lbs/yr	Estimated Load Reduction (TSS) lbs/yr
Future planned projects									
Invasive species control efforts: Yellow iris, Eurasian watermilfoil, Curly-leaf pondweed	Mitigate the presence of invasive species and reduce nutrient contribution by AIS to the lake	Invasive species extent documented and reduced for Yellow iris Eurasian watermilfoil Curly-leaf pondweed	# species reduced # maps # estimated pounds TP reduced		X	X	X	16	
Subwatershed neighborhood raingarden projects	Reduce phosphorus loading from the watershed and decreasing TP and TSS concentrations in Wilkinson Lake	2-3 completed raingardens over the full grant program timeframe through cost share projects annually	# raingardens # cost share projects # estimated pounds TP reduced	X	X	X	X	1.5	
BMP from 2020 feasibility study focused on upgrading storm ponds in WB Township and NO	Reduce phosphorus loading from the watershed and decreasing TP and TSS concentrations in Wilkinson Lake	1-2 pond upgrades constructed as identified from retrofit analysis/report	# ponds upgraded # estimated pounds TP reduced		X	X	X	1.5	
Constructed wetland project as identified in 2020 feasibility study	Reduce phosphorus loading from the watershed and decreasing TP and TSS concentrations in Wilkinson Lake	Build constructed wetland as identified from retrofit analysis/report and subsequently enhanced in footprint if amenable with North Oaks Company	# acres wetland # acres treated # estimated pounds TP reduced	X	X	X		1.5	
Large BMP (possible stream meander) in development with North Oaks Company and Barr Engineering: This would require a separate feasibility phase to go forward.	Reduce phosphorus loading from the watershed and decreasing TP and TSS concentrations in Wilkinson Lake	1 large meander constructed in partnership with North Oaks Company and others	# feet of meander constructed # estimated pounds TP reduced			X	X	432	

Implementation Activity	Goal	Milestone	Assessment	2021-2023	2024-2026	2027-2029	2030-2032	Estimated Load Reduction (P) lbs/yr	Estimated Load Reduction (TSS) lbs/yr
Alum treatment feasibility to quantify internal load and dosing study	Decrease internal phosphorus load to decrease lake water TP concentrations and decreased algal blooms	Feasibility study completed and dosing calculated	# pounds alum needed # estimated pounds TP reduction			X	X		
Alum treatment to address internal load	Decrease internal phosphorus load to decrease lake water TP concentrations and decreased algal blooms	Alum treatment applied	# alum applications # pounds alum applied # estimated pounds TP reduced			X	X	35	
Bathymetry & vegetation surveys	Decrease internal phosphorus load to decrease lake water TP concentrations and decreased algal blooms	Lake contours included in VLAWMO/ESRI online GIS resource; veg survey report included on Wilkinson Lake page on VLAWMO website	Schedule created # bathymetry updates # vegetation survey updates		X				
Barr Project: Detailed erosion inventory and targeted erosion control and bank stabilization along agricultural ditch on North Oaks Company/MLT easement	Reduce phosphorus loading from the watershed and decreasing TP and TSS concentrations in Wilkinson Lake	Erosion survey of entire ditch length; Efforts to reduce erosion completed along the ditch corridor	Survey completed # (and length or volume - ?) of sites restored # estimated pounds TP reduced			X	X	7	19,000
Barr Project: "Treatment Spine" of a series of wetlands along the agricultural ditch on North Oaks Company/MLT easement that removes pollutants being transported through the ditch flows	Reduce phosphorus loading from the watershed and decreasing TP and TSS concentrations in Wilkinson Lake	Phased plan and design and specifications completed, construction completed	# wetlands created # estimated pounds TP reduced	X	X	X	X	42	64,000
Barr Project: Regional filter (i.e. iron-enhanced sand, spent lime, or proprietary device) to treat agricultural ditch flows	Reduce phosphorus loading from the watershed and decreasing TP and TSS	Design and specifications completed, construction completed	Regional filter installed # estimated pounds TP reduced		X	X	X	8.4	5,000

Implementation Activity	Goal	Milestone	Assessment	2021-2023	2024-2026	2027-2029	2030-2032	Estimated Load Reduction (P) lbs/yr	Estimated Load Reduction (TSS) lbs/yr
	concentrations in Wilkinson Lake								
Completed projects									
Carp control efforts including large fish barrier	Keep internal phosphorus load from increasing and increasing lake water TP concentrations and algal blooms	Carp not detected in fish surveys	# surveys without carp						
Biological monitoring (remote cameras and frog call survey)	Evaluate faunal condition of the watershed landscape	Monitoring complete, reports posted, and maps available for future comparison and evaluation (especially for restoration projects)	# native species Frequency of presence						
Minnesota Land Trust easement for ~900 acres, the largest in the metro area	Reduce phosphorus loading from the watershed and decreasing TP and TSS concentrations in Wilkinson Lake	Easement in place	MLT annual site inspection, survey, report						
Total estimated reductions								**546**	**88,000**

Table 4. Birch Lake implementation activity, measure, assessment, status, schedule, and estimated load reductions

Implementation Activity	Goal	Milestone	Assessment Criteria	2021-2023	2024-2026	2027-2029	2030-2032	Estimated Load Reduction P lbs/yr	Estimated Load Reduction (TSS) lbs/yr
Current/ underway projects									
Ongoing biweekly monitoring and reporting (May-Sept)	Gain an understanding of water quality conditions and trends for Birch Lake	EQuIS/MPCA reporting completed on time annually; Annual monitoring report included on website and provided to BWSR	# data entered in EQuIS annually # annual reports filed with BWSR/MPCA # reports posted on website	X	X	X	X		
Use existing educational materials and/or create materials for homeowners about chloride, raking leaves, and other water friendly yard management techniques	Develop meaningful relationships with community and further their understanding of water quality	Chloride brochure, notice/ad placed in local paper, coordination with member cities to provide information at central locations, training for key employees to reduce salt application, 1 newspaper article or ad per year; 1 webpage on municipality website	# articles # webpage/ municipality website # salt trainings for key employees # coordination events with municipalities	X	X	X	X		
Digital communications and social media outreach	Develop meaningful relationships with community and further their understanding of water quality	Website page views, social media engagement, email newsletter engagement	# website views annually # social media page likes annually # email opens/yr	X	X	X	X		

Implementation Activity	Goal	Milestone	Assessment Criteria	2021-2023	2024-2026	2027-2029	2030-2032	Estimated Load Reduction P lbs/yr	Estimated Load Reduction (TSS) lbs/yr
Subwatershed neighborhood raingarden projects	Reduce phosphorus loading from the watershed and decreasing TP and TSS concentrations in Birch Lake to protect from impairment	1-3 completed raingardens through cost share projects annually	# raingardens completed # cost share dollars # estimated pounds TP reduced	X	X	X	X	2	4555
Partner with BLID to reduce Eurasian watermilfoil in areas identified in veg survey/delineation. This would be an extension of a current project. The current project is done by BLID and includes a general harvest, not only focused on invasives	Establish appropriate native plants and mitigate the presence of invasive species to decrease internal P loading	Reduced contribution of organic matter to P loading in the lake; area of Eurasian watermilfoil and hybrid watermilfoil	# acres Eurasian milfoil reduced # pounds hybrid watermilfoil removed # plant surveys # estimated pounds TP reduced	X	X	X	X	10	
Future planned projects									
4th and Otter Lake Road reconstruction incorporating infiltration and/or filtration BMPs Step 1: Completion of feasibility	Reduce phosphorus loading from the watershed and decreasing TP and TSS concentrations in Birch Lake	Feasibility study completed	Feasibility/design phase completed		X	X	X		
4th and Otter Lake Road reconstruction incorporating infiltration and/or filtration BMPs Step 2: Upon completion of feasibility study, proceed with implementation of "project"	Reduce phosphorus loading from the watershed and decreasing TP and TSS concentrations in Birch Lake	Construction of project, completion of project	Construction of project begun Project completed # estimated pounds TP reduced Maintenance plan in place		X	X	X	4	
Neighborhood retrofit continued implementation (curb-cut raingardens) as identified in Ramsey County SWCD retrofit study (previously completed)	Reduce phosphorus loading from the watershed and decreasing TP and TSS concentrations in Birch Lake	Additional raingardens added using VLAWMO cost-share program and stakeholder/City partnerships	# raingardens completed # estimated pounds TP reduced Amount of drainage area treated		X	X	X	3	1000
Rotary Nature Preserve restoration to support improved wetland function	Reduce phosphorus loading from the	Restoration completed and	# acres restored wetland # estimated tons TSS reduced		X	X	X		900

Implementation Activity	Goal	Milestone	Assessment Criteria	2021-2023	2024-2026	2027-2029	2030-2032	Estimated Load Reduction P lbs/yr	Estimated Load Reduction (TSS) lbs/yr
	watershed and decreasing TP and TSS concentrations in Birch Lake	maintenance plan in place							
Completed projects									
Bathymetry & vegetation surveys	Decrease internal phosphorus load to decrease lake water TP concentrations and decreased algal blooms	Lake contours included in VLAWMO/ESRI online GIS resource; veg survey report included on Birch Lake page on VLAWMO website	Schedule created # bathymetry updates # vegetation survey updates						
Support BLID efforts	Develop meaningful relationships with community and further their understanding of water quality	TEC representation from BLID member and continued collaboration	# BLID activities supported	X	X	X	X		
4th and Otter Lake Road project development and implementation (iron-enhanced sand filter)	Reduce TP loading from stormwater runoff at 4th and Otter Lake Road	1 CIP constructed at location identified from retrofit analysis/report	# maintenance	X	X	X	X	8.1	1245
Shoreline restoration on north shore	Reduce TP loading through erosion control from shoreline erosion activities.	Restoration of 850 acres (150 initial and 700 added) completed and maintenance plan in place	# acres maintained # estimated pounds TP reduced	X	X	X	X	1	2200
Native plantings; restoration underway to support iron-enhanced sand filter	Restore ecological function of the watershed	Restoration completed and maintenance plan in place	# acres maintained	X	X	X	X		45
Picture Post (U.S. Phenology Network) installed and photos utilized to report on phenology	Increase awareness of the native landscape in the watershed	Picture Post installed, digital article published on	# coordination with Picture Post sites	X	X	X	X		

Implementation Activity	Goal	Milestone	Assessment Criteria	2021-2023	2024-2026	2027-2029	2030-2032	Estimated Load Reduction P lbs/yr	Estimated Load Reduction (TSS) lbs/yr
		VLAWMO website, and coordination with other PP sites							
Biological monitoring (remote cameras and frog call survey)	Evaluate faunal condition of the watershed landscape	Monitoring complete, reports posted, and maps available for future comparison and evaluation (especially for restoration projects)	# native species Frequency of presence						
Engage partner on additional street sweeping & chloride management	Reduce TP and chloride loading through street management practices	E&O outreach workshops, and cohost for annual salt symposium	# workshops # salt symposium	X	X	X	X		
Total estimated reductions								**28**	**9,945**

Table 5. Tamarack Lake implementation activity, measure, assessment, status, schedule, and estimated load reductions

Implementation Activity	Goals	Milestones	Assessment criteria	2021-2023	2024-2026	2027-2029	2030-2032	Estimated Load Reduction (P) lbs/yr	Estimated Load Reduction (TSS) lbs/yr
Current /underway projects									
Ongoing biweekly monitoring and reporting (May-Sept)	Gain an understanding of water quality conditions and trends for Tamarack Lake	EQuIS/MPCA reporting completed on time annually; Annual monitoring report included on website and provided to BWSR	# data entered in EQuIS annually # annual reports filed with BWSR/MPCA # reports posted on website	X	X	X	X		
Subwatershed neighborhood raingarden projects, including a large raingarden and pervious pavers at Tamarack Nature Center	Reduce phosphorus loading from the watershed and decreasing TP and TSS concentrations in Tamarack Lake	4 completed raingardens over the grant program through cost-share projects	# raingardens completed # cost share funds # estimated pounds TP reduced	X	X	X	X	6	1017
Digital communications and social media outreach	Develop meaningful relationships with community and further their understanding of water quality	Website page views, social media engagement, email newsletter engagement	# website views annually # social media page likes annually # email opens/yr	X	X	X	X		
Woodland restoration (underway by RCSWCD with CPL grant, 18 acres)	Reduce phosphorus loading from the watershed and decreasing TP and TSS concentrations in Tamarack Lake	18 acres of restoration completed	# acres restored # maintenance plan	X					

Implementation Activity	Goals	Milestones	Assessment criteria	2021-2023	2024-2026	2027-2029	2030-2032	Estimated Load Reduction (P) lbs/yr	Estimated Load Reduction (TSS) lbs/yr
Wetland restoration project at Teal Pond in partnership with RCSWCD (in progress ~3.37 acres)	Reduce phosphorus loading from the watershed and decreasing TP and TSS concentrations in Tamarack Lake	3.37 acres of restoration complete	# acres wetland restored # maintenance plan # estimated pounds TP reduced	X				1	800
Future/planned project									
1-3 CIP projects constructed		1-3 CIP constructed at location identified from retrofit analysis/report. Projects include curb-cut raingardens of 3 different possible types (simple bioretention, moderately complex bioretention, and complex bioretention).		X	X	X	X	7	
Alum treatment feasibility to quantify internal load and dosing study	Decrease internal phosphorus load to decrease lake water TP concentrations and decreased algal blooms	Feasibility study completed and dosing calculated	Feasibility and plan for alum application		X	X			
Alum treatment to address internal load	Decrease internal phosphorus load to decrease lake water TP concentrations and decreased algal blooms	Alum treatment applied	# alum treatments applied # estimated pounds TP reduced			X	X	28	

Implementation Activity	Goals	Milestones	Assessment criteria	2021-2023	2024-2026	2027-2029	2030-2032	Estimated Load Reduction (P) lbs/yr	Estimated Load Reduction (TSS) lbs/yr
Bathymetry & vegetation surveys	Increase understanding of internal loading of Tamarack Lake	Lake contours included in VLAWMO/ESRI online GIS resource; veg survey report included on Tamarack Lake page on VLAWMO website	# survey updates	X					
Completed projects									
Prairie restoration (done by Tamarack and RCSWCD, previously completed, ~80 acres)	Improve habitat for wildlife	Restoration of ~80 acres completed and maintenance is ongoing	# acres restored						
Floating island experimental site and educational signage	Evaluated feasibility of floating islands for nutrient treatment of waterbodies	Floating island in place, monitoring conducted by UMN scientist and students, reporting complete, load reductions reported.	Report completed Reductions estimated						
Biological monitoring (remote cameras and frog call survey)	Evaluate faunal condition of the watershed landscape	Monitoring complete, reports posted, and maps available for future	# native species Frequency of presence						

Implementation Activity	Goals	Milestones	Assessment criteria	2021-2023	2024-2026	2027-2029	2030-2032	Estimated Load Reduction (P) lbs/yr	Estimated Load Reduction (TSS) lbs/yr
		comparison and evaluation (especially for restoration projects)							
Total estimated reductions								**42**	**1,817**

Element a. Sources identified

An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this watershed-based plan (and to achieve any other watershed goals identified in the watershed-based plan), as discussed in item (b) immediately below. Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed (e.g., X numbers of dairy cattle feedlots needing upgrading, including a rough estimate of the number of cattle per facility; Y acres of row crops needing improved nutrient management or sediment control; or Z linear miles of eroded streambank needing remediation).

EPA's Handbook for Developing Watershed Plans to Restore and Protect Our Waters (2008)

Wilkinson Lake

The sources of phosphorus to Wilkinson Lake are shown in Table 6. The load estimates represent the baseline phosphorus loads for Wilkinson Lake when the TMDL was completed. As explained in Element b, the loads are likely overestimated because the subwatershed size used in the TMDL was larger than is currently understood to be accurate and because natural wetlands and ponds were not included in the modelling.

Table 6. Existing (baseline) TP loads and TMDL by source for Wilkinson Lake (adapted from Wenck, 2014, p. 6-12)

	Existing TP Load		TP TMDL		Load Reduction	
Source	**(lbs/year)**	**(lbs/day)**	**(lbs/year)**	**(lbs/day)**	**(lbs/year)**	**%**
Drainage Areas	740.4	2.027	179.4	0.491	561.0	76%
Atmosphere	23.3	0.064	23.3	0.064	0.0	0%
Groundwater	1.4	0.004	1.4	0.004	0.0	0%
Internal Load	51.8	0.142	51.8	0.142	0.0	0%
Upstream Lakes	49.8	0.136	49.8	0.136	0.0	0%
MOS			16.1	0.044		
TOTAL	**866.7**	**2.373**	**321.8**	**0.881**	**544.9**	**63%**

The estimated phosphorus loads from the drainage areas represents loads from the watershed area downstream of Birch, Tamarack, and Black Lakes and upstream of Wilkinson Lake given that the lakes act as phosphorus sinks that discharge a small amount of phosphorus to the streams leading to Wilkinson Lake. When the TMDL was developed, the VLAWMO staff believed that the drainage area was overestimated. The TMDL calculated that the drainage area was 2.7 times too high. This was determined during a feasibility study. The TMDL used 2,972.82 acres for the calculation. Based on analysis from the VLAWMO engineer and GIS technician, the actual size of the catchment is approximately 1,100 acres. A simple mathematical estimate of the drainage area without detailed modeling for TP load is about 274 lbs/yr.

The primary sources within this area are lawn runoff and wetland discharges. The area is comprised of single family, residential homes with relatively large lots (approximately 29% of the watershed); 37% wetlands, 10% impervious areas, and 24% of parks. The estimated phosphorus loading by land uses are also listed.

Much of the drainage area consists of wetlands that have been degraded through channelization and has resulted in increased P discharge. Reconnecting wetlands and ditch to a more natural system will provide significant P reductions. These will be addressed through a combination of meandering channel and the network of BMPs included in the stormwater spine described in Element c.

Table 7. Sources of pollutant loading by land use in the Wilkinson Lake Subwatershed. The subcatchment area is 1,112 acres.

Land use	Acres	% of direct drainage area	Estimated P load (lbs)	% of direct drainage area and upstream lake P load
Wetlands (includes Wilkinson open water basin)	414	37%	--*	--*
Impervious area	114	10%	210.8	65%
Parks (1 park/ recreational area and 1 preserve area)	264	24%	45.2	14%
Large lot development	320	29%	18.0	6%
Upstream lake contributions	--	--	49.8	15%
Total	1,112		323.8	100%

*Wetlands and ponds were not included in the model for the TMDL.

The subwatershed area consists of primarily large residential parcels. Most areas have lower density development with buffers along wetlands and waterways. There are some areas of higher density development, but these are still primarily single-family homes. Large lawns contribute nutrient loading. Stormwater also flows into Wilkinson from upstream sources in White Bear Township and the City of White Bear Lake. These areas contain higher-density development. Consequently, continued efforts to improve stormwater treatment into Tamarack and Birch Lakes will also be beneficial to Wilkinson Lake.

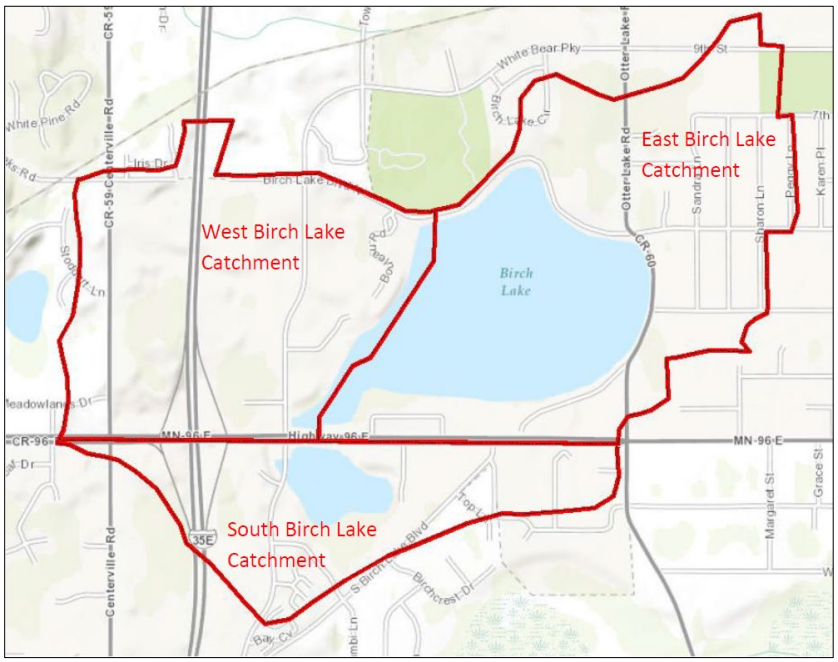
Birch Lake

The source of TP for Birch Lake is primarily runoff from the subwatershed, as illustrated in Figure 1. Many TP sources are anthropogenic, including waste (primarily animal/avian), soil erosion, SSTS, and stormwater runoff (Birch Lake SLMP). The contribution by the three catchments is summarized in Table 8.

Table 8. Contribution by catchment in the Birch Lake Subwatershed (Ramsey Conservation District, n.d.)

Drainage area	Total TP (lbs/yr)	Acres	TP (lbs/acre/yr)
South	81	111	.73
West	146	202	.72
East	110	179	.61

Figure 1. Birch Lake Subwatershed Catchments (Ramsey Conservation District, n.d.)



Catchment area acreage varies slightly over the various iterations, years, and developers for the Birch Lake studies and plans. This is not a substantive difference, but the variations exist. Urban areas were broken down into example neighborhoodsheds in the WinSLAMM model to account for the impervious source areas as illustrated in Figure 2.

Figure 2. An example of a neighborhoodshed and the source areas that are entered into WinSLAMM (RCD, 2013, p. 7)

Critical source and loading areas will be discussed in Section Element c.

Table 9. Sources of pollutant loading by land use in the Birch Lake Subwatershed. The subcatchment area is 575 acres.

Land use	Acres	% of subwatershed	Estimated P load (lbs/yr)	% of drainage area P load
Wetlands (includes Birch open water basin)	147	26%	--	
Impervious area (including dense development)	177	31%	327.3	97%
Parks (2 parks, recreational or preserve area)	16	3%	2.8	1 %
Residential development	235	40%	6.9	2 %

The methodology used by VLAWMO for loading estimates in Table 9 were VLAWMO subwatershed size (smaller than the TMDL calculation), Metropolitan Council 2010 land use, Ramsey County impervious surface, and 2019-updated NWI GIS data. Estimated P loadings were calculated using the VLAWMO TMDL, MIDS, and the MPCA TMDL loading estimator. There was not a model available that would generate an export number for wetlands. In the professional judgement of VLAWMO staff, the wetlands are exporting P because of the degradation of the natural system; however, existing modeling tools do not provide an estimated number. The BMPs included in the stormwater spine will decrease the export of P. The TMDL did not include the wetlands and ponds in the model of the drainage area.

The wetlands are overtaxed and have a simplified vegetation community (cattails and native phragmites) and likely export nutrients rather than removing them from runoff. The increased water storage through ponds with more extensive and complex vegetation are expected to pick up the pace. Ongoing maintenance of the ponds will help to maintain a healthy plant community that will filter nutrients effectively.

Tamarack Lake

Table 10. Sources of pollutant loading by land use in the Tamarack Lake Subwatershed. The subcatchment area is 1,231 acres.

Land use	Acres	% of subwatershed	Estimated TP load (lbs/yr)	% of drainage area TP load
Wetlands (includes open water)	387	31	--	--
Impervious area	211	17	390.1	81.83
Parks (5 parks, recreational or preserve area)	504	41	78.8	16.53
Residential development	129	11	7.8	1.64

Element b. estimated reductions

An estimate of the load reductions expected for the management measures described under paragraph (c) below (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time). Estimates should be provided at the same level as in item (a) above (e.g., the total load reduction expected for dairy cattle feedlots; row crops; or eroded stream banks).

EPA's Handbook for Developing Watershed Plans to Restore and Protect Our Waters (2008)

Wilkinson Lake

Wilkinson Lake has a TMDL that was written in 2014. The TMDL is summarized in Table 1. The estimated load reductions planned and recent implementation for Wilkinson Lake are summarized in Table 3. With the load reductions from the activities planned in the Wilkinson Lake Watershed, it is expected that the projects have the potential to meet the reductions needed as identified in the TMDL in 10 years.

The VLAWMO, through analysis completed by their engineering team, has evidence that the load reduction identified in the TMDL is an overestimate compared to what will be needed to meet the requirements. The TMDL reduction that was determined to require a 544 lbs/yr reduction; however, the TMDL was determined using a much larger subwatershed of almost 3,000 acres. The VLAWMO has delineation of the subwatershed that is approximately 1,100 acres. At this point, there is not a firm reduced number for the number of pounds as a required reduction. The modelling done for the TMDL also did not simulate any natural ponds or wetlands and their treatment of water in this system. There are many factors that would influence this load and the expected reductions planned in Table 3 will address the reduction determined by the TMDL. The management strategies that have been completed since the TMDL and the planned implementation activities described in Table 3 are estimated to yield a 545 lbs/yr P and 88,000 lbs/yr TSS reduction, which will meet the reductions estimated by the current TMDL.

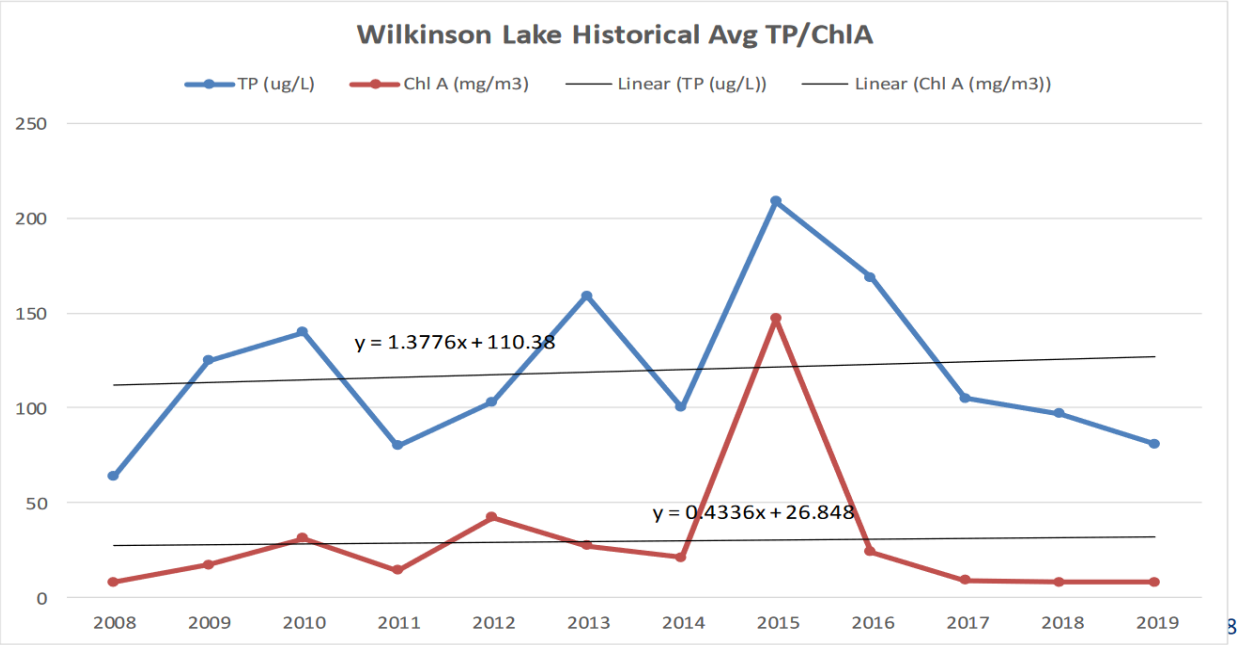
To prepare for the projects that will be implemented with support from the 319 program, the VLAWMO has worked with partners including the primary landowners in North Oaks, the North Oaks Company (NOC) and others: White Bear Lake Township, Lino Lakes, Ramsey County, and Anoka County. Two feasibility studies were conducted, one that identified smaller projects that could be implemented alone but gave fairly low reductions. That feasibility was conducted in partnership with Ramsey County and completed by SEH engineering in 2020. A second feasibility was conducted by NOC with Barr Engineering. That project identified large and connected networks of projects with a focus on land owned by NOC. NOC is dedicated to improving water quality in Wilkinson Lake and prepared to work with the VLAWMO and others to implement projects that have been identified. At this time, a stormwater spine is being pursued by partners with a phasing plan currently in development to meet the timeframe and intervals in the 319 grant program.

Monitoring is essential in understanding the status of the lake and establishing progress over time. Monitoring for Wilkinson Lake has been ongoing since 1998 and reported to the MPCA.

Seasonal average TP (micrograms/L) has fluctuated over the years. TP has ranged from a low of 38 (2000) to a high of 299 (2001). In 2019, the average was 81. A summary graph of the trends through

time is shown below. This graph was taken from the annual monitoring report that is prepared by VLAWMO and available on the VLAWMO website.

Figure 2. Phosphorus and chlorophyll a trends through time in Wilkinson Lake.



Values have fluctuated over time with varying water levels. Current levels are lower than when the TMDL was prepared and load reductions were established for the lake.

Birch Lake

Birch Lake is located in the headwaters of the Wilkinson Lake drainage area. The estimated load reductions from planned and recent implementation for Birch Lake are summarized in Table 4. With the load reductions from the activities planned in the Birch Lake Watershed, it is expected that the reductions needed to protect the lake and continue trends that demonstrate improvement in 10 years. Birch Lake has the benefit of an active lake improvement district (the Birch Lake Improvement District, BLID), engaged residents, ongoing projects, and collaboration among many partners, including the City of White Bear Lake. Given Birch Lake is currently meeting water quality standards, the primary goal is protection through BMP activities that would occur within other infrastructure improvements and education and outreach.

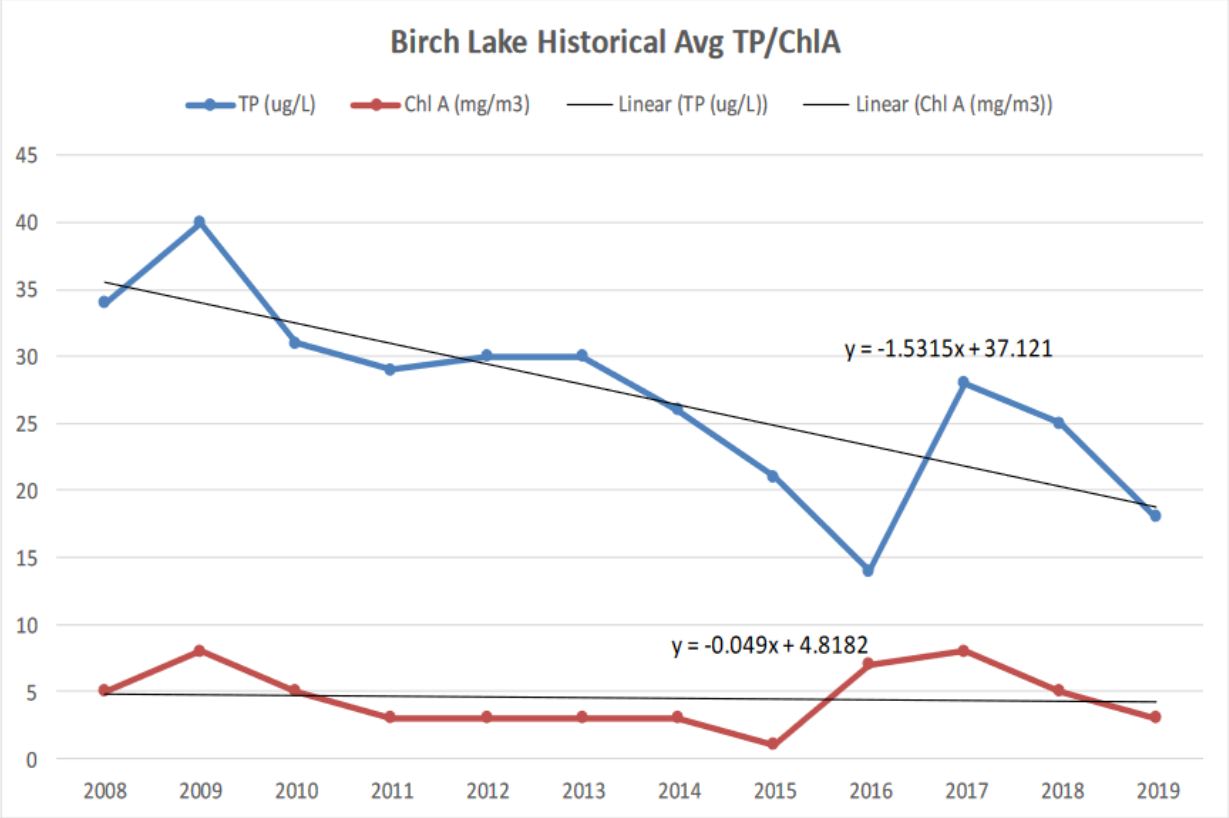
Reductions will also be gathered through additional rain gardens in the residential areas. The reductions gained through these practices will benefit Wilkinson Lake. Active projects support the goal of protecting water quality in Birch Lake. Recently completed projects include an iron-enhanced sand filter that was completed in partnership with the VLAWMO, the City of White Bear Lake, and Ramsey County during 2020. The location was identified through the Retrofit Reports completed by Ramsey County in 2013. Land was donated by a private landowner to the City of White Bear Lake, with support from the VLAWMO, for the project. Funding was provided by a Board of Water and Soil Resources (BWSR) grant. Additional funding and habitat restoration was conducted to support the site and help ensure long-term optimal function of the filter in partnership with the VLAWMO and the City of White Bear Lake. Funding was provided by a Conservation Partners Legacy grant from the Minnesota Department of Natural Resources (DNR). Long-term projects that have helped to protect Birch Lake over time include shoreline restoration that has ongoing maintenance provided in partnership with the VLAWMO and the BLID.

Additional wetland restoration would continue to support and improve water quality in the lake at the Rotary Nature Preserve, which is a future-planned project identified in Table 4.

The management strategies that have been completed since 2014 and the planned implementation activities described in Table 4 are estimated to yield a 28 lbs/yr P and 9,945 lbs/yr TSS reduction, which will help maintain and improve water quality in Birch Lake.

Monitoring is essential in understanding the status of the lake and establishing progress over time. Monitoring for Birch Lake has been in place since 1997 and reported to the MPCA. Seasonal average TP (micrograms/L) has fluctuated over the years. TP has ranged from a low of 14 (2016) to a high of 42 (2001). In 2019, the average was 18. This graph was taken from the annual monitoring report that is prepared by VLAWMO and available on the VLAWMO website.

Figure 3. Phosphorus and chlorophyll a trends through time in Birch Lake.



Values have fluctuated over time with varying water levels (Figure 3). Current levels show a fairly steady decline in P levels. The dip in 2016 likely corresponded to a fairly wet year and high water levels.

Tamarack Lake

The estimated load reductions from planned and recent implementation for Tamarack Lake are summarized in Table 5. With the load reductions from the activities planned in the Tamarack Lake Watershed, it is expected that projects will be implemented from the Table 5 and adaptively managed over the life of the grant program. If all projects are implemented, it would be possible to achieve the reductions needed to achieve the water quality standard in 10 years.

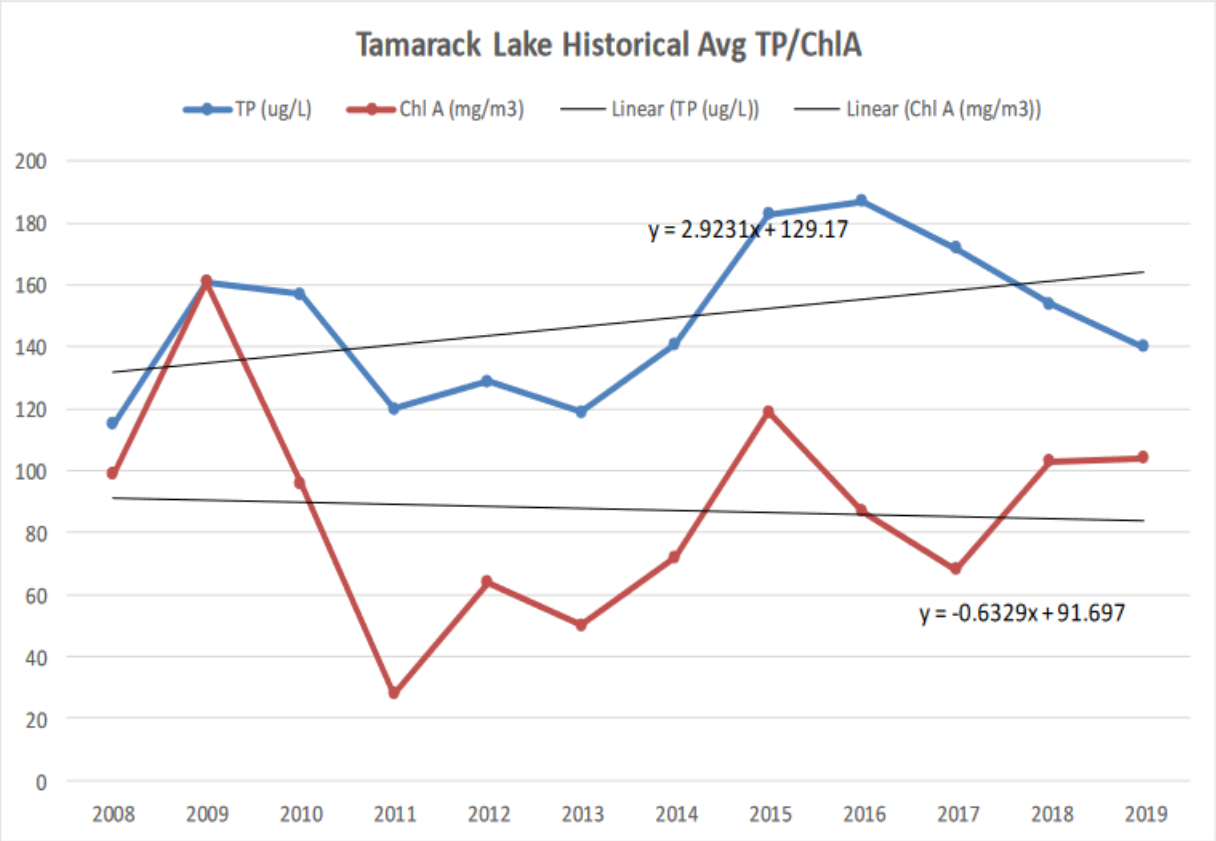
Tamarack Lake is scheduled for a TMDL in 2024. At that time, additional information will be made available to modify established targets for load reductions. That information will be used adaptively to update Tamarack lake goals during the timeframe of the grant program.

Tamarack Lake is located within Tamarack Nature Center and a park managed by Ramsey County Parks. The County and the VLAWMO have been partnering on habitat improvement projects. These projects usually do not provide substantial load reductions in the model. However, they improve habitat, increase resilience, and help to buffer water resources for climate change. Large-scale projects have been underway for many years and continue. A large invasive species removal project was completed by Ramsey County during 2020, and inter-seeding is underway for that woodland area. A wetland/pond restoration is currently underway. Invasive species were treated in 2020, and seeding/supplemental planting are scheduled for 2021-2022. Additional projects, including an alum treatment if the feasibility study supports that project, have the potential to rapidly improve water quality in a lake that is highly accessible to residents and a valued resource within the nature center land area.

The management strategies that have been completed since the 2014 and the planned implementation activities described in Table 5 are estimated to yield a 42 lbs/yr P and 1,817 lbs/yr TSS reduction, which will meet the reductions estimated by the current TMDL.

Monitoring is essential in understanding the status of the lake and establishing progress over time. Monitoring for Tamarack Lake has been ongoing since 1997 and reported to the MPCA. Seasonal average TP (micrograms/L) has fluctuated over the years. TP has ranged from an outlier in 1997 of 17 to a high of 187 (2016). In 2019, the average was 140. A summary graph of the trends through time is shown below. This graph was taken from the annual monitoring report that is prepared by VLAWMO and available on the VLAWMO website.

Figure 4. Phosphorus and chlorophyll a trends through time in Tamarack Lake.



Values have fluctuated over time with varying water levels (Figure 4). Current levels show an increase in TP levels. This small lake is responsive to changes in lake levels with environmental fluctuation. Consequently, the data are more variable overall than the other two lakes in this document.

Element c. Best management practices

A description of the BMPs (NPS management measures) that are expected to be implemented to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in this watershed-based plan), and an identification (using a map or a description) of the critical areas (by pollutant or sector) in which those measures will be needed to implement this plan.

EPA's Handbook for Developing Watershed Plans to Restore and Protect Our Waters (2008)

Critical areas and implementation strategy by lakeshed

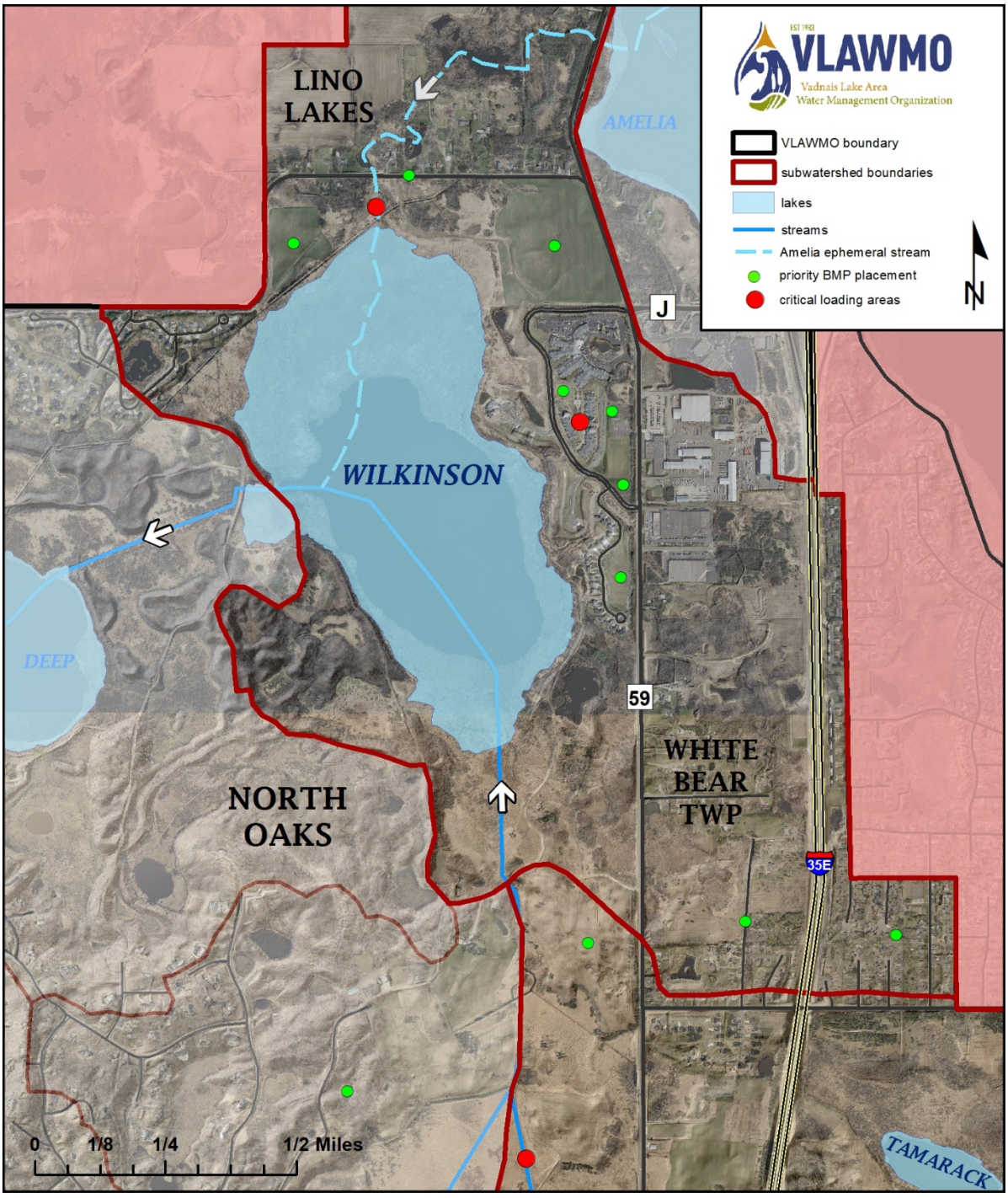
Wilkinson Lake Subwatershed critical areas

Pollutant sources in the watershed include stormwater runoff from Interstate Highway 35E and the commercial and industrial area between Centerville Road and the interstate. Pollutant loads to the lake may be attenuated through existing stormwater ponds and natural wetland treatment. Additional sources from the north include a mixture of commercial, residential, and agricultural land. Pollutant contribution from the southern part of the watershed include lower density residential areas. The land surrounding Wilkinson Lake is under a conservation easement and therefore no development directly abuts the lake.

Water quality monitoring conducted in 2016, 2017, and 2018 at four stormwater sites by the VLAWMO indicated that the runoff coming from upstream of County Road J has the highest amount of pollutants in it. These results are not definitive but offer insight into sources of pollutant loading. The feasibility study that the VLAWMO completed in 2020 with SEH engineering focused on these areas and identified areas that are intended to be part of road upgrade projects. As the County, White Bear Township, and the City of White Bear Lake have these road projects scheduled, they will continue to communicate with the VLAWMO so that additional water-quality improvements projects can be included as part of the road upgrade process.

Significant loading also flows into the lake from the southern channel (Figure 5). This area was the focus of the large feasibility analysis by the North Oaks Company (NOC) and Barr Engineering in late 2020. NOC is completing their multi-decade development process over the coming years. NOC and its Board seek to leave a water-quality improvement legacy for Wilkinson Lake. Consequently, they are partnering with the VLAWMO to assist in implementing the stormwater spine series of projects that was identified by Barr Engineering. Barr Engineering is currently working on a phasing plan for the stormwater spine that will be the focus of the VLAWMO's upcoming grant proposal(s). Following the stormwater spine, the VLAWMO will continue to conduct feasibilities for an alum treatment and a large meander to adaptively continue with water-quality improvements over the life of the grant program. The southern area that has been a focus of the NOC feasibility effort is critical because of the new developments that are currently underway and important opportunities available to implement projects as part of those development projects.

Figure 5. Wilkinson Lake critical loading areas and BMP placement



Initial sediment sampling from the lake indicated that internal loading is unlikely to be a critical source. However, further study is desired. Soil chemistry studies indicate the potential for Curly-leaf pondweed to become a nuisance and a source of phosphorus on Wilkinson Lake is low. Past efforts to remove carp from the lake appear to have been successful, according to recent carp work completed in Pleasant Lake and connected lakes in the chain. Specifically, NOC planned and oversaw the building of a large fish barrier in 1994 from Pleasant and Deep Lake into Wilkinson. They also conducted a drawn-down to kill carp in the lake. Follow-up fish surveys have not detected carp in the lake. Recent biomass and

movement monitoring with Carp Solutions, Inc. supports that this important spawning and nursery area has been cut off for the population. See report here.

Wilkinson Lake Subwatershed implementation activities

Wilkinson Lake benefits from being in the Minnesota Land Trust, which preserves land in its natural conditions. This is augmented by the City of North Oak's requirement to have a 150 foot buffer along the lake edges. Table 3 includes the goals, strategies, milestones, assessments, load reductions, and estimated costs of implementation to protect the water quality of Wilkinson Lake.

The Minnesota Land Trust (MLT) is part of the current plans by NOC. Water-quality, invasive species control efforts, and other habitat improvements fill well within the goals of the MLT. The North Oak's conservation area is the largest metro easement that is part of the MLT protected-area network. MLT is being consulted on projects that are included in the stormwater spine and helping to guarantee habitat protections is accordance with easement requirements.

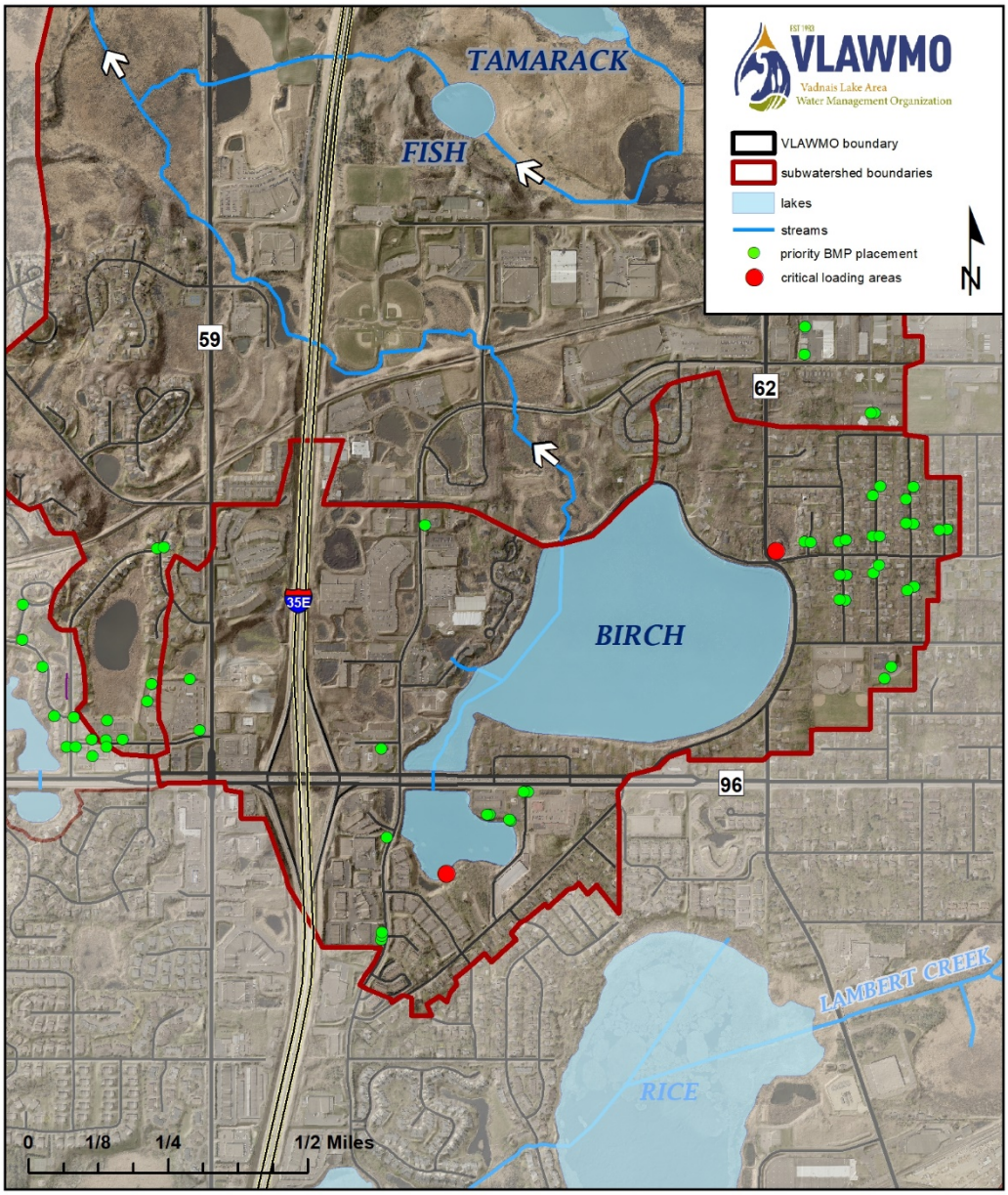
Additionally, as part of remaining development areas currently underway, NOC is working to incorporate treatment including raingardens and possibly larger iron-enhanced or other media filters. The VLAWMO identified stormwater ponds implemented as part of past development projects, with lower water-quality treatment standards that are suitable for upgrade. NOC has approved those plans and supports the upgrades.

Birch Lake Subwatershed critical areas

The retrofit analysis identifies the critical areas for Birch Lake BMP placement (Figure 6). The three catchments and their total TP base loads are listed in Table 8. Contribution by catchment in the Birch Lake Subwatershed (Ramsey Conservation District, n.d.). The source of TP for Birch Lake is primarily runoff from the subwatershed. Many TP sources are anthropogenic, including waste (primarily animal/avian), soil erosion, SSTS, and stormwater runoff. The contribution by the three catchments is summarized in Table 8. Contribution by catchment in the Birch Lake Subwatershed (Ramsey Conservation District, n.d.). The Birch Lake SLMP provides additional information.

It is estimated that the West Birch Lake Catchment is producing the most TP load overall at 146 lbs TP per year, and the South Birch Lake Catchment has the highest yield of TP at 0.73 lbs/ac/yr. This information is suggested to be used in prioritizing which catchments should be considered first when efforts are put forth in installing the associated identified retrofits.

Figure 6. Critical areas and BMP placements for Birch Lake Subwatershed (RCD, 2013)



In the Birch Lake Subwatershed Retrofit analysis, the WinSLAMM model, desktop analysis GIS, and field reconnaissance was used to identify critical potential BMP locations. Due to the intense development of the area, significant consideration was given to feasibility of the placement. Several factors and key locations were considered during the desktop analyses to identify these locations. These included areas that are well known for contributing increased polluted runoff (gas stations, sites with large impervious areas, storage facilities, etc.), public land (due to ease of cooperation during the installation process) and areas slated for redevelopment. During the reconnaissance phase, the drainage area and stormwater infrastructure mapping data were verified. Site constraints were assessed to determine the most feasible retrofit options as well as eliminate sites from consideration. Treatment analysis and cost estimates were completed by delineating drainage areas. Loads and load reductions were modeled in WinnSLAMM using site-specific drainage areas, NRCS soils information, and site information. Extensive

information regarding the analyses of the subwatershed is available in *Birch Lake Subwatershed: Urban Stormwater Retrofit Analysis* (2013).

The location of the iron-enhanced sand filter that was constructed in 2020 was selected because it was a hotspot for nutrient loading that was identified in the retrofit analysis. These reports completed for the entire watershed have continued to guide project placement and cost-share project support since they were completed in 2013.

Birch Lake implementation strategies

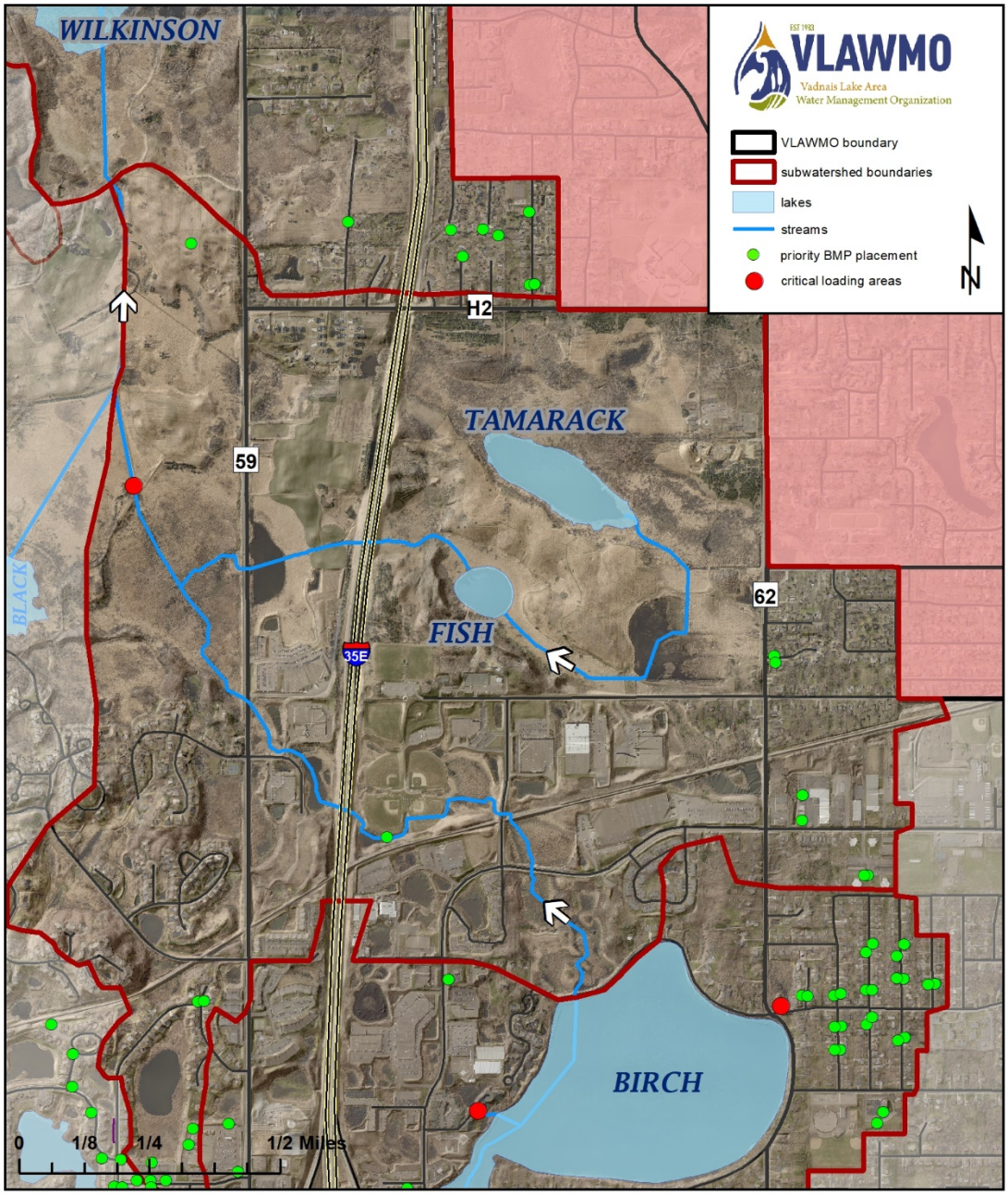
Table 4 includes the goals, strategies, milestones, assessments, load reductions, and estimated costs of implementation to protect the water quality of Birch Lake. If this plan is fully implemented as described over the next ten years, the water quality in Birch Lake will be protected from impairment. The implementation efforts will be targeted to the critical areas identified in the previous sections.

Tamarack Lake Subwatershed critical area

Tamarack is surrounded by wetlands and a nature center, providing little direct runoff and P load to the lake. Interstate highway 35E corridor covers 1.27% % of the watershed and runs north to south in the mid-west center of the watershed. Initial sampling of inflows to the lake indicated elevated TP concentrations with an average concentration of 265 ug/l at the 35E monitoring site. Critical areas are illustrated in Figure 7.

The nature center is an important resource in the watershed for education, outreach, and habitat protection/restoration. Tamarack Lake is located within the nature center and part of the 320-acre preserve area. The preserve itself is a priority area because of its direct influence on waterbodies within its area and because of its importance as a local protected area with extensive green space. Habitat restoration has been an ongoing effort that is continuing and expanding with partnership from Ramsey County SWCD. Specifically, prairie restoration areas are being expanded and incorporated into larger management units, woodland invasive species areas are being restored, and ponds and wetlands are also being restored. Current identified projects focus within the lake and nature center area. The TMDL, when completed in 2024, will provide additional information to be used adaptively to increase critical areas during the life of the grant program.

Figure 7. Tamarack Lake critical areas and BMP placement



The Subwatershed Retrofit analysis for Tamarack Lake used the WinSLAMM model, desktop analysis GIS, and field reconnaissance was used to identify critical potential BMP locations. Due to the intense development of the area, significant consideration was given to feasibility of the placement. Several factors and key locations were considered during the desktop analyses to identify these locations. These included areas are well known for contributing increased polluted runoff (gas stations, sites with large impervious areas, storage facilities, etc.), public land (due to ease of cooperation during the installation process) and areas slated for redevelopment. During the reconnaissance phase, the drainage area and stormwater infrastructure mapping data were verified. Site constraints were assessed to determine the most feasible retrofit options as well as eliminate sites from consideration. Treatment analysis and cost estimates were completed by delineating drainage areas. Loads and load reductions were modeled in WinnSLAMM using site-specific drainage areas, NRCS soils information, and site information. Extensive

information regarding the analyses of the subwatershed is available in *Gilfillan- Tamarack – Wilkinson Lakes Subwatershed: Urban Stormwater Retrofit Analysis* (2012).

These included areas well known for contributing increased polluted runoff (gas stations, sites with large impervious areas, storage facilities, etc.), public land (due to ease of cooperation during the installation process) and areas slated for redevelopment. Redevelopment was reviewed because of the cost savings when installing retrofits in conjunction with other construction. Efforts were put forth discussing future redevelopment projects with VLAWMO contacts and reviewing cities website information for future construction plans. From what was determined, there were no construction projects within the drainage areas that would be conducive to retrofitting BMPs. The field investigation revealed additional retrofit opportunities that were not identified as part of the desktop search. Redevelopment at the nature center itself has provided opportunities for stormwater BMPs that have been implemented since the retrofit report was completed.

Tamarack Lake implementation activities

The retrofit types identified include: simple bioretention, moderately complex bioretention, complex bioretention, dry swales, or permeable asphalt. The Tamarack Lake Subwatershed is well-buffered by the nature center. These two waterbodies are expected to receive minimal influence from the surrounding land. Pollutant loadings are further up the watershed via stormwater runoff. Primary treatment options involve activities tied to infrastructure improvements. Individual property owner activities will also reduce loading.

Table 5 includes the goals, strategies, milestones, assessments, load reductions, and estimated costs of implementation to protect the water quality of Tamarack Lake.

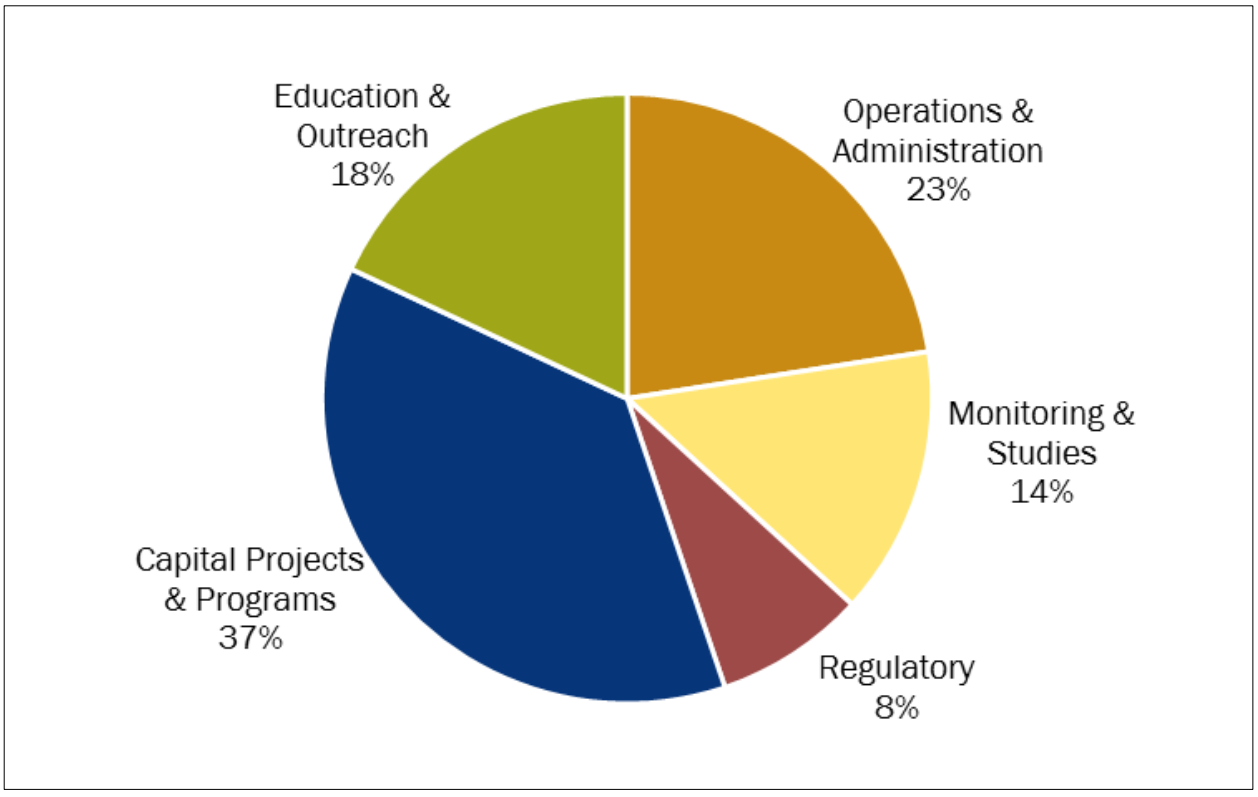
Element d. Expected costs and technical assistance

An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement the entire plan (include administrative, Information and Education, and monitoring costs). Expected sources of funding, States to be used Section 319, State Revolving Funds, USDA's Environmental Quality Incentives Program and Conservation Reserve Program, and other relevant Federal, State, local and private funds to assist in implementing this plan.

EPA's Handbook for Developing Watershed Plans to Restore and Protect Our Waters (2008)

It is estimated that it will cost $10,617,830 to complete all the watershed work and work to meet water quality standards in this small watershed over the next 10-year focal timeframe of this NKE document. This is the projected budget for the VLAWMO over the 10 years, without additional partner contributions or grant-funded projects. Figure 8 demonstrates the overall breakdown of the VLAWMO budget for the watershed.

Figure 8. VLAWMO core activities and budget (EOP, 2021, p. 11 Figure 4)



Element e. Education and outreach

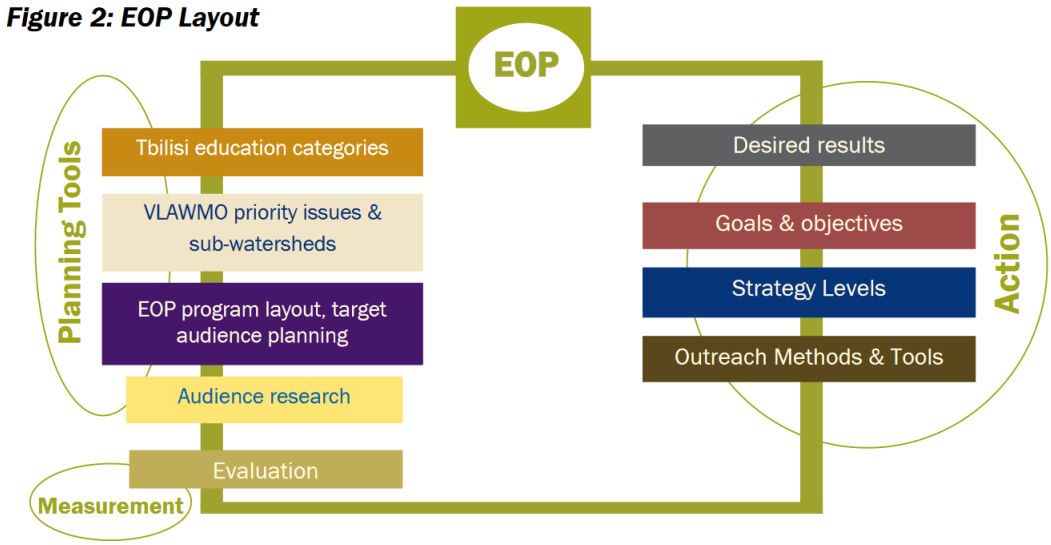
An information/education component that will be implemented to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, implementing and maintaining the NPS management measures that will be implemented.

EPA's Handbook for Developing Watershed Plans to Restore and Protect Our Waters (2008)

The Education and Outreach Plan (EOP) describes how the VLAWMO will prioritize and organize its education and outreach activities. The EOP for 2021 can be found at: https://www.vlawmo.org/files/4516/0711/7355/EOP_2021.pdf. The education plan is updated annually. It is the desire and intent of the WMO to achieve the measurable outcomes listed below. However, achievement is highly dependent on partner interest, opportunity, funding, schedule and capacity.

The EOP describes the goals, objectives, target audiences, strategies, and tactics that will be used to support VLAWMO's Comprehensive Watershed Management Plan. Each of these components are situated in a sequence to bring the plan from theory to action. The EOP is an extension of the Comprehensive Watershed Management Plan, particularly Priority Issue 3: Need for education and involvement from citizens and stakeholders. As shown in Figure 8the EOP includes reference to external support mechanisms as well as internally planned frameworks. (VLAWMO, 2021; p. 7).

Figure 8. EOP layout (Figure 2 from EOP 2021)



Each year, the VLAWMO updates its education and outreach plans for the watershed. The activities described in Measurable Outcomes on p. 25 of the 2021 EOP. These measurable outcomes are updated and adapted as the needs and expected results change in the community. Activities are tracked and measured in accordance with the plan. The subwatersheds included in this NKE document represent approximately 25% of the watershed. It is estimated that 18% of the budge will be spend in this area, or approximately $400,000 over a ten-year period.

The following annual outcomes will apply to all of the planned activities.

Measurable Outcomes: *Measured program participation that indicates incremental accomplishment of goals. Objectives attributed to each goal are evaluated through this pool of outcomes.*

1. Adopt-a-Drain: Observe a minimum of 50 new drain adoptions, exceed 20 reported volunteer hours, maintain 20 active annual volunteers and achieve 50 lbs of debris collected and reported by adopt-a-drain volunteers.
2. Grow email subscriptions and social media following by 75 people annually.
3. Achieve 300 social media engagements annually.
4. Achieve 10,000 website visits annually.
5. 50 new social media followers annually.
6. 500 VLAWMO received and opened email newsletters annually.
7. 20 end-of-year annual survey results or Facebook engagements reporting independent watershed stewardship (goal 2c).
8. Successfully published articles in various newspapers, newsletters, and custom mailings. A minimum of four times annually.
9. Reach 4 classrooms (90-100 students) annually through school programs or use of VLAWMO web resources.
10. A reported increase in Tblisi education categories: Knowledge, awareness, attitude, skills, and behavior. Increases in each category as a result of VLAWMO workshop or tour survey, or annual end-of-year survey.
11. Monthly phenology posts made at each picture post, at least one new participant engaging in program annually.
12. A minimum of 50 watershed residents attending VLAWMO workshops, open houses, tours, and Blue Thumb workshops annually.
13. A minimum of 5 VLAWMO event participants from the past two years will participate in a VLAWMO cost-share or soil health grant.
14. A minimum of 5 VLAWMO cost-share participants from the past two years will also participate in education and outreach through a spotlight article or volunteering with VLAWMO.
15. A minimum of 2 Lawns to Legumes applications in the VLAWMO watershed annually.
16. At least 5 public raingardens are adopted and annually maintained by volunteers under Adopt-a-Raingarden.
17. Achieve over 500 reported volunteer hours through volunteer opportunities such as leading a short-term service projects, citizen science, specific or custom volunteer roles, or utilizing a VLAWMO education display.
18. A minimum of five volunteers will act as educators to their local citizen peers annually.
19. A minimum of three volunteer efforts completed annually, at least 25 participants across all activities.
20. One or more trained AIS volunteers will report and monitor at least once on each lake in VLAWMO annually.
21. At least two schools each year will schedule and complete raingarden maintenance with or without VLAWMO assistance.
22. A minimum of one engagement annually with a resident in Lino Lakes portion of watershed.
23. TEC and BOD quorum met at each meeting.
24. If cost-share best management practices are successfully installed as a result of education and outreach efforts (workshops, events, etc.), VLAWMO will report these as supplementary measurable outcomes.

Element f. Reasonably expeditious schedule

A schedule for implementing the activities and NPS management measures identified in this plan that is reasonably expeditious.

EPA's Handbook for Developing Watershed Plans to Restore and Protect Our Waters (2008)

The schedules for the implementation of activities in the Wilkinson, Birch, and Tamarack Lakes are contained in Table 3, Table 4, and Table 5.

It is expected that if this plan is implemented as written in the next 10 years, the estimated loading reductions should meet the required reductions to meet water quality standards. Element e describes the planned, annual activities for the education and outreach for the watershed.

Element g. Milestones

A description of interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented.

EPA's Handbook for Developing Watershed Plans to Restore and Protect Our Waters (2008)

The VLAWMO has developed milestones to determine the success and progress of their work. These are included in Table 3, Table 4, and Table 5

The milestones will help inform the effectiveness of implemented projects and provide data that will be used as feedback to adjust the plan to measure and report progress toward the goals of the VLAWMO.

Load reductions for the projects will be evaluated with actual implementation designs and reported to the MPCA. As implementation occurs, the final design of the project may increase or decrease the estimated reductions associated with practices. As these adjustments are made, the plan will be updated and data will be shared with the MPCA and project partners.

The VLAWMO utilizes adaptive management on a short-term implementation schedule. Actions will be implemented, then monitored and evaluated for success using the milestones identified in Tables 3, 4, and 5. Depending on the outcomes of those actions, the plan will be reevaluated every three years to develop a new set of actions to be implemented.

To measure the success of actions and the response of each lake (i.e. interim milestones), the VLAWMO will implement monitoring, as is currently conducted with additional focused monitoring on projects to compare post-project water quality data to long-term records of baseline data. Baseline data and long-term monitoring reports are available on the VLAWMO website. Key graphs from the monitoring reports are included in Element b of this NKE document.

Element h. Assessment criteria

A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards.

EPA's Handbook for Developing Watershed Plans to Restore and Protect Our Waters (2008)

Assessment criteria for implementation are found in Table 3, Table 4, and Table 5. Assessment criteria will be used to determine if the implementations plans are implemented and that they are reaching the expected results.

For each of the three lakes, goals are outlined differently. Birch Lake has a status of protect, and projects are well underway and functioning well to continue to meet this goal. Tamarack Lake is impaired with clear projects determined, extensive habitat restoration that in continuing to expand upon decades-long efforts. Additional projects will be determined when the TMDL is completed in 2024 and adaptively managed to meet additional goals that will likely be part of that process. Wilkinson Lake is impaired and has a calculated TMDL.

The load reduction criteria developed as part of the Wilkinson Lake TMDL is for an 85% reduction from the drainage area. Consequently, projects that will be pursued first for this grant program projects will focus on a stormwater spine, discussed previously in this document. The stormwater spine is designed to incorporate a suite of projects that work together to reduce external load coming from the drainage areas. As part of the adaptive management approach, load reduction criteria will be assessed every 3 years. Management actions will be implemented and regularly monitored to evaluation progress at interim milestones so that the direction of the plan can be modified, if needed, to achieve desired goals and objectives.

Monitoring, described in Section Element i. describes the monitoring efforts for this plan. The EOP has specific assessment criteria and measurable outcomes to determine if the plan is progressing. This is summarized in Table 10 and the list following the table.

There is an annual review process to will identify gaps in programmatic and project performances. An example of a subwatershed evaluation for Birch Lake is summarized in **Table 11** Adjustments will be made over the next 10 years, based on the assessment information and new scientific information becomes available, in consideration with the VLAWMO's core activities (VLAWMO, 2019). The VLAWMO also works with the member cities and townships to gain their perspective and to assess the approach to reaching goals.

Table 11. Example report card for Birch Lake (adapted from, VLAWMO, 2019, p. 55)

BIRCH LAKE	2019 Activities and Results	Progress in 2020	Plans and Goals for 2021
Monitoring:			
TP (ug/L)			
Chl A (ug/L)			
SDT (m)			
Support BLID in fish and vegetation surveys			
Education and Outreach:			
Engage partners on additional street sweeping and chloride management			
Capital Projects and Programs:			
Assess potential for stormwater management project at 4th & Otter Lk Rd			
Support stormwater management activities during redevelopment			
Landscape Grant Projects completed			

Element i. Monitoring

The monitoring & evaluation component to track progress and evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

EPA's Handbook for Developing Watershed Plans to Restore and Protect Our Waters (2008)

VLAWMO operates a robust data collection and analysis program on Wilkinson, Birch, and Tamarack Lakes (Figure 9 and Table 12). Monitoring data and reports are available on the VLAWMO website. The purpose of the monitoring program is to track long-term water quality trends; provide a scientific basis to identify, target, and design programs and projects to meet goals; and to evaluate project and program effectiveness and progress towards water quality goals.

The program prioritizes baseline monitoring by VLAWMO staff, trained volunteers through the Citizen Lake Monitoring Program, and partners such as the St. Paul Regional Water Service, as well as periodic special monitoring for a variety of purposes on an as needed basis. The bulk of the water sample collection season is between May through September each year.

Figure 9. Lake monitoring locations for lakes in the watershed with Wilkinson, Birch, and Tamarack Lakes outlined.

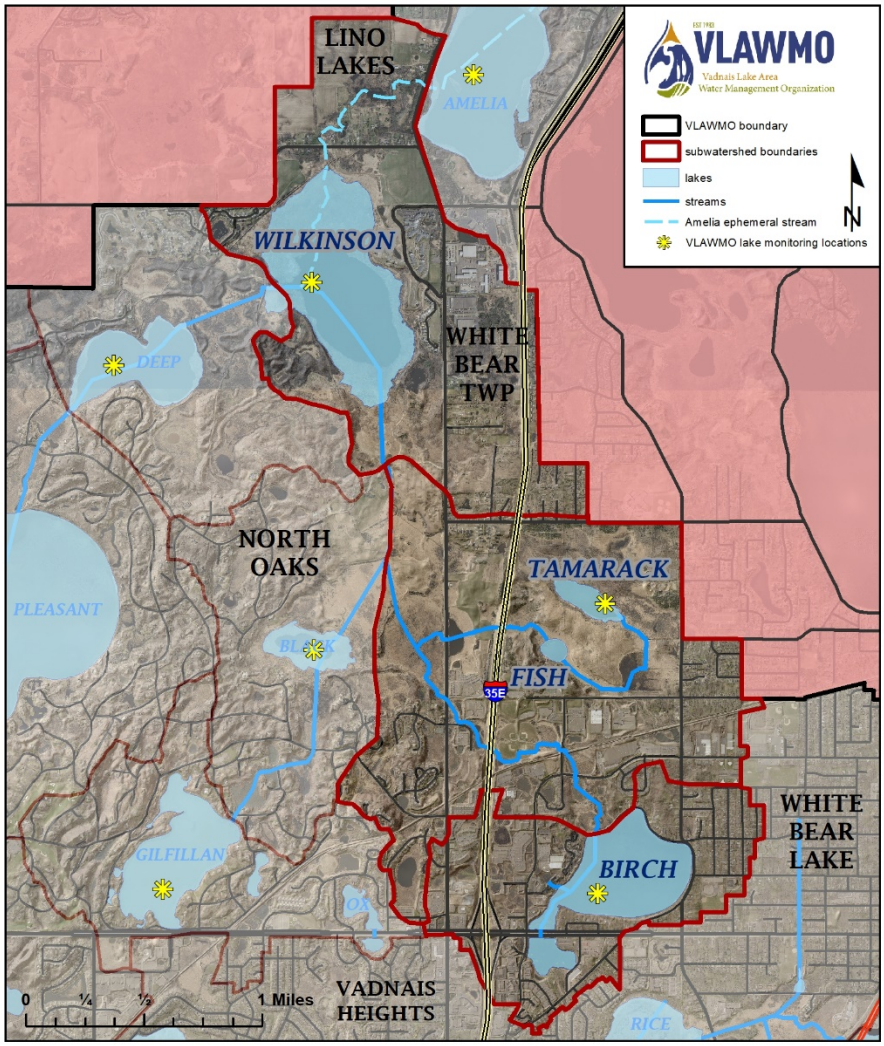


Table 12. Summary of annual monitoring conducted on Wilkinson, Birch, and Tamarack Lakes (adapted from Table 1 in VLAWMO amendment document, 2020)

Monitoring location	Station type	Parameters	Sampling period	Frequency
Birch Tamarack Wilkinson	Lake	Secchi depth, lake level (on some), profile for Temp, DO, pH & Conductivity; TP, TN, SRP, ChlA (surface), Total Iron (bottom only)	May-September	Every two weeks
Birch	Lake	Chloride	9-10 months	Once per month
Birch	Lake	Lake Level	May-September	Every two weeks
Tamarack Wilkinson	Lake	Chloride	Ice out	Once per year

In addition to the chemistry monitoring, there is monitoring conducted for aquatic invasive species on both Birch and Wilkinson Lakes. At the inflow of Wilkinson Lake, there are plans for an automated sampling station. Fish, invertebrate and aquatic plant surveys have been conducted on all three lakes and they have been identified as high priority for additional biological monitoring. Additional biological monitoring has been completed watershed-wide from frogs and toads with call surveys and mammals with remote-camera surveys. The results of this work are summarized in reports and featured in StoryMaps. These data will allow additional pre/post analyses of projects besides standard water-quality monitoring protocols. The VLAWMO either plans to conduct or has already completed bathymetry surveys, including a BioBase Survey, for all three lakes in partnership with Ramsey County Soil and Water Conservation Division (included in Table 3, Table 4, and Table 5.

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