SUOMI AREA LAKES ASSOCIATION

LITTLE BOWSTRING LAKE WATERSHED

LAKE MONITORING PLAN

2004

Developed by Suomi Area Lakes Association
with the assistance of
River Council of Minnesota
Minnesota Lakes Association
River Network

April 20, 2004

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Organization Name: Suomi Area Lakes Association

Name of Program: Little Bowstring Watershed Monitoring Plan

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Funding for this project was recommended by the Legislative Commission on Minnesota Resources (LCMR) from the Minnesota Environment and Natural Resources Trust Fund.

The goal of this grant is to enhance and expand the ability of citizen volunteers to collect water quality data that will be useful for lake and stream assessments and management. Minnesota Lakes Association and Rivers Council of Minnesota, with assistance from River Network, will work collaboratively to provide training, technical support, education and communications for individuals and organizations statewide interested in citizen volunteer lake and stream monitoring.

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INTRODUCTION AND OVERVIEW

Introduction Narrative

Lake Management Water Quality Goals

The 1998 Little Bowstring Lake Assessment Report prepared by Justin Watkins and Rian Reed documents a reduction of water quality based on Secchi disk readings. Within the Fisheries Management Plan was this statement: "If phosphorus has risen over the last twenty five years as much as the Secchi disk transparency implies, then it is unlikely that natural sources are completely to blame. The main cause of this apparent rise in nutrient levels is not clear." Possible explanations are livestock in the riparian area of Grave Creek, failing septic systems, excess lawn fertilizers, increased impervious areas, and/or improper shoreline uses. However, two tests for total phosphorus (TP) in Grave Creek were inconclusive.

The 2002 Little Bowstring Assessment Report prepared contains historical background on land use in the Little Bowstring watershed. During the 1890's the predominately hilly area was logged of white pine and much of the area burned. This cutover land was sold by the Itasca Lumber Company to farmers who fenced the lands for cattle grazing and who cut timber from lowlands for personal use and sale. Logging, burning, and grazing exposed vast areas of the Little Bowstring watershed to erosion and phosphorus rich materials. Today three residents continue to have livestock and animals within the immediate proximity of Grave Creek.

The 1998 report reveals that internal loading of phosphorus occurs in Little Bowstring. The lower levels of the lake have anaerobic conditions and elevated phosphorus concentrations 5.6 times greater than the surface waters. In late April and October the lake "turns over", this mixing brings phosphorus rich water to the surface stimulating algal production. Secchi disk readings go from spring readings of an average of ten to three feet in late fall. Could this source of phosphorus be more historical than present day livestock and farm animals? Would the use of a diatom test core provide data to provide an understanding of the water quality of Little Bowstring? Would water analysis testing of Grave Creek and selected sites in Little Bowstring help Association members understand why water quality differences exist between Grave and Little Bowstring Lake?

Boy, Grave, Pike and Maki Lakes all have Secchi reading better than Little Bowstring. It would seem that monitoring of water that flows to Little Bowstring by way of Grave, Spring and Maki Creeks would indicate an upstream source of possible influencing agents. Secondly, several testing sites on Little Bowstring may indicate a local problem, or even a natural condition that would explain why there is such a wide difference in Secchi readings.

In February of 2004 members of the Board of Suomi Area Lakes Association (SALA) entered into a partnership with Itasca County Soil and Water Conservation District (ICSWCD) to conduct an assessment of Little Bowstring and its watershed to determine water quality and any potential hazards from runoff within the watershed. The ICSWCD would provide training to SALA volunteers in sampling and be the contact with Natural Resources Research Institute in Duluth to conduct testing of samples. Their staff will provide in-kind labor for technical assistance, and SALA will volunteers to collect samples, and grant monies from the Healthy Lakes and Rivers Program and Water Quality Monitoring Plan training to fund the monitoring study.

The study will consist of the following components:

1. Continue Secchi readings on all lakes in the watershed.
2. Monitor six sites on streams for total phosphorus, stream flow and depth.
3. Monitor Little Bowstring for specific nutrient levels.

The purpose of the study is to determine if feeder streams to Little Bowstring are carrying elevated amounts of nutrients into the lake, or does the lake have elevated levels of nutrients based on historical or natural causes.

Little Bowstring Watershed - Historical Background

The opening of lands for purchase was made possible after the 1855 treaty with the Chippewa of the Mississippi who ceded these lands to the U.S. government. The General Land Office contracted survey crews who worked in the areas between 1869 and 1900. Even before surveys were complete squatters began to erect claim shanties. Logging had been started in the Deer Lake area before the survey was completed.

Between 1893 and 1900 the Minneapolis-Rainy River railroad better known locally as the 'Gut and Liver Line' was constructed north from Deer River with International Falls as its destination. By the winter of 1893, the railroad extended north from Deer River to Bowstring Hill near Little Bowstring Lake. The Itasca Logging Company, owners of the railroad and a large mill at Deer River, accomplished most of the logging in this area. Sidetracks were built all along the line and by 1895 most of the pine were logged off the area south of Marcell. Many of the lakes in the upper Bowstring watershed became holding ponds for logs from the winter's cut. Rail was laid to these lakes; the logs were hoisted unto railroad cars and hauled to Deer River. Remnants of this time period are still visible today. After 1932 the railroad track bed was converted to an all-weather gravel road locally known as the Alder Road, or "track road". The spur that ran along the south and east shore of Little Bowstring became a county road and became lakeshore frontage with the construction of highway #48 in 1959-60. Little Bowstring has several rows of pilings that supported the rails for the cars to haul away the logs hoisted from the lake. Several of the hoist and boom logs lie on the bottom of the northeast section of the lake. Clear-cut sidings are still found along the Alder Road where rail spurs were laid to bring logs to the main line of the 'Gut and Liver'.

Scattered in the area surrounding Little Bowstring are signs of trapper camps and other short-term dwellers. Once the pine had been removed the Itasca Logging Company began to make cutover areas available for public sale. In 1916 Jaffet Heikkinen, Otto Salo, and Edwin Juntunen came to the area from Alexandria and purchased land that bordered the creek between Grave and Little Bowstring. By 1920 several Finnish homesteads were established and the community of Suomi had come into existence.

The types of land use in the watershed affect the quality of the receiving water. In general, undisturbed forested and wetland watersheds will provide less nutrient and sediment delivery than developed or agricultural watersheds. The lowland areas seem to have little change since the early 1900's and uplands have changed dramatically. This is not the case however. Accounts of travel on the Bowstring River by early settlers indicate the river was deeper and did not meander as it does today. Between 1915-20 a drainage ditch was dug to drain the lowlands to the west of the old 'Gut and Liver' track. This ditch ran north and south, cutting across the Bowstring River. This

attempt to drain these lowlands diverted the natural flow of the drainage system and was later deemed a mistake and an attempt was made to correct it. This project also opened this area up to beaver. Over the years their dam building further impacted water flow and created new habitats. Willow and wetland brush began to choke the natural drainage, slowing down stream flow, with deposition of silts further restricting flowage. The shorelines of streams and lakes within the watershed have remains of trees downed by beaver many years ago. Water levels of Suomi, Maki, Pike, and Little Bowstring are all higher due to beaver dams of the past as well as today. The upland areas were once pine covered. Few pine remain, the greatest area of pine is south of Maki and McDonald Lake, the Bowstring Hill - gravel pit region. The first settlers of Suomi purchased cut over lands - the upland areas were covered only with stumps. Much of this once pine covered land was subject to burning. The entire vegetation cover was removed. Great long open slopes subject to erosion resulted in ash and soil deposition in bogs, rivers, and lakes. Logs were dragged across the ground loosening the soil. Logs were dumped into shallow areas of lakes destroying shoreline vegetation, disturbing lake bottoms in fish breeding areas. Roads were cut through forested slopes, and along stream and lakeshores with additional runoff into the watershed.
The entire area around Little Bowstring was fenced and pastured. Cattle roamed this cutover land for years. Barns were built to house the cattle; streams and the lake were their water source. The phosphorus and nitrogen content of the manure washed into the watershed. This same development was taking place in the Grave Lake area and its waters flowed into Little Bowstring. Over the years cattle grazing and farming has decreased. Today these former cutover lands have established grasslands that reduce the surface erosion of soils. Within the watershed 3 different livestock operations continue to exist, and the largest has cattle with direct access to Grave Creek.

Water Quality Data

See Water Quality Data Appendix A.

Water Quality Today

From an historical perspective, the Little Bowstring watershed has been greatly impacted by soil and vegetation alteration. Virtually new environmental communities were created. To think the water quality would be the same as in the past is completely impossible. A modern management plan for Little Bowstring must determine what water quality exists today and consider the wants and needs of the landholders - both members and non-members of the Suomi Area Lakes Association.

The consensus of the Suomi Area Lakes Association Lakes Management Plan Visioning Session held September 22, 2001 was that water quality is our number one concern. There is considerable difference in the water data of Little Bowstring and its tributary lakes. Little Bowstring ranks the poorest in water quality. Before that can be changed we must answer the big question, why? Are the feeder lakes sending poor quality water? Are the people living around the lake causing the problem? Is it a natural condition that can't be changed? Must our expectations of water quality be adjusted?

History of Suomi Area Lakes Association

The Suomi Area Lakes Association began in 1993 as a non-stock, not-for-profit organization with membership available to any property owner on and within one thousand feet of the shoreline of the following lakes: Dead Horse, Little Dead Horse, Boy, Grave, Pike, Maki, Little Bowstring and McDonald. Full membership entitled each property owner to one vote. Other persons who were interested in and subscribed to the purposes of the Association were eligible as non-voting Associate members with full rights of discussion and suggestion.

On April 24, 1994 President Tom Ryan extended an invitation to lakeshore owners of the Suomi area to join the 46 current members as new members of the Suomi Area Lakes Association. The stated purpose of the Association was to maintain and improve the quality of the environment, water, watershed, soil, flora and fauna of the area. Some projects were in the planning stage. Predominant among them was a search for infestation of Eurasian milfoil and the opening of the flowage to and from the lakes.

Those purposes are so stated in Article II of the By-Laws of Suomi Area Lakes Association. Seven points are listed consistent with the dedication to that purpose.

1. Members believe all parts of the environment are related and affected by other parts.
2. Members believe that they have a special privilege and responsibility to maintain and improve the quality of this environment with its unspoiled beauty, accessibility and freedom from pollution.
3. Members realize that human occupation and use of the area lakes environment can positively or negatively affect its future.
4. Education is an important priority to learn about how human activity influences change on the area lakes. Through education we can find out how to effect positive change.
5. Specifically, through using governmental agencies, civic environmental groups with similar purposes and communication with each other we can protect the quality of the total environment.
6. We seek to organize ourselves so that members can contribute their particular talents and expertise toward bettering the environment.
7. We are dedicated to effective positive environmental change not only through education and communication, but also through political and legal channels where desirable and necessary.

At the 1998 Annual Meeting the Association members voted to change the by-laws for membership. Approved was the change to permit "any property owner with the Suomi Area Lakes Association Watershed Area to be eligible for full membership in the Association". In 2004 there were 85 paid memberships.

The Suomi Area Lakes Association was formed by landowners in the areas around eight lakes: Boy, Grave, Little Bowstring, Pike, Maki, and McDonald. All eight lakes are in northwestern Itasca County. McDonald Lake is outside of the Little Bowstring watershed, but does join the Bowstring River to the west of Little Bowstring. All eight lakes flow into the Bigfork River and are within the Rainy River Drainage Basin. The eastern and southern hills of the Suomi area are the divide between the Rainy River and Mississippi Drainage Basins. Boy Creek flows from Boy Lake to Grave Lake. Grave Creek flows from Grave Lake to Little Bowstring. Spring Creek flows from Pike Lake to Little Bowstring. Maki Creek flows from Maki Lake to Little Bowstring. The Bowstring River is the outlet of Little Bowstring; which flows to Bowstring Lake to the west.

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Flow Chart of Annual Citizen Monitoring Cycle

Developing Assessment Plan - SALA Officers and Board authorize Lake Assessment of Little Bowstring based on available data and reports. Norman Ford was primary author of the report with revisions based on input by Art Norton of the ICSWCD.

Developing Lake Monitoring Plan - Four members of SALA Board attend Citizens Volunteer Water Quality Monitoring Program Workshops. Norman Ford is primary author of the Plan to obtain funding for assessment of Little Bowstring watershed

Putting Plan into Action - Attendees of Training program meet with ICSWCD to partner for assessment of the Watershed. Art Norton and Noel Griese agreed to provide in-kind labor and assist in sampling with SALA volunteers. A prepared schedule of monitoring events will be provided for citizen volunteers and Soil and Water staff.

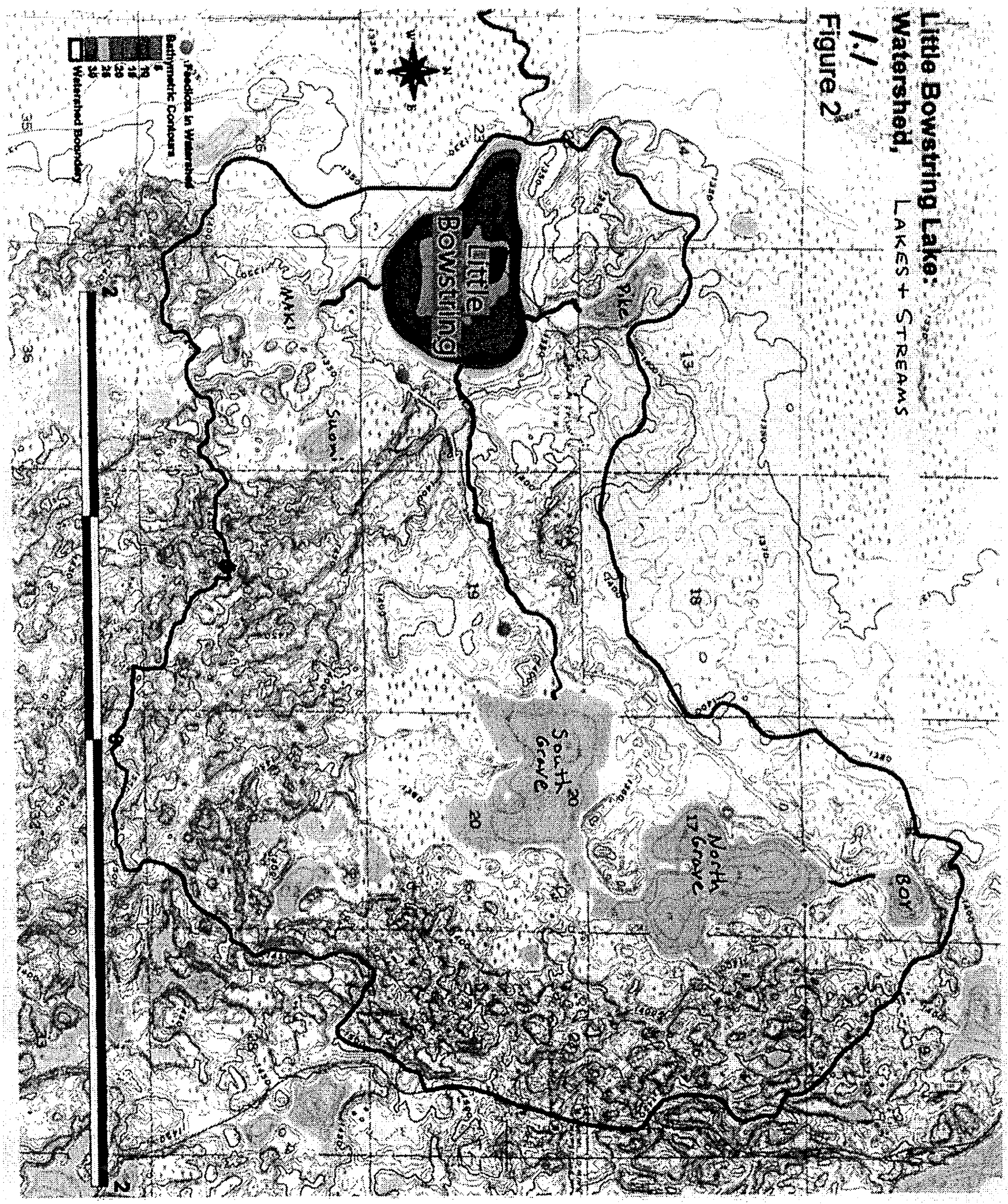
Interpreting the Samples and Data - ICSWCD will send collected samples to NRRI in Duluth for analysis. When the results are returned a written report will be prepared by ICSWCD as an appendix to the 1998 Little Bowstring Lake Assessment. SALA will receive a copy of the 2004 Monitoring Plan.

Reporting the Findings - ICSWCD will go over what the report findings mean with the four monitoring workshop attendees and provide a copy of the report for SALA. From this report articles will be written for the Quarterly SALA Newsletters. A presentation will be given at the Annual Meeting in September.

Monitoring Goals - The SALA Board will meet to go over the Assessment to determine what goals should be developed for the coming year, and years.

1.1 Watershed Maps:

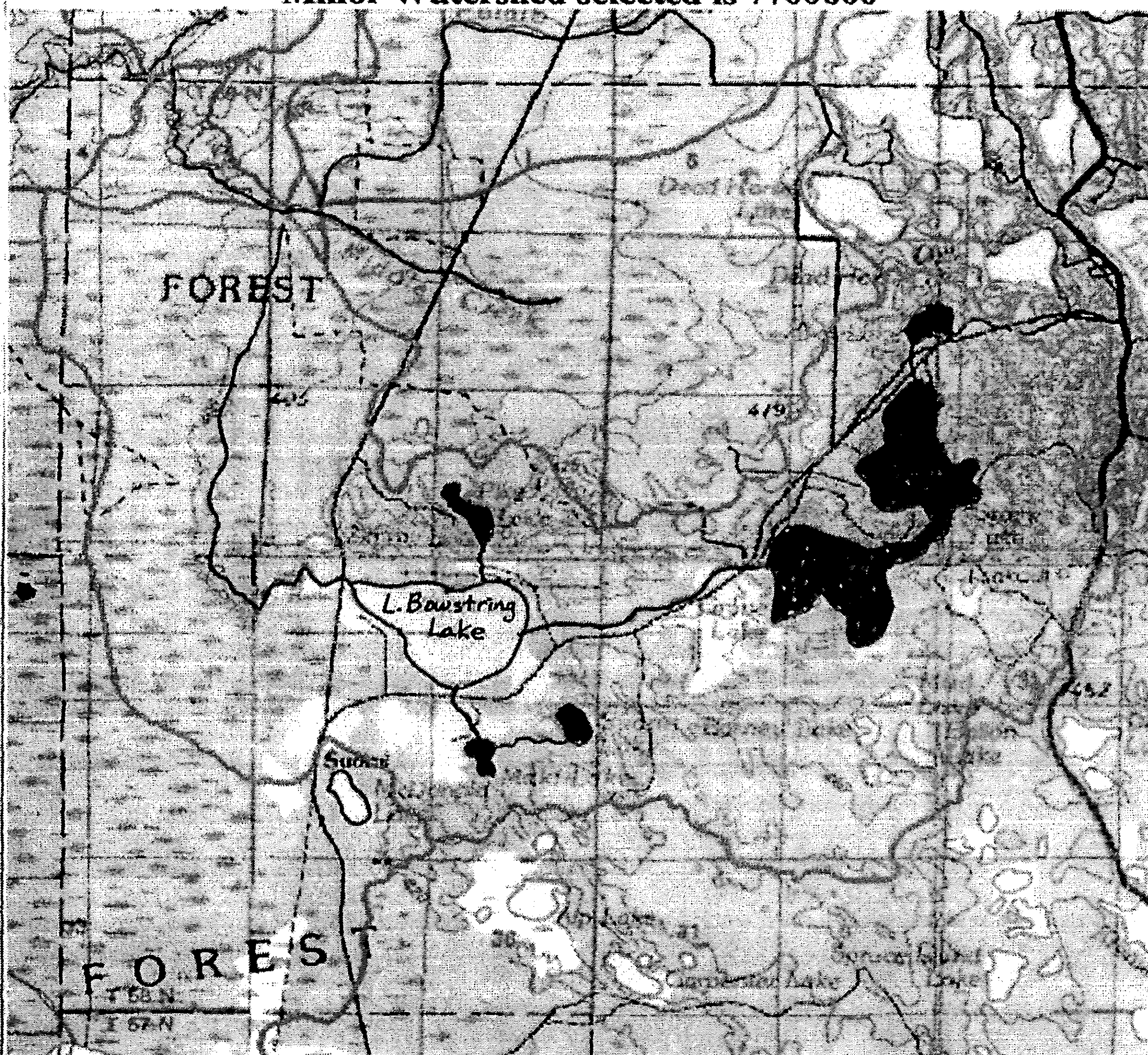
See Appendix B for additional maps.



LITTLE BOWSTRING WATERSHED MAP

Lakes: Boy, Grave, Pike, Suomi, Maki, Little Bowstring
Creeks: Grave, Maki, Spring
River: Bowstring

Minor Watershed selected is 7700600



SELECTED MINOR WATERSHED (Highlighted in Yellow)

LITTLE BOWSTRING	Drainage Area (Sq. mi)
7700600	16.51

WATERSHED BACKGROUND AND INFORMATION

Little Bowstring Watershed

1. **Grave Creek**
   Flows from the south basin of Grave Lake to Little Bowstring for a distance of approximately two miles. Within this stretch three separate livestock operations are located. One of these has actual access to Grave Creek. There are six full time residences, one Church and one unoccupied mobile home along Grave Creek

2. **Maki Creek**
   Flows from Maki Lake to Little Bowstring for a distance of less than a mile. Numerous springs and runoff from wetlands support Maki Lake. There are two full time residences, a seasonal cabin and an abandoned house along Maki Creek

3. **Spring Creek**
   Flows from Pike Lake to Little Bowstring for a distance of less than a mile. Numerous springs and runoff from wetlands support Pike Lake. There is a seasonal and year around home along Spring Creek.

4. **Bowstring River**
   The outlet for Little Bowstring flows north to the Bigfork and Rainy River Systems. Flows through bog and wetlands have many restrictions of floating bog and beaver dams. There are no building sites along the
   Bowstring River for several miles until one gets close to Big Bowstring Lake to the west.

5. **Little Bowstring Lake**
   Located in basin surrounded by hills that were logged of white pine in the late 1800's. Cutover land was pastured and supported dairy farming into the 1960's. Cabins and boat rentals came into use in the late 1940's. A new County road was built along the lake in the late 1950's Culverts replaced bridges and lake levels changed. Natural spawning areas were lost. Seasonal cabins and homes began to surround the lake in the 1970's. Today there are eight year around residences and sixteen seasonal cabins or homes around Little Bowstring Lake

1.2 General Information on your watershed and surface water:

INFORMATION TOPIC	ANSWER
Major Basin	Rainy River
Watershed Major	Big Fork River
Minor	Bowstring River
Local	Little Bowstring Lake
Ecoregion	Northern Lakes & Forest (NLF)
Watershed size (acres)	
Little Bowstring	6204
Land to water ratio	19.76
Dominant Soils	
Hydric	11% - 654 acres
Water	11% - 680 acres
Well drained upland	78% - 4870 acres
Land Use	
Forest	65% - 4023 acres
Brushland	4% - 238 acres
Water, Marsh & Wetland	21% - 1319 acres
Cultivated	0% -
Pastured	10% - 597 acres
Developed	<1% - 27 acres
Little Bowstring Lake	31-758
Surface Area	314 acres
Littoral area	115 acres
Mean Depth	20 feet
Maximum Depth	33 feet
Mean Thermocline Depth	16.4 feet
Watershed Number	77006
Shoreland zoning	Rec. Dev. 2 – Itasca Co.
Boy Lake	31-0623
Surface Area	27 acres
Maximum Depth	40 feet
Secchi Disk	3.6m, (TSI 42, mesotrophic, 65% in NLF)
Grave Lake	31-0624
Surface Area	503 Acres
Maximum Depth	46 feet
Secchi Disk	3.8m (TSI 41, mesotrophic, 65% in NLF)
Maki Lake	31-0759
Surface Area	41 acres
Secchi Disk	3.9m (TSI 40, oligiotrophic, 74% in NLF)
Pike Lake	31-756
Surface Area	33 acres
Maximum Depth	75 feet
Secchi Disk	9.5 feet

Rivers/Creeks	**Boy**	**Grave**	**Spring**	**Maki**	**Bowstring**
Mean Width (ft)		2.0	3.0	2.0	40.0
Mean Depth (ft)		1.2	.5	1.5	2.5
Flow (cfs)		1.6	+0	1.2	12.7
Elevation Difference from Grave Lake to Little Bowstring (ft)		27.25			

1.3 Inventory of your Uses of Watershed and Surface Water:

Primary Water Use	Recreation - fishing
Public Access Little Bowstring Grave Boy, Pike, Maki	 County - Earthen –Co. Rd #48 DNR – Concrete – north basin None
Fisheries Management Little Bowstring Grave	 Walleye – 3 yr fry stocking Bluegill, N. Pike, Walleye, Largemouth Bass 5 bluegill limit
Fish Consumption Advisory	None
Historical Events	Lakes in watershed were holding ponds for logs during logging era. Cutover area was used as grazing area after logging.
Data Collection	Itasca County Soil and Water Conservation District Mn DNR Mn PCA CLMP – Suomi Area Lakes Assoc
Wastewater Systems along Shorelines	Septic: tank with drain field, mounds, or holding tanks

1.4 Current Status of Your Waters of Interest: For this exercise, please refer to the Chapter 7050 of the State Water Quality Standards, the 305(b) Assessed Waters Report, and the 303(d) Impaired Waters List.

1) **Water of Interest** (name, location, and/ or segment/ lake number)	2) **Use Classifications** WQS-7050	3) Lakes: **What is the Carlson Trophic Status?** 305(b)	4) Assessed?	5) **Are there Uses that are Fully Supported?** 305(b) (List)	6) **Are there Uses that are NOT Fully Supported?** 305(b) (List)	7) Streams: **Does Ecoregion Data Indicate any Threats?** 305(b) (List)	8) **If Impaired, what is the Affected Use?** 303(d)	9) **If Impaired, what is the Pollutant or Stressor?** 303(d)	10) **Suspected Sources** 305(b)
Little Bowstring 31-0758	2B, 3B, 4A, 4B, 5 and 6	Mesotrophic 51	Y	Swimming					
Grave 31-0624	2B, 3B, 4A, 4B, 5 and 6	Mesotrophic 42	Y	Swimming					
Boy 31-0623	2B, 3B, 4A, 4B, 5 and 6	Mesotrophic 42	Y	Swimming					
Maki Lake 31-0759	2B, 3B, 4A, 4B, 5 and 6	Oligotrophic 40	Y	Swimming					
Pike Lake 31-0756	2B, 3B, 4A, 4B, 5 and 6		N						
Grave Creek	Same as Above		N						
Maki Creek	Same as Above		N						
Spring Creek	Same as Above		N						
Bowstring	Same as Above		N						

2B-cool & warm water fish
3B-general industry but not food processing
4A-irrigation
4B-livestock & wildlife
5-enjoyment & navigation
6-limited resource

1.6 What are the things you value in your watershed?

1. Little Bowstring Watershed area includes Boy, Grave, Pike and Maki Lakes. Grave and Little Bowstring is the primary fishing and recreation lakes in the watershed. Grave has a strong bluegill base, while walleye is the major attraction of Little Bowstring. Both lakes support a year around fishery. Northern spearing and tubillie netting are important winter activities as well.

2. In addition to fishing, hunting of grouse and whitetail deer is supported in the watershed area.

3. The Suomi Hills form the eastern and southern boundary of the watershed. Cross-country skiing, snowmobile, and hiking trails are provided in this area. The Laurentian Divide Wayside Rest along Highway #38 is maintained by the Suomi Area Lakes Association; as well as the picnic and swimming area on Grave Lake.

4. The Watershed was an important region of logging operations in the 1890's and farming area for Finnish settlers after 1916. Resorts were developed on Grave and Little Bowstring in the late 1940's. Today Little Bowstring Resort continues to attract business. The lake shore continues to see a steady addition of seasonal and retirement homes.

5. Boy, Maki, and Pike remain primarily isolated and undeveloped.

Comparison of the Use Classifications to the actual uses and values.

1) Water of Interest	2) Use Classifications	Actual Uses and Values (from own experience)
Little Bowstring Lake 31-0758	2B, 3B, 4A, 4B, 5 and 6	Recreational - fishing
Grave Lake 31-0624	2B, 3B, 4A, 4B, 5 and 6	Recreational - fishing
Boy Lake 31-0623	2B, 3B, 4A, 4B, 5 and 6	Recreational - fishing
Pike Lake 31-0756	2B, 3B, 4A, 4B, 5 and 6	Recreational - fishing
Maki Lake 31-0759	2B, 3B, 4A, 4B, 5 and 6	Recreational - fishing
Grave Creek	2B, 3B, 4A, 4B, 5 and 6	Fish spawning (Walleye & Sucker) Water for cattle
Maki Creek	2B, 3B, 4A, 4B, 5 and 6	Fish spawning (Northern & Walleye)
Spring Creek	2B, 3B, 4A, 4B, 5 and 6	Fish spawning (Suckers)

2B-cool & warm water fish
3B-general industry but not food processing
4A-irrigation
4B-livestock & wildlife
5-enjoyment & navigation
6-limited resource

2.1 Issues, efforts to address those issues, and evaluation

Issue	Known Effort to Address the Issue	Evaluating Known Efforts, Identifying Niches
Secchi readings lower for Little Bowstring Lake than from inflowing lake waters.	CLMP – several years of data collected for Boy and Grave Lake. CLMP – regular collection of data for Little Bowstring last 5 years. DNR and ICSWCD did assessments for Grave 1997 and Little Bowstring in 1998. DNR Fisheries drafted new fish management plan for Little Bowstring 3/3/2003.	This data collection continues by Tom Ryan and Hal Rime. Norm Ford has committed to continue weekly readings. SALA to develop Secchi monitoring on other feeder lakes. Work with ICSWCD to monitoring feeder streams
Lack of sufficient data to know what the water quality of Little Bowstring Lake	ICSWCD Assessment Grave Lake – 1997 and Little Bowstring – 1998 Boy MPCA Database Report Pike, Maki – lack of data	In 2004 ICSWCD made a tentative plan to test nutrients, dissolved oxygen, temperature, chlorophyll-a and total suspended solids, pH and conductivity in Little Bowstring. Total phosphorus, dissolved oxygen, temperature, stream levels and flows of Grave, Maki, and Spring Creeks and outlet of Little Bowstring. Additional Secchi disks readings on Pike Maki, Boy and Grave
Variability of water level in Little Bowstring Lake	SALA – removed debris from Boy, Spring, Grave, & Maki Creek to increase flow. SALA – hired trappers to trap beaver in Bowstring River. SALA – trapping and dam removal SALA – petition County Highway and DNR Waters Division to lower culverts and remove floating bog.	SALA plans to continue to keep mouth of Maki and Grave Creek free of debris. SALA will continue trapping and dam removal. SALA will continue to lobby for County and DNR action to maintain water levels.
Livestock in Grave Creek Watershed	ICSWCD Assessment identifying possible link to water quality. DNR Fisheries Report stating possible link for high algal bloom.	ICSWCD tentative plan to monitor incoming water from Grave Creek summer of 2004. SALA to collect weekly Secchi readings on Little Bowstring and Grave Lake

MONITORING GOALS

4.5 Monitoring Goal

1. Monitor nutrient levels of Little Bowstring Lake and the incoming streams and to establish a Program of data collection based on Quality Assurance and Quality Control measures.
2. Use 305b Lake Condition and Trend Assessment to assess the condition of the monitored lakes.
3. Educate SALA membership as to the condition of the watershed.

3.1 Data Users and Uses

Questions or Hypothesis	User/Decision Maker	Uses/Decisions
Little Bowstring has lower Secchi readings because the entire watershed was logged in the 1890's that allowed heavy runoff of phosphorus rich nutrients into streams.	1) SALA Members 2) Shoreland Owners 3) DNR Fisheries 4) ICSWCD 5) MPCA 6)DNR Waters	Understand reason for higher TP and algal bloom (1-5) Adjust fish management plans (3) Adopt appropriate stream flow standards to maintain flushing of lake (1-4, 6) Implement and fund lake sediment diatom core test when funding becomes available (1, 4)
Little Bowstring has lower Secchi readings because the watershed was pastured by settlers beginning in1916 and through the 1960's adding agricultural runoff to the lake.	1) SALA Members 2) Shoreland Owners 3) DNR Fisheries 4) ICSWCD 5) MPCA	SALA conduct weekly Secchi disc readings. Understand reason for higher TP and algal bloom (1-5) Implement and fund lake sediment diatom core test when funding becomes available (1, 4)
Little Bowstring has lower Secchi readings because spring and fall turnover releases phosphorus due to internal loading of natural and/or historic factors.	1) SALA Members 2) Shoreland Owners 3) DNR Fisheries 4) ICSWCD 5) MPCA	SALA conducting an internal loading study to determine its effects on algal blooms (chlorophyll a and water clarity) (1-5)
Little Bowstring has lower Secchi readings due to runoff from three (3) present day livestock sites within the watershed.	1) SALA Members 2) Shoreland Owners 3) DNR Fisheries 4) ICSWCD 5) MPCA	Understand that farm runoff is not the only source of phosphorus (1-5) Be pro-active in water quality issues (1) Effects on fish spawing areas (3) To determine if BMPs are required (4)
Little Bowstring has lower Secchi readings because beaver activity in the outlet river (Bowstring) holds water back during the summer allowing increased algal bloom.	1) SALA Members 2) Shoreland Owners 3) DNR Fisheries 4) ICSWCD 5)DNR Waters	Support management of beaver in watershed (1, 2) Support efforts to establish and maintain water levels (3, 5) Provide for nuisance beaver control (3 ,5) Support efforts to maintain water levels by removal of blockage to stream flow (2.3)

2.2 From Issues to Indicators

Current Issues or Problems to be Addressed	Desired Outcomes	Benchmarks	Indicators
Secchi Readings lower for Little Bowstring than from inflowing lake waters.	Understand the reason for the differences.	Using monitoring results from all feeder lakes	Results can be used to explain the differences
Inconsistencies in Secchi disk readings between volunteers	Improve the quality of Secchi disk readings	The same readings by all Secchi Disc volunteers. All lakes monitored with the same protocols	95% of the readings are within established precision requirements 95% of monitoring data follows protocols
Lack of sufficient data to know what the water quality is of Little Bowstring	Collect data needed to determine the water quality of Little Bowstring	Determine use support using Northern Lake and Forest criteria.	Knowing what the use support is.
Variability of water level in Little Bowstring Lake	To understand what is the cause of the variability	General: Established benchmark level. Specific: DNR Waters establish bench mark level for lakes in watershed Relate water level to water clarity	*Published levels. *Known shoreline for BMP. *Dock level set. *Goal for water level management of beaver dams. *Culvert heights adjusted uniformly. *Establish natural spawning in creeks
Livestock in Grave Creek Watershed	Resolve question of livestock in Grave Creek impact on nutrient inputs into Little Bowstring Lake	Comparison of nutrient levels above, in and below livestock impacts	ICSWCD report.

REVIEW: Linking Sections

Stream Monitoring

1. Grave Creek. The issue here is cattle within the watershed and with actual access to the stream itself. The plan is to monitor for phosphorus above and below the pasture area. Additionally, stream flow will be monitored at the same time sampling occurs, as well as during storm events to determine the increased phosphorus load from runoff.

2. Maki Creek. Since Maki Lake has many springs it will be monitored to determine if it has a high level of natural occurring phosphorus. Stream flow will be monitored.

3. Spring Creek. This stream form Pike Lake will be monitored for phosphorus and stream flow.

4. Bowstring River. This outlet of Little Bowstring Lake will be monitored for phosphorus and stream flow. It is of interest to see how the amount of phosphorus coming into the lake compares to the amount leaving.

Little Bowstring Monitoring

1. Historic Impact. The watershed has been subjected to logging and cattle grazing which has given the lake a buildup of phosphorus, which is released during turnover in the spring and fall. At issue today is how much impact the remaining cattle in the watershed are having by increasing phosphorus levels. By monitoring above and below this area data should be gathered to answer this question.

2. Natural Impact. It has been suggested that since Grave, Maki, and Pike Lake receives water from wetlands and have a high number of natural springs the natural phosphorus level in these waters would be elevated and therefore increase the level of phosphorus in the lake they empty into, Little Bowstring.

Stream Monitoring

1.Grave Creek. This stream will be monitored above and below the pasture land and at its mouth as it enters Little Bowstring. This is to determine if any additional sources of phosphorus may be involved.

2. Maki and Spring Creek. Monitoring sites will be at the mouth of these streams as there short stream are relatively isolated from human activity.

3. Bowstring River. The monitoring station will be at the outlet of the lake near the bridge on CR 253.

WHAT, HOW, WHERE, WHAT WILL YOU MONITOR

5.2 Sources of Stressors, Parameters and Scale

Sources of Stressors	Parameters	Scale
Nutrients	Total Phosphorus (TP)	Lake - Streams
Nutrients	Dissolved Oxygen (DO) Temperature (T)	Lake - Streams
Nutrients	Chlorophyll-a, Transparency (SD)	Lake
Nutrients	Total Kjeldahl Nitrogen (TKN) Nitrate + Nitrite Nitrogen (NO_2-NO_3) Ammonia Nitrogen (NH_3) Conductivity (Cond) pH	Lake
Sediments	Total Suspended Solids (TSS)	Lake
Stream level variability and nutrients	Flows to determine residence time, mass water budget, and TP in/out	Stream reach

5.3 Data Quality Objectives for Sampling

Sampling Method / Parameter	Completeness	Representativeness	Comparability
Lake Sampling			
Use an integrated sampler to collect a sample from the epilimnion for TP and chlorophyll a	10 samples (2 per month during the sampling season) (100%)	Collected at deepest part of the lake May – September	Using standardized protocol for collection and methods comparable to those use for historic data
TP collected from hypolimnion using a Kemerer sampler	8-9 samples when the lake is stratified. (100%)	Collected 1 meter from the lake bottom at the same location as the surface TP during lake stratification	Using standardized protocol for collection and methods comparable to those use for historic data
Secchi Disk Visual reading with Secchi disk	10 samples (2 per month during the sampling season) (100%)	Collected at deepest part of the lake May – September	Duplicate readings by Soil and Water and lake association volunteers.
Sample from the epilimnion using an integrated sampler for NO_2-NO_3, NH_3, and TSS	3 samples (1 sample per month) (100%)	May, July, Sept	Using standardized protocol for collection and methods comparable to those use for historic data
Sample from the epilimnion using an integrated sampler for TKN	5 samples (1 per month during the sampling season (100%)	May - Sept	Same as above
Sample at one meter intervals in water column for DO/T, Cond., pH	10 samples (2 per month during the sampling season) (100%)	May – Sept.	Same as above
Stream Sampling			
TP, collected mid-stream, subsurface using sample bottle	2 samples per month Additional sampling during storm events (100%)	Mid-stream sample twice a month from May – Sept.	Using standardized protocol for collection and methods comparable to those use for historic data
DO/T, pH, conductivity with meter	Same as above	Same as above	Same as above
Stream Level Gauge bench mark established for water level	Weekly reading Additional readings during storm events (100%)	Read and record weekly May – September and during storm events at the inlets from Grave, Maki and Spring Creek. Readings at outlet from Grave and Little Bowstring Lake. Reading below pasture.	Duplicate readings by Soil and Water personnel and lake association volunteer.
Stream Flow Flow meter	2 samples per month Additional readings during storm events (100%)	Read and record May – Sept. Measured Mid-stream at same location as stream level sampling.	Duplicate readings by Soil and Water personnel and lake association volunteer.
Rain Gage Readings collected at south shore of Little Bowstring and south basin of Grave Lake	Daily readings (100%)	Readings taken from April - September at both locations	Follow procedures established by Minnesota Climatological Network.

5.4 Sample Collection Methods:

Parameter	What will be sampled	What will be used to collect sample	Sample Containers/ Preservation	Quantity of sample to be collected	Number of samples to be collected per site	Sampling Methods Reference and Source
Lake Sampling						
TP	Epilimnion of water column & bottom layer	Intergrated sampler for top and Kemerer for bottom	Acid washed plastic bottle, H_2SO_4, 4^0C	1000 ml	2	NRRI
Chlorophyll-a	Epilimnion of water column	Intergrated sampler	Plastic bottle, keep in dark, 4^0C	1000 ml	1	NRRI
Water Clarity by Secchi Disk	Upper level of water column	Secchi Disk	None	None In-lake test	2	CLMP Handbook
NO_2-NO_3,	Epilimnion of water column	Intergrated sampler	Plastic bottle, 4^0C	500 ml	1	NRRI
NH_3	Same as Above	Intergrated sampler	Plastic bottle, 4^0C	500 ml	1	
TKN	Same as Above	Intergrated sampler	Plastic bottle, 4^0C	500 ml	1	NRRI
TSS	Same as Above	Intergrated sampler	Plastic bottle, 4^0C	1000 ml	1	
DO / T Conductivity pH	1 m interval in water column	Hydrolab Mini Sonde	In-lake Sample	In-lake Sample	1	ICSWCD
Stream Sampling						
TP (stream)	Mid stream, subsurface	Sample Bottle	Same as for lakes	1000 ml	1	NRRI
DO / T Conductivity pH	Mid stream, subsurface	Hydrolab Mini Sonde	In-lake Sample	In-lake Sample	1	ICSWCD
Stream Flow and Stream Level	Stream and lake gauges	Bench mark measuring stake and flow meter	No Sample Collected	No Sample Collected	10 plus storm events	NRRI

See Appendix C for Natural Resources Research Institute (NRRI), U of M, Duluth

5.5 Data Quality Objectives for Analysis

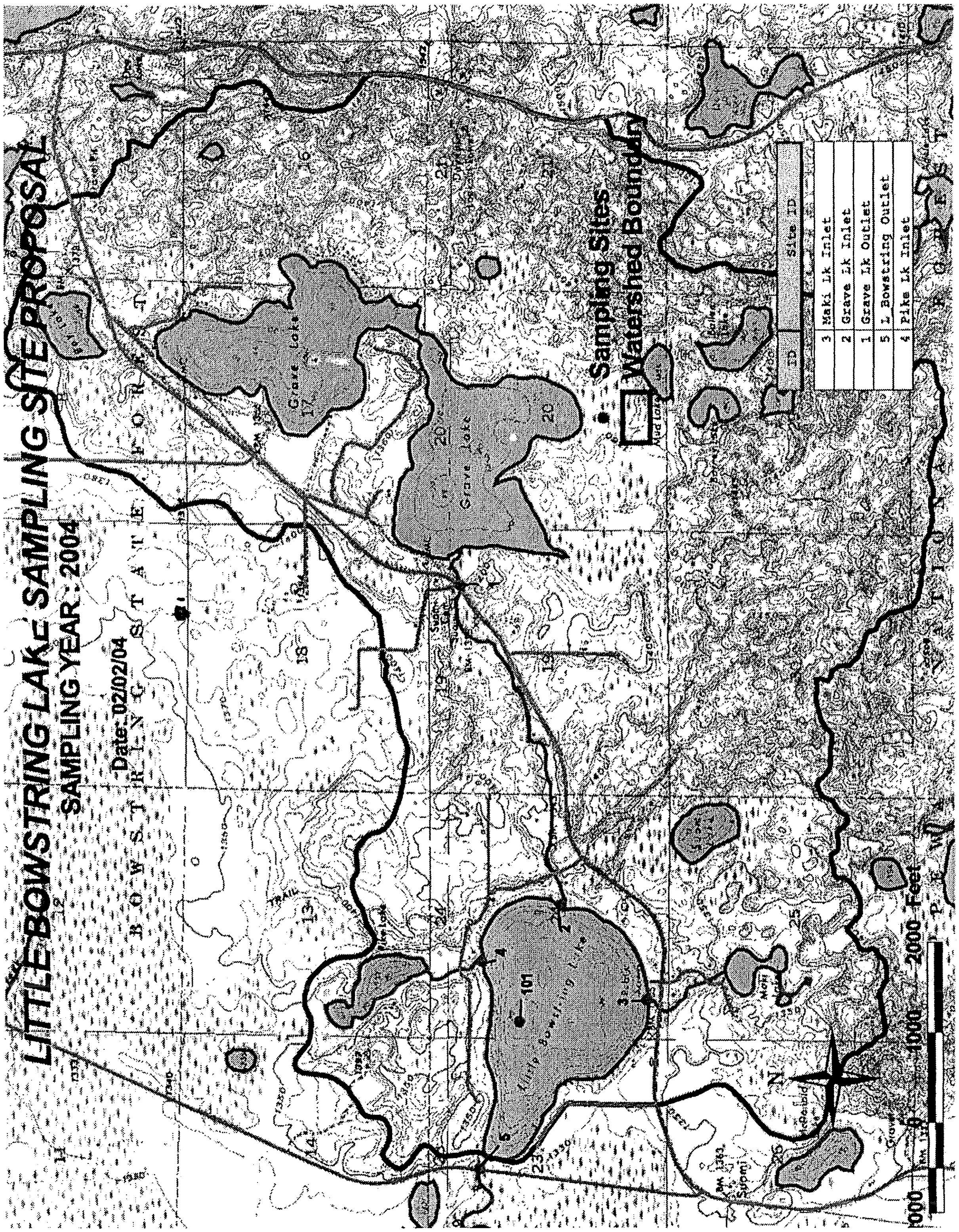
Parameter	Accuracy	Precisin	Detection Limit (DL) Measurement Range
Secchi disk	Not Available	$\pm$ 0.2 m for duplicate readings by the same monitor as well as different monitors	DL = 0.2 m Range = 0.2m – 10 m
Chlorophyll-a	75-125% recovery for QC standard	$\pm$ 2.0 if < 15 µg/L or 25% RPD if >15 µg/L	DL = 1.0 µg/L Range = 1.0 – 100 µg/L
TP	80-120% recovery for QC std. And lab fortified matrix	$\pm$ 0.0005 mg/L if < 0.050 mg/L or 20% RPD if >0.050 mg/L	DL = 0.005 mg/l as P Range = 0.005- 0.500 mg/L as P
NO_2-NO_3,	80-120% recovery for QC std. And lab fortified matrix	$\pm$ 0.02 if < 0.1 mg/L or 20% RPD if >0.1 mg/L	DL = 0.010 mg/L Range = 0.010 – 2.0 mg/L
NH_3	80-120% recovery for QC std. And lab fortified matrix	$\pm$ 0.01 if < 0.1 mg/L or 20% RPD if >0.1 mg/L	DL = 0.010 mg/L Range = 0.010 – 1.0 mg/L
TKN	80-120% recovery for QC std. And lab fortified matrix	$\pm$ 0.20 if < 0.5 mg/L or 20% RPD if >0.5 mg/L	DL = 0.025 mg/L Range = 0.025-2.0 mg/L
TSS	75-125% recovery for QC standard	$\pm$ 1.0 or 25% RPD whichever is higher	DL = 0.010 mg/L Range = 0.010 –500 mg/L
DO	+0.5 for zero standard	<0.5 difference between duplicates	DL = 0.0 Range = 0.0 – 15.0 mg/l
Temperature	$\pm$0.5 ^{o}C in comparison to NIST-traceable thermometer	+/- 0.5 ^{0}C	DL = 0.0 ^{0}C Range = 0.0 – 30.0 ^{0}C
Conductivity	$\pm$5% of known quality control standard	10% RPD	DL = See meter instructions Range = 10-200 µS/cm
pH	See meter instructions	$\pm$ 0.2 pH units	DL = 0.2 pH units Range = 4.0 – 10.0 pH units

See Appendix C for Natural Resources Research Institute (NRRI), U of M, Duluth

6.1 Sampling Site List

Site #	Brief Description of Location (Code for Segment, if any)	How and Where the Site Will Be Sampled	Type of Site	Parameters
Little Bowstring #LB101	47.53333 -93.90833 200yds off north shore	Sample top & bottom at deepest point	B.1. Condition/ Trend Lake-Deepest site	TP, chl-a, TKN, NH_3, NO_2-NO_3, DO/T, pH, cond Water clarity
Boy #B101	47.52083 -93.66667	Sample epilimnion at deepest point	B.1. Condition/ Trend Lake-Deepest site	Water clarity
Grave #GR101 #GR102	47.50139 -93.67361	Sample epilimnion at deepest point	B.1. Condition/ Trend Lake-Deepest site	Water clarity
Pike #P101	47 -93	Sample epilimnion at deepest point	B.1. Condition/ Trend Lake-Deepest site	Water clarity
Maki #M101	47.48194 -93.72083	Sample epilimnion at deepest point	B.1. Condition/ Trend Lake-Deepest site	Water clarity
Grave Creek #1	East end of culvert along C.R.48 by Suomi Church – outlet Grave Lake	Below the surface sample at mid point of stream	B.3. Condition/ Trend Lake-Outlet C.1. impact reference site/ Stream channel	TP, DO/T, pH, cond Stream level Stream flow
Grave Creek #2	North of Arvo Maki garage, south side of Juntunen pasture	Below the surface sample at mid point of stream	C.2. Impact site Stream channel	TP, DO/T, pH, cond Stream level Stream flow
Grave Creek #3	East side of Little Bowstring – inlet from Grave Lake	Below the surface sample at mid point of stream	B.2. Condition/ Trend – stream inlet C3 Impact recovery site	TP, DO/T, pH, cond Stream level Stream flow
Spring Creek #4	North side of Little Bowstring – inlet from Pike Lake	Below the surface sample at mid point of stream	B.2. Condition/ Trend – stream inlet	TP, DO/T, pH, cond Stream level Stream flow
Maki Creek #5	South side of Little Bowstring – inlet from Maki Lake	Below the surface sample at mid point of stream	B.2. Condition/ Trend – stream inlet	TP, DO/T, pH, cond Stream level Stream flow
Bowstring River #6	West end of Little Bowstring – outlet of Little Bowstring	Below the surface sample at mid point of stream	B.3. Condition/ Trend – Lake outlet	TP, DO/T, pH, cond Stream level Stream flow

6.2 Sampling Site Map



6.3 Site Specific Sampling:

Parameters Monitored	**Site #**	**Where In the Water Column?**	**Where Across Transect?**
LAKE SAMPLING			
TP, Chl-a, TKN, NO_2-NO_3, NH_3, TSS	Little Bowstring #101	Epilimnion	Deepest part
DO/T, pH, Conductivity	Little Bowstring #101	Water column at 1 meter intervals	Deepest part
TP	Little Bowstring #101	Hypolimnion, 1 meter above sediment	Deepest part
Water clarity	Little Bowstring #LB101 Boy #B101 Grave #GR101, GR102 Pike #P101 Maki #M101	Epilimnion	Deepest point
STREAM SAMPLING			
TP DO/T, pH, Conductivity	Grave Creek #1 Grave Creek #2 Grave Creek #3 Spring Creek #4 Maki Creek #5 Bowstring River #6	Just below surface	Mid stream
Stream level Stream flow	Grave Creek #1 Grave Creek #2 Grave Creek #3 Spring Creek #4 Maki Creek #5 Bowstring River #6	At gauge established by ICSWCD Will be doing where ICSCD indicates during training	At gauge established by ICSWCD Mid stream

6.4 Sampling Schedule

Parameter(s)	Frequency	Time of Day	Time of Year	# of Years	Special Weather Conditions
Lake Sampling					
Total Phosphorus Chlorophyll-a	2 times a month	Between 10am and 3 pm	May – Sept.	Next 2 years for trend then every 3-5 years	Collect same time as Secchi disk readings
Water clarity Secchi disk	2 times a month	Same time as above	May – Sept.	On-going	Bright calm days
DO/T, pH, Conductivity	2 times a month	Same time as above	May – Sept.	Every 10 years	Same time as TP
NO_2-NO_3, NH_3, TSS,	3 times over growing season	Same time as above	May, July, Sept	Every 10 years	Same time as TP
TKN	5 times over growing season	Same time as above	May-Sept.	Every 10 years	Same time as TP
Stream Sampling					
Total Phosphorus DO/T, pH, Conductivity	2 times a month and high flows if possible	Same time as above	May – Sept.	Every 10 years	Scheduled dates and storm events
Stream Flow Stream Level	Weekly over growing season	Same time as above	May – Sept.	On-going	Weekly and when storm event

Quality Assurance and Quality Control

7.1 Quality Control Measures

Quality Control Measures	Evaluation: Statistical Methods	Parameters and % Quality Control Samples					
		TP	Chl a	Secchi Disk	DO/T, pH Conductivity	NO_2-NO_3, NH_3, TKN	TSS
Internal *							
Field Duplicates	Relative percent difference (RPD)	10%	10%	10%	Random duplicates at random depths, one per site	10%	10%
External							
Knowns	**						
Unknowns	**						

Response Action: All data will be analyzed for accuracy immediately so we have the ability to re-run sample within the holding time if the data is suspect.

* Additional quality control measures will be presented at training by ICSWCD.
**These are determined by Natural Resources Research Institute (NRRI), U of M, Duluth Minnesota will be followed.

7.2 Instrument and Equipment Requirements

Itasca County Soil and Water located in Grand Rapids will provide all equipment for the 2004 water quality monitoring study. The Natural Resources Research Institute, U of M, Duluth, Minnesota will conduct all lab work. Noel Griese of Soil and Water will be the contact person. Volunteers from SALA will collect lake and samples, read stream gauges, collect rain data, and assist with flow measurements. We will be using a Hydrolab: mini sond 4A. It will be maintained by the ICSWCD.

7.3 Instructions, Documentation, Records and Manuals

Instructions

ICSWCD staff, Noel Griese, and DNR specialist, Rian Reed, will provide instruction to SALA volunteers.

Rain gauge instructions provided by the MN Dept. of Climatology

Field instructions on for stream gauges

Documentation and records

Precipitation records
Stream gauge records
Stream flow data records
Lake monitoring field sheets
CLMP data sheets

Manuals used by volunteer monitors

CLMP Manual

7.4 Training

Training Aspect	Description
Secchi Disk reading	Soil and Water will demonstrate the use of and reading of Secchi disk to SALA volunteers
Stream level reading	Soil and Water will demonstrate the use of and reading of level gauges to SALA volunteers
Lake & Stream Sampling	Soil and Water will train SALA volunteers in sampling methods

DATA STORAGE & MANAGEMENT

8.1 Data Management

Itasca County Soil and Water will be supplying all forms and lab sheets. This information will be stored at their office in Grand Rapids. SALA volunteers will conduct duplicate Secchi disk readings and retain those collect sheets, sharing the data with Soil and Water as well as with MPCA. All SALA paper data records and electronic records are stored at the home of the Association President, Norman Ford, 42307 County Road 48, Deer River, Minnesota 56636 Rain gauge data is submitted to Art Norton of the SWCD and maintained at that office.

CLMP data sheets are submitted to the MPCA. A copy is kept at Norm Ford's.

8.2 Data Management

Name of Sheet Or Database	From Field to Lab	From Lab to Data	Data Entry/Validation	Final Resting Place
Field Recording Sheets for all Chemical/Physical Sampling	Soil & Water will send data sheets and samples to NRRI lab at U of M Duluth	Natural Resources Research Institute will conduct all testing and analysis	Noel Griese ICSWCD	Soil and Water will keep a copy of the Report and supply copy to SALA
Secchi Disk	Not Applicable	Sent to MPCA	MPCA	MPCA and Norm Ford's
Rain Gauge	Not Applicable	Sent to DNR	Sent to DNR, State Climatology Department	Norm Ford's

8.3 Data Management. Meta-data.

We will check this again at the end of the season and note what the actual placement of these items is.

PROJECT INFORMATION *Check Where Found*:

Meta-data element	**In the Plan**	**On Field Sheet**	**On Lab Sheet**	**In Computer Program**	**Other:**
Project ID					
Project name	X	X	X	X	
Project purpose	X				
Start date	X				
Planned duration	X				
Lead organization name	X			X	
Project manager (with contact info	X			X	
Other Contact (like MPCA rep, SWCD rep)					
Sampling personnel		X	X		
Sample medium		X	X		
Sample collection methods		X	X		
Equipment Used		X	X		
Field measurement methods		X	X		
Comments about data transfer, submission		X	X		
Project Study Area	X			X	
Design & sampling frequency	X			X	
Programs associated					
Cooperating Org.'	X			X	
QA plan summary/reference	X			X	

LABORATORY *Check Where Found:*

Meta-data element	In the Plan	On Field Sheet	On Lab Sheet	In Computer Program	Other:
Lab ID					
Laboratory name (w/ address and contact info	X		X	X	
Laboratory name (w/ address and contact info	X		X	X	
Citation for lab (Manual or Handbook).	X		X	X	
Parameter	X	X	X	X	
Sample fraction			X		
Reporting units		X	X		
Comparable standard method			X		
Field preservation method			X		
Detection limit					
Lab certified for parameter?			X		
Length of Analysis			X		
Temperature basis			X		

STATION INFORMATION *Check Where Found:*

Meta-data element	In the Plan	On Field Sheet	On Lab Sheet	In Computer Program	Other:
Project station ID					
Related station					
Station name	X	X	X	X	
Station type	X	X	X	X	
Waterbody type (stream, lake, wetland)	X	X	X	X	
Station description	X	X	X	X	
Site ID	X	X	X	X	
Ecoregion name	X			X	
Travel directions	X			X	
Station latitude-longitude or UTM	X	X	X	X	
Geo-positioning method					
Datum					
Map scale	X			X	
Site lat-long	X			X	
State/county	X			X	
HUC code					
River Reach	X			X	
DNR Lake ID	X			X	
Habitat Type	X			X	

MONITORING RESULTS *Check Where Found:*

Meta-data element	In the Plan	On Field Sheet	On Lab Sheet	In Computer Program	Other:
Station and site ID	X	X	X	X	
Date		X	X	X	
Time		X	X	X	
Station ID		X	X	X	
Site ID		X	X	X	
Activity ID, type and category		X	X	X	
Medium		X	X		
Sample depth		X	X		
Sampling personnel		X	X	X	
Activity comments		X	X		
Sample collection method and equipment		X			
Sample preservation		X			
Lab ID			X		
Lab sample ID			X		
Lab certified?			X		
Results			X		
Field/lab ID			X		
Lab Sample Temperature			X		
Remark codes			X		

8.4 Data Management

Parameter	Reporting Units Entered (e.g. mg/l, taxa, etc.)	Source of Data (for external data)	Computer Application (s) Used for Data Entry	Who Will Enter Data	Validation Steps and Who
Chemical/ Physical Sampling	NRRI protocol			NRRI and ICSWCD	NRRI and ICSWCD
Water Clarity Secchi Disk	Feet			MPCA	MPCA

8.5 Data Management. Miscellaneous problem data. *.How will problem data, such as missing values, detection limit, nonsensical data, ranges, narrative, etc., be handled (e.g. not entered, special characters, etc.).*

Parameter	Data Entry Protocol for "Problem" Data
All	Soil and Water will handle all problems data

ANALYSIS, INTERPRETATION, REPORTING

9.1 Data Analysis – Summarizing and Comparing Your Data to Benchmarks and Interpretation

Parameter	Data User(s)	Statistical Summaries To Be Used	Types of Graphs	Benchmark Used (Note Use Class if WQS Used)	How Data Will Be Compared with Benchmark	How Comparison Will Be Interpreted
Lake Data						
TP	SWCD SALA	Mean TSI Min max Std Dev Relationship to Chla, SD, and TSS	Box whisker Scatter Graphs-line and column	NLF 14-27 µg/L	Look at previous reports. Try to see if levels are natural or not	See section 9.2 below
Chl-a	SWCD SALA	Same as above Relationship to TP, SD, and TSS	Same as above	NLF 4-10 µg/L	Look at previous reports. Try to see if levels are natural or not	See section 9.2 below
Secchi Disk	SWCD SALA MPCA	Same as above Relationship to Chla, TP, and TSS	Same as above	2.4 – 4.6 m 8 – 15 feet	Look at previous reports. Try to see if levels are natural or not. Compare to other lakes monitored in watershed	See section 9.2 below
NO_2-NO_3	SWCD SALA	Mean Min max Std Dev	Same as above	NLF <0.01 mg/L	Look at previous reports. Try to see if levels are natural or not	See section 9.2 below
NH_3	SWCD SALA	Mean Min max Std Dev	Same as above		Look at previous reports. Try to see if levels are natural or not	See section 9.2 below
TKN	SWCD SALA	Mean Min max Std Dev	Same as above	NLF 0.4-0.75 mg/L	Look at previous reports. Try to see if levels are natural or not	See section 9.2 below

Parameter	Data User(s)	Statistical Summaries To Be Used	Types of Graphs	Benchmark Used (Note Use Class if WQS Used)	How Data Will Be Compared with Benchmark	How Comparison Will Be Interpreted
TSS	SWCD SALA	Mean Min max Std Dev	Points related to TP, SD, etc	NLF <1-2 mg/L	Look at previous reports. Try to see if levels are natural or not	See section 9.2 below
pH	SWCD SALA	Mean Min max Std Dev	Box whisker Scatter Graphs-line and column	NLF 7.2-8.3 ph units	Look at previous reports.	See section 9.2 below
Conductivity	SWCD SALA	Mean Min max Std Dev	Same as above	NLF 50-250 µmhos/cm	Look at previous reports.	See section 9.2 below
DO/T	SWCD SALA	Relate to TP from lake lowest depth	Display as value at depths		Relate to TP from lake lowest depth	See section 9.2 below
Stream Data						
TP	SWCD SALA	Mean Min max Std Dev		NLF 30-50	Look at previous reports. How much is coming in	See section 9.2 below
pH	SWCD SALA		Display as value at depths	NLF 7.6-7.9 pH units	Look at previous reports.	See section 9.2 below
Conductivity	SWCD SALA		Display as value at depths		Look at previous reports.	See section 9.2 below
DO	SWCD SALA		Display as value at depths		Look at previous reports.	See section 9.2 below
Temperature	SWCD SALA		Display as value at depths	NLF 0.5 – 17 ^{0}C	Look at previous reports.	See section 9.2 below

9.2 Data Interpretation and Analysis

1) How will you develop findings

1. Compare the Chemical/Physical properties of Little Bowstring to the NLF profile
2. Compare Secchi disk reading for monitored lakes
3. Compare the water quality of Little Bowstring to the south basin of Grave
4. Compare the quality of water coming to Little Bowstring from Maki and Pike
5. What is the internal loading in Little Bowstring
6. Compare stream flow and nutrients levels
6. Compare stream levels to lake levels
7. Compare the 1998 assessment to the 2004 assessment
8. Correlate precipitation to chlorophyll a, Secchi disk and total phosphorus
9. Correlate precipitation to stream total phosphorus and flow

2) How will you develop conclusions?

1. What effect does internal loading in Little Bowstring have on algal blooms?
2. Does removal of beaver dams from the Bowstring River improve water quality?
3. What effect does runoff have on total phosphorus levels in streams
4. What is the impact of livestock on Grave Creek
5. Wetlands and springs contribute phosphorus to Little Bowstring
6. Removing the beaver and dams maintains flow and has a favorable affect on the water quality of Little Bowstring
7. Internal loading has a negative effect on the water quality of Little Bowstring

10.1 Reporting, Presenting, and Planning for Change

1) Who will be preparing the reports and presentations?

Itasca County Soil and Water upon completion of field work and sample analysis by the Natural Resources Research Institute, U of M, Duluth, will prepare a report of the study as an appendix to the 1998 Little Bowstring Lake Assessment Report. SALA will receive a copy of the 2004 Monitoring Report.
Art Norton, Water Planner
Noel Griese, Lake Assessment and Citizen Lake Monitoring Program

2) Who are the target audiences for reporting and presenting your information?

Suomi Area Lakes Association
Suomi Area landowners
Cattle owners within the Little Bowstring Watershed

3) What formats will be used to present the story?

ICSWCD will provide SALA with a copy of the Lake Assessment Report in a 3-ring binder.

Quarterly Newsletters will include stories and report highlights.

Art Norton and Noel Griese of Soil and Water will make a presentation to the membership at the Annual Meeting of Suomi Area Lakes Association.

4) What tools will be used to tell your story?

Maps, graphs, charts, tables.

5) What kind of report information do your data users need?

Data User/ Target Audience	Report Information Needed
ICSWCD	Raw data, lab data
Suomi Area Lakes Association	Intro info, interpreted data, recommendations
Cattle Owners in watershed	Interpreted data, recommendations

6) When/Where will the message be delivered?

SALA newsletter in April and August with updates on progress of monitoring program

Annual Meeting of Suomi Area Lakes Association – Sept 4, 2004 Marcell Family Center

Assessment results will be available in printed format upon conclusion

Additional meetings to be scheduled based on result of Assessment.

7) What would you expect to happen as a result of your report or presentation?

The reason for the Lake Assessment was to help SALA membership, the Suomi community and owners of livestock in the Watershed to have a correct view of the water quality of the Little Bowstring Watershed. Much controversy and hard feelings have developed over the last several years over the issue of livestock in the watershed. It is our desire that a study conducted by SALA in conjunction with Soil and Water personnel, lab results from a certified lab, and a professionally prepared Lake Assessment would provide "the facts" about Little Bowstring's water quality.

If livestock in the watershed are contributing to a decline in water quality then a plan of action can be developed. If others factors have, or are contributing causes to water quality differences between Little Bowstring and surrounding lakes the concerned parties need to know this as well. Our goal is to have all members of the Watershed contributing to the betterment of our lakes and streams. Relationships between people are of as much concern as the quality of the water where we live. We hope this will resolve some misunderstanding as to water quality within the Little Bowstring Watershed.

FEEDBACK, EVALUATION

1) Follow-up:

Group/Audience	**How Follow-up will happen:**	**When follow-up will occur (and times/year)**
Citizens Vol. Monitors	Newsletter Survey Certificate of Appreciation	Quarterly At Annual Meeting
SALA Membership	Newsletter Speaker	Quarterly At Annual Meeting
Community	Speaker	At Annual Meeting
SWCD	Newsletter	Invitation to SALA Annual Meeting

2) Evaluation

Evaluations Done Annually (Program and/or Outcome Based Components)	***Tools used for evaluation***
Volunteer Recruitment/Retention	Survey
Volunteer Training	Practice sessions on lake/streams
Monitoring Goals	Meeting with SWCD, SALA board, and monitoring committee
Survey of Membership as to SALA goals	Prepared survey questionnaire
Did the monitoring program answer the questions of the membership	Evaluation form at the annual meeting

Evaluations Done Every 3 to 5 Years (Program and/or Outcome Based Components	***Tools used for evaluation***
Monitoring Plan	Meeting with SWCD, SALA board, and monitoring committee

3) Where can the results of my evaluation be accessed?

All reports and records are housed with the SALA President – 2004 - Norman Ford

VOLUNTEER NAMES, TASKS, TIMELINE

11.1 Task Identification and Timeline

Monitoring Goal or Assessment:

Dates covered by timeline: March 2004 – Spring 2005

Target Start Date	Target End Date	Main Category (Planning, Mgt,, Monitoring, Post-Monitoring)	Task / Activity Description	Person(s) Responsible to Organize/ Evaluate	Other Resources (human or financial) to Carry-Out Task	Fill in Date when done
3/26/04	9/25/04	Sample collection	Chemical/Physical monitoring of lake and streams	Noel Griese	SALA volunteers	
5/10/04	9/25/04	Secchi Disk reading	Collect readings at same time as ICSWCD	Norman Ford	SALA volunteers	
5/01/04	9/30/04	Post Monitoring	Continue to take Secchi readings	Norman Ford	Volunteer	
3/26/04	9/30/04	Post Monitoring	Continue stream level readings	Norman Ford	Volunteer	
5/15/04	1/15/05	Present findings	Write monitoring up-date in Newsletter	Norman Ford	Volunteer	
9/01/04	9/01/04	Present findings	Oral Report at Annual Meeting of SALA	Norman Ford	Volunteer	
Fall 04	Spring 2005	Written Report	ICSWCD prepare Lake Assessment Report	Noel Griese	ICSWCD Staff	

11.2 Volunteer Monitors

NAME	NOTES	Address	Phone	Email
Norman Ford	Little Bowstring – SALA President - Volunteer	42307 CR 48 Deer River 56636	246-9398	ndford @paulbunyan.net
Robert Poenix	Beaver trapping and dam removal	42298 CR 48 Deer River	246-2740	poecon @paulbunyan.net
Tom Ryan	Secchi Reader Grave Lake	43755 Forest Rd Deer River	246-2007	rinbar @paulbunyan.net
Paul Andersen	Grave Lake Volunteer	38305 Grave Lake Road Deer River	246-8076	pcarx @msn.com
Mike Bellomy	Little Bowstring Volunteer	42228 CR 48 Deer River	246-2540	mbellomy @paulbunyan.net
Dennis Johnson	Little Deadhorse Volunteer	44805 CR 48 Deer River	832-3105	kaydenjohn @yahoo.com
Oliver Juntunen	Grave Lake Volunteer	42828 CR 48 Deer River	246-8890	
Eugene Lysne	Grave Lake Volunteer	37974 Grave Lake Forest Rd Deer River	832-3638	erlysne @earthlink.net
Hal Rime	Secchi Reader Grave lake	42952 CR 48 Deer River	246-2164	hwrime @paulbunyan.net
Ron Salo	Little Bowstring Volunteer	40369 CR 311 Deer River	246-2696	remsalo @paulbunyan.net
Mary Salo	Little Bowstring Vol/ Sec/Treasurer	40369 CR 311 Deer River	246-2696	remsalo @paulbunyan.net
Frank Johnson	Little Bowstring Volunteer	40821 CR 311	246-8255	
Curtis Dahleen	Little Bowstring Water Level Reader	41269 CR 311	246-2065	

11.3 Committees and Data Users

Little Bowstring Watershed Monitoring Committee

Name/Organization	Area of Expertise	Address	Phone	Email
Itasca County SWCD Art Norton	District Manager/ Water Planner	1889 E. Hwy 2 Grand Rapids, MN 55744	218-326-0017	arthur.norton @mn.usda.gov
Suomi Area Lakes Association Norman Ford	President	42307 CR 48 Deer River	218-246-9398	ndford @paulbunyan.net

Data Users

Name/Organization	Expected Data Use	Address	Phone	Email
Itasca County SWCD Art Norton- District Manager/Water Planner	BMP	1889 E. Hwy 2 Grand Rapids, MN 55744	218-326-0017	arthur.norton @mn.usda.gov
Noel Griese - Lake Specialist/Limnologist	Lake Assessment	1889 E. Hwy 2 Grand Rapids, MN 55744	218-326-0017	noel.griese @mn.usda.gov
Kathy Loucks - Rain Gauge	Water Budget	1889 E. Hwy 2 Grand Rapids, MM 55744	218-326-0017	kathy.loucks @mn.usda.gov
Chris Kavanaugh - DNR Fisheries Supervisor	Fisheries Planning	1201 E. Hwy 2 Grand Rapids	218-327-4322	chris.kavanaugh @dnr.state.mn.us
Suomi Area Lakes Association Norman Ford – President SALA	Member Education	42307 CR 48 Deer River	218-246-9398	ndford @paulbunyan.net

BUDGET

11.4 Over-all Budget

Revenues:

Item	Description	Budget	
Healthy Lakes grant	One time only	$	**1884.00**
RCM/MLA grant	One time only	$	**3000.00**
Lake Association dues	Each year	$	**1275.00**
TOTAL REVENUE		**$**	**6159.00**

Expenses:

Type of Expense	(unit price)	(number of units)	Budget	
Sampling = 1 lake site				
Chlorophyll-a & phaeophytin	33.10	10	**$ 331.00**	RCM/MLA
Hypolymnetic total phosphorus	15.30	9	**$ 137.70**	RCM/MLA
TKN & TP (Upper layer)	26.90	5	**$ 134.50**	RCM/MLA
Additional TP (Upper layer)	26.90	5	**$ 134.50**	RCM/MLA
Ammonia	10.80	3	**$ 32.40**	RCM/MLA
Nitrate + Nitrite	11.80	3	**$ 35.40**	RCM/MLA
Total suspended solids	15.90	3	**$ 47.70**	RCM/MLA
Sampling 6 stream site				
TP (12 times each)	15.30	(6sites x 12 = 70)	**$ 1071.00**	RCM/MLA
TP (4 Storm events)	15.30	(6sites x 4) = 24	**$ 367.20**	RCM/MLA
Other Costs				
Record Keeping - Software; Report Printing; Print Supplies	286.00 10.00 50.00	1 10 1	**$ 436.00**	HLP
Volunteer Training (SWCD)			**$ 300.00**	RCM/MLA
Equipment Rental (SWCD for DO, pH, Conductivity)			**$ 300.00**	RCM/MLA
Report Writing (SWCD)			**$ 108.60** **300.00**	RCM/MLA HLP
Manual Stream Flows (SWCD)			**$ 600.00**	HLP
Lake Modeling/Stream Rating Curves (SWCD)			**$ 400.00**	HLP
TOTAL EXPENSES 2004			**$ 4727.40**	

BALANCE (revenue minus expense): ***$1431.60***

In-Kind Contributions:

Item	Description	Value
Volunteer Mileage (2200 miles at $.36)	Sampling / Stream Gauge; Secchi Reading Training; Planning Sessions; Reporting	**$ 792.00**
Volunteer (200 Hours at $16.00)	Sampling / Stream Gauge; Secchi Reading	**$ 3200.00**
Volunteer (90Hours at $16.00)	2 people monitoring 2 rain gauges daily, April - September	**$ 1440.00**
SWCD	Technical Assist / Report	**$ 3125.00**
TOTAL IN-KIND VALUE		**$8557.00**

2004 Lake Sampling Schedule

Top & Bottom sample days in red - hypolimnion sampling begins when lake stratifies

May		June		July		August		Sept	
10	25	10	25	10	25	10	25	10	25
TP	TP	TP	TP	TP	TP	TP	TP	TP	TP
chl-a	chl-a	chl-a	chl-a	chl-a	chl-a	chl-a	chl-a	chl-a	chl-a
	NO2NO3				NO2NO3				NO2NO3
	TN		TN		TN		TN		
	FE				FE				FE
	DOC				DOC				DOC

2004 Stream Sampling Schedule

May		June		July		August		Sept	
10	25	10	25	10	25	10	25	10	25
TP	TP	TP	TP	TP	TP	TP	TP	TP	TP

Note - additional samples taken during storm events

APPENDIX A

Water Quality

Water studies indicate considerable differences between the waters of Little Bowstring and the waters of the lakes that flow into her - Maki, Pike, and Grave. Based on historical written and oral accounts the lake's biosystems have undergone considerable change. Little Bowstring Lake, elevation 1327 MSL, lies in the western edge of the Marcell Moraine. This moraine contains abundant lakes and wetlands, and is characterized by steep and irregular topography. A general summary of the soils in the watershed is 11 hydric soils, and 78 well drained upland soils. Apart from the 314 acres of the lake itself, 680 acres (11) of open water exists in the watershed. Almost half (47) of this area is deemed unsuitable for cultivated crops, poorly suited to pasture, and generally unsuitable as a site for dwelling, sanitary facilities, and local roads due to slope and severe hazard of erosion.

Studies indicate there is between 125 and 175 feet of glacial till overburden on the bedrock in the area. Many of the private water wells in the watershed use a confined water aquifer near the middle of the glacial till, approximately 14 to 100 feet below the surface. The static water table is 18-30 feet. The subsurface bedrock is sloped to the west, with ground water moving the same general direction, toward the Bowstring River. A number of flowing wells are found on the south shore of the lake at 30 feet or less and others as deep as 90 to 110 feet. Some of these have been in use for 80 years while a flowing well was obtained as late as the fall of 2001. A number of large springs are active within the watershed as well.

Water Quality – Data: Little Bowstring Lake Assessment Report, 1998

Little Bowstring is located within the Northern Lakes and Forest ecoregion, approximately 11 miles north of Deer River. It has a surface area of 314 acres and a watershed of 6204 acres. It has a maximum depth of 33 feet with the major basin being 20 feet. It has 3 inlets: Suomi to Maki Lake (Maki Creek), Pike Lake (Spring Creek), and Boy to Grave (Grave Creek). The Bowstring River provides an outlet that flows into the Bigfork to Rainy River system.

Sampling monthly from May to September 1998 mean summer total phosphorus was 26 ppb; chlorophyll-a was 10.0 ppb; Secchi disc transparency was 7.4 feet. These results are slightly worse than most lakes in the county, having typical values of 14.0 to 27.0 ppb total phosphorus; 0 to 10 ppb chlorophyll-a, and; 8.2 to 13.8 feet Secchi disc transparency. The mean Trophic Status Index for Little Bowstring in 1998 was 50. This would be considered a mesotrophic lake (although it is on the lower bound of eutrophy). The lake was dimictic during the monitoring period, experiencing a full turnover in late April. The lake stratified by July but mixed again in October. A survey dated 8/28/95 gave water clarity of 3.9 feet with an abundance of aquatic plants with a maximum of growth to 14 feet. The 1998 survey had a best reading of 9.5 feet in mid-June and a low of 4.0 feet by September 9th with definite algae of green, yellow, or brown color apparent. Samples in 1999 were improved; readings of 10.0 feet in June and 7.5 the lowest in mid-August. The 2001 Secchi disc mean was 5.3 feet based on 12 readings. The TSI for Little Bowstring was 52 or eutrophic, and the percentile ranking of TSI value based on all lakes in the ecoregion was 19.

The historical data is irregular over the years. There are years with no data, some with one reading, and others with up to 12 readings. Although it is impossible to give an accurate account of what is happening, there are some general observations.

1. The data shows an irregular pattern to water clarity from year to year - some years are better than others.
2. Algae and other aquatic growth have a recreational suitability impact by mid-July through early Sept.
3. Years with limited snow melt and a dry spring result in increased water clarity.
4. Phosphorus readings over the years fluctuate, but tend to be moving upward.
5. Water quality decreases seem to mirror years of high water associated with increased beaver activity

General Water Quality Averages of Feeder Lakes

Grave: Lake Area - 503 acres Max. Depth - 46 feet Water clarity - 12.1 feet TSI - 42 Mean Total Phosphorus – 14 ppb Mean chlorophyll-a - 3.7 ppb TSI rank – 65%

Boy: Lake Area - 27 acres Max Depth - 42 feet Water clarity - 12.0 feet TSI – 43 Mean Total Phosphorus - Mean chlorophyll-a - TSI rank – 64 %

Maki: Lake Area - 41 acres Max. Depth - 80 feet Water clarity - 12.8 feet

Pike: Lake Area - 33 acres Max. Depth - 75 feet Water Clarity - 9.5 feet

Water Quality - Lake Levels

Five feet west of the Public Access is a steel fence post driven into an ice ridge parallel to the water's surface. Based on this benchmark there was a water level increase of 2.3 feet between 8-27-1984 and 8-22-95.

Minnesota DNR, Department of Waters has been gathering lake water gauge readings beginning 5-12-94. Since 1994 the recorded range is 2.08 feet, with the highest level on 7-7-99 and the lowest level on 10-25-97. The DNR established a reference point along the shoreline and each spring sets a water level gauge nearby in the lake. Curtis Dahleen reads the gauge and sends the information to DNR Waters.

Historical and oral accounts Indicate water levels of today are much higher than those of the past. From the "History of Suomi" is an account of moving a cow down the Bowstring River by flat boat to Bigfork. That would be impossible in the meandering, shallow, beaver dam restricted river of today.

Oliver Juntunen remembers "seeing the tops of the pilings where the railroad had been built over the lake". This trestle was built across the mouth of the creek coming from Grave Lake. Oliver reasoned the take level must have been much lower as "Walter Filpus made hay between the Public Access Road and the creek from Maki Lake during the 1930's".

During the construction of the log loading facilities on Little Bowstring the water level had to be 4 to 5 feet lower than today. Walter Salo, who was born in 1921, relates as a boy going fishing by "taking a boat and tying it to the pilings which were 2 feet above the water level". In 1935, Walter drove the horses to help his Uncle Karl pull 7 lengths of rails onto the ice. He recalls during the summer "the ties and rails were on the bottom of the lake. The water was so low that Karl stood on the ties and pulled the spikes from around the rails. He jacked one end of the rail up so it extended above the water. When winter came they went out on the ice, chopped the exposed rail loose, and used the horses to pull the rails to shore". Walter remembers a number of hoist poles extending 10 to 12 feet above the water. Three logs were chained together to form tripods to support booms, which lifted logs from the lake to the rail cars that had been backed out over the lake. Just a few years ago Norman Ford saw one of these tripods on the bottom on a sandbar NW of the pilings. In the past years it has been common to have 2 to 3 feet of water over the pilings. By the accounts of Oliver and Walter the lake was 4 to 5 feet lower during the 1930's. In order to construct the railroad across pilings and operate lift-booms the lake level had to be that low during the logging days of the late 1890's. In December of 2001 only 9 inches of water covered the pilings.

Of some interest is this fact: During these periods of low lake levels is when great numbers of fish were spawning in the creeks and rivers. The 1998 study had this to say: "Dams on the outlet of Little Bowstring Lake have caused water levels to rise and may be degrading water quality" (as noted in the 1996 DNR Lake Survey Report). In addition, beaver management could potentially increase the quality of walleye spawning habitat.

Water Quality - Additional data

a. Temperature and Stratification - Little Bowstring is deep enough to experience mixing or "turnover" in spring and fall. When this occurs, the entire water column mixes, including the very bottom.

b. Stratification and Oxygen - The primary source of oxygen in a lake is from the atmosphere. At turnover all the lake's water is exposed to the atmosphere. However, once stratification starts, the wind only effectively mixes the surface water of the lake. The bottom portion is isolated from the atmosphere, so it has non-source of additional oxygen. At this level bacteria breaks down organic matter, using up oxygen in the process. Heavy algae growth on the surface aggravates the depressed oxygen concentrations on the bottom. Little Bowstring exhibits this condition in July with summer kills of tullibee and whitefish.

c. Oxygen and Release of Materials from the Sediment - Under low oxygen conditions Iron, magnesium, hydrogen sulfide, methane, mercury, ammonia and phosphorus may be released from the sediment into overlying water. This process is called internal loading. At turnover these materials are mixed into the entire lake. Sampling indicates internal loading of phosphorus occurs in Little Bowstring. This material becomes available for even greater algae growth. Elevated phosphorus concentrations about 5.6 times greater than surface concentrations were observed in the lake's lower levels.

d. Phosphorus - Typical ranges for lakes In the Northern Lakes and Forest Ecoregion is 14.0 to 27.0 ppb. Since phosphorus is not very soluble it does not readily dissolve in water. Therefore algae and plant growth in water is usually limited by the availability of phosphorus. If it increases, algal populations will increase. Other than natural sources, phosphorus can come from surface runoff of fertilizers, septic systems, feed lots and pastures. The mean growing season total phosphorus concentrations in Little Bowstring's surface water was 26 ppb in 1998. This concentration is typical for the region. The bottom concentration in the spring was 25.79 ppb and rose to 345.57 ppb later in the year. This concentration, following spring and fall turnover and wind mixing contributes to rapid algal growth.

d. Chlorophyll-A - This is a measure of the amount of algae in a lake. Typically this is found in the surface waters, but when it dies settles to the bottom where the decay process will break it down. This consumes the oxygen, leading to internal loading of phosphorus, which in turn promotes more algal growth. The mean chlorophyll-a for 1998 in Little Bowstring was 10.0 ppb. This value is greater than the typical concentrations of other lakes in the ecoregion, 0 to 10 ppb.

e. Water Clarity - Secchi Disc Transparency - This simple test has been established to measure water quality because abundant algae makes the water cloudy, limiting water clarity. Secchi disc reading averaged 7.4 feet in 1998; this is below the typical range for the ecoregion of 8.2 to 13.8 feet. Some years the average has been below 4.0 feet, but again this could be based on one sample for the year in late summer.

f. Nitrogen - Ammonia and nitrate nitrogen are major plant nutrients and can stimulate the growth of aquatic plants and algae. The presence of elevated amounts of nitrogen usually indicates human activity, septic systems, agricultural waste, fertilization, and erosion. Again these elements find their way into the bottom of the lake and during turnover spur aquatic growth. Total nitrogen in Little Bowstring was 658.5 ppb. This is above the average of other lakes in the ecoregion, 500 to 600 ppb.

g. pH and Alkalinity - These factors are important because these chemical parameters affect the lake ecosystems by inhibiting survival of fry and increasing toxicity of ammonia. Little Bowstring has a past alkalinity of 138 ppm. It has a pH of 8.3 and is not susceptible to pH swings, which is a positive factor. Typical ground water has a pH of 7.0 to 7.8.

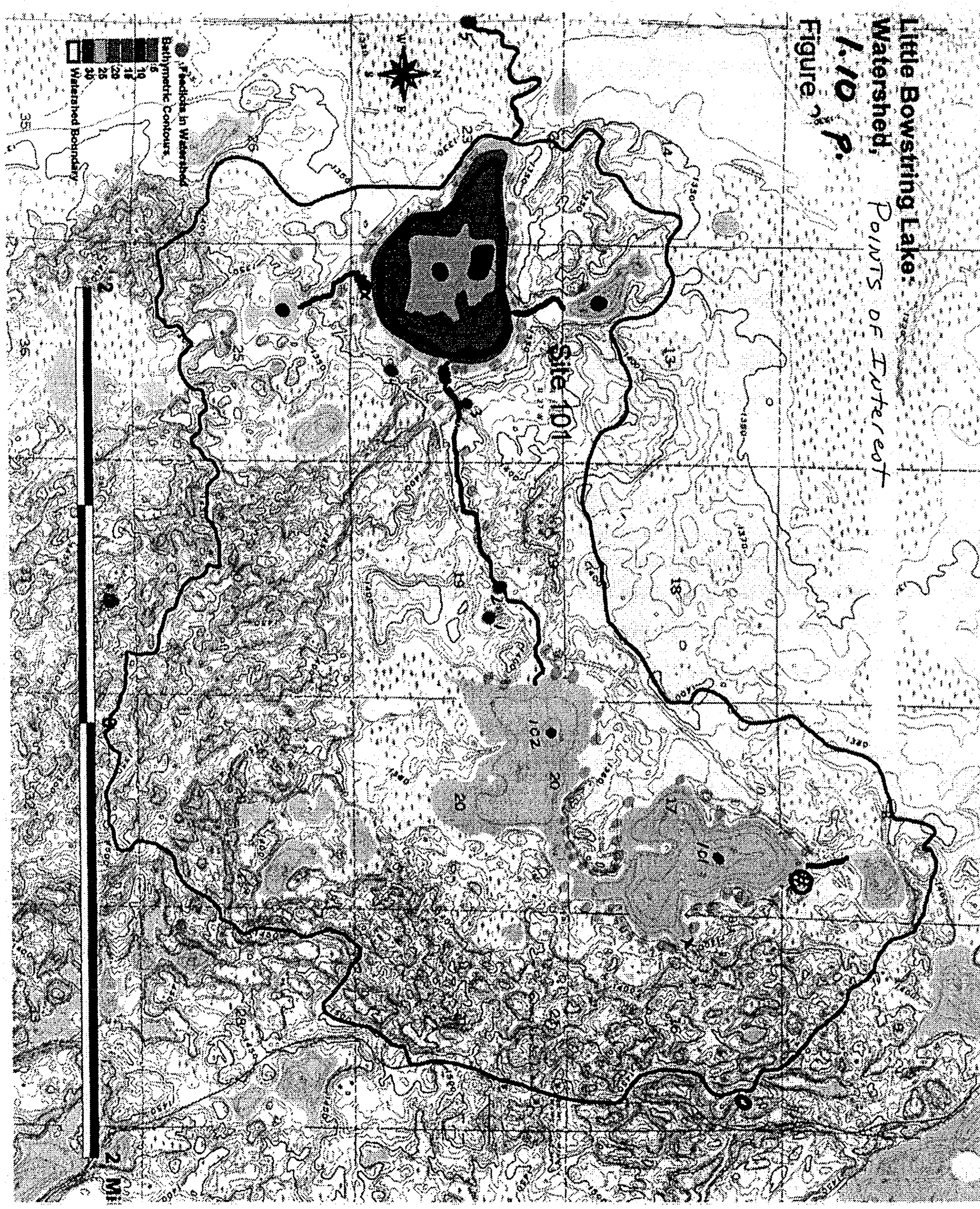
Recommendations - Based on the 1998 sampling conducted as part of the Itasca County Soil and Water Conservation District Lake Assessment Program seven recommendations were provided.

1. Continue to monitor Secchi disc transparency in a least one location, within the main basin of the lake, at a minimum of weekly from June 1 to September 5, or ideally until October 1st. A mean summer Secchi disc reading of 3.39 feet should be established as a baseline for additional evaluation or investigation. Every 5 to 7 years, total phosphorus and chlorophyll-a concentrations, Secchi disc transparency, pH, and oxygen/temperature profiles should be monitored monthly, May through September. Mean seasonal concentrations for total phosphorus at the surface should not exceed 26 ppb; mean chlorophyll-a should not exceed 10 ppb.

2. To prevent future problems, the local zoning and building ordinances should be strongly adhered to, especially in proper sizing, placement, operation and maintenance of septic systems for the residences in the watershed and shoreline areas. Existing systems should be Inspected and upgraded when necessary In accordance with code or when nutrient loading is suspected.
3. If Secchi disc reading change dramatically need to locate sources of nutrient and sediment loading and eliminate it.
4. Take a pro-active stance to prevent eutrophication problems before they arise, such as: up grade under sized septic systems, maintain shore land vegetation, limit shoreline runoff, control erosion sites, maintain buffer strips, establish grassed waterways in areas of erosion, exclude cattle from waterways, establish best management practices during logging, be compliant with all permits, establish safe areas to transfer fuels, inspect for exotic plants and animals, properly dispose of all waste, restrict use of fertilizer and pesticides near water, limit development of wetlands.
5. Continue efforts to remove beaver dams and control beaver populations.
6. Work with ICSWCD and Natural Resource Conservation Service to control livestock in the watershed.

APPENDIX B - Watershed Maps

1.10 Points of Interest Map



Map key next page.

Step 1 – *worksheets*

1.10 Optional In-depth Mapping Exercise: For homework or future activity with your larger group of citizens and/or citizen monitors.

Using a map of your watershed, work with others to identify what is already known about this land and water. Complete the 'watershed mapping' below. In the space after each activity, write down specific notes as to what has been outlined on your maps.

1) Using markers, outline stretches of the river and/or lake that have certain status or protection (use designations, current 303(d) listings, special designations (e.g. wild and scenic/canoe routes)

Marker color: blue Status/Protection:__Streams of Little Bowstring Watershed are marked in blue: Boy Creek from Boy to Grave Lake; Grave Creek from Grave to Little Bowstring; Spring Creek from Pike to Little Bowstring; Maki Creek from Maki to little Bowstring. The Bowstring River drains to the west from Little Bowstring

2) Identify with yellow dots where you and other members of your group live, major landmarks, etc. Also mark where you know certain parts of the river or lake are being used (e.g. scenic areas, places to picnic, historical)
   Yellow dots show the general location of cabins and homes.

   X shows location of Public Access.

   # indicates location of Forestry Swimming Beach (Sandy Beach)

Identify with green dots – areas of the watershed where you know "good things" are happening (e.g. conservation practices, previously addressed water quality concerns)

Sandy Beach maintained by SALA – provides porta-pottie

O Laurentian Divide Wayside Rest maintained by SALA.

. Grave Lake Site 101 and 102 – Secchi Disc Readings by SALA.

. Little Bowstring Site 101 – Secchi Disc Readings by SALA.

- SALA removed debris from Grave Creek to maintain walleye spawning area.

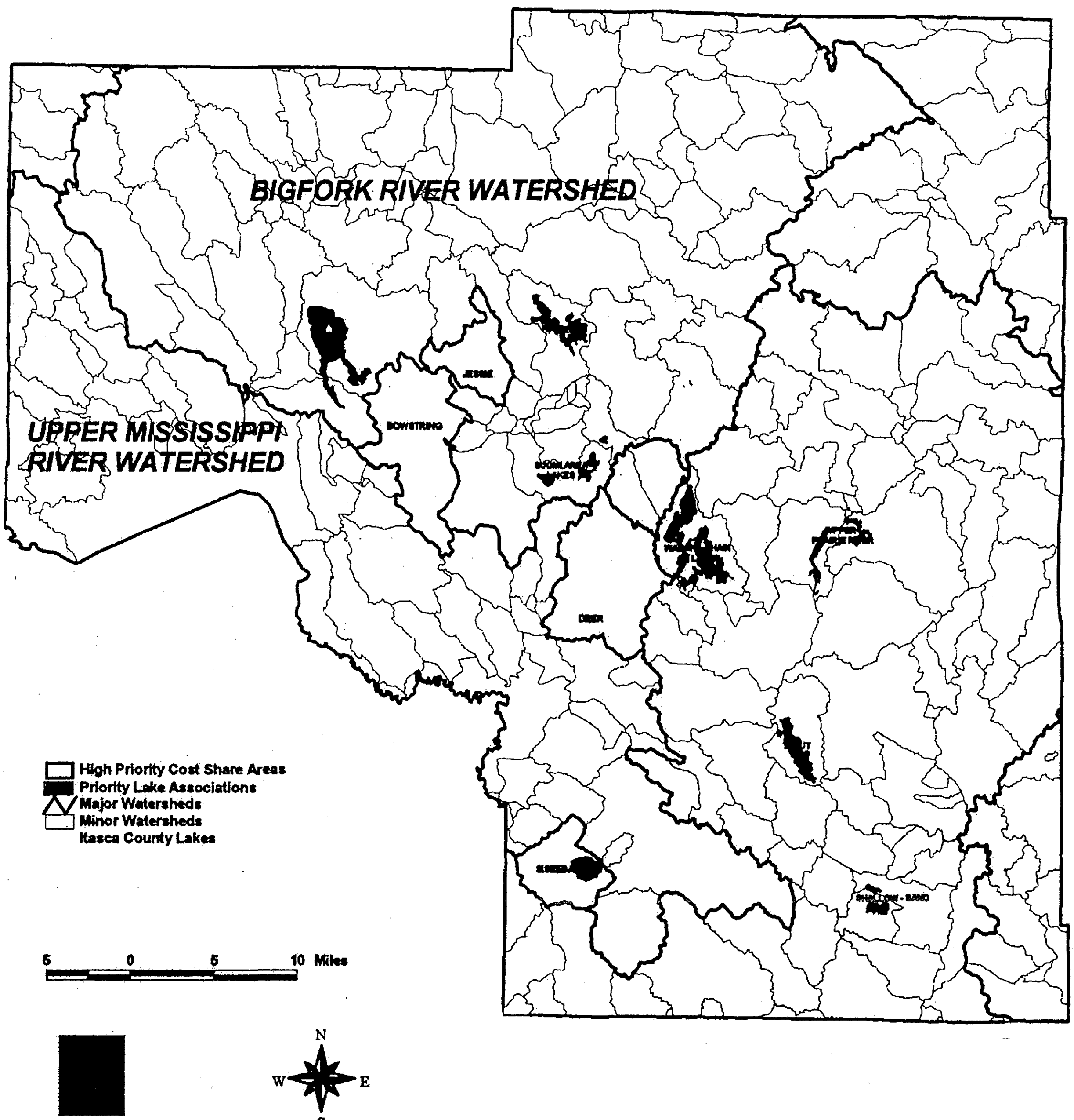
- SALA removed floating bog from Maki Creek mouth to maintain flow

3) Identify with red dots – areas of the watershed that you are concerned about (e.g. potential hot spots, pollution concerns)
   O1 Feedlot – cattle O2 Cattle access to Grave Creek O3 Feedlot – animals and fowl

   O4 Pasture – bison O5 Beaver dams on Bowstring River

4) Identify with blue dots areas that you are potentially interested in monitoring (this can change!)
   O Secchi Readings Maki and Pike Lake. Stream flow on Grave, Maki and Bowstring.

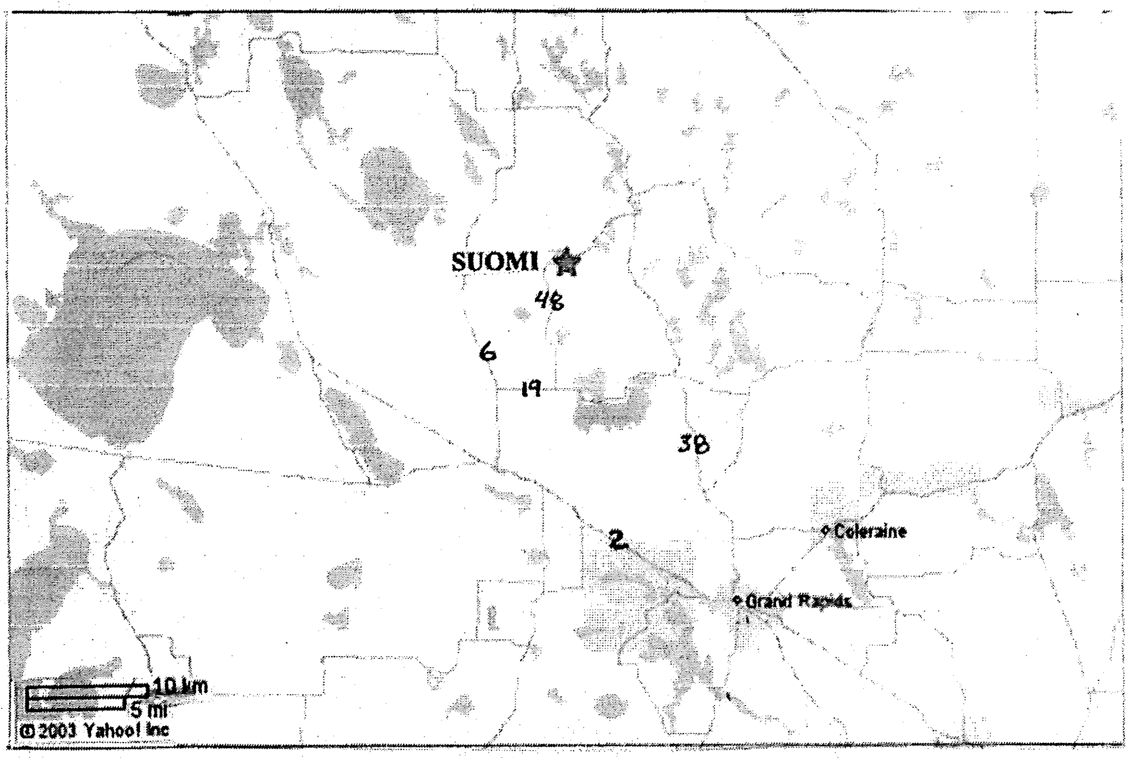
ITASCA COUNTY
SOIL AND WATER CONSERVATION DISTRICT
HIGH PRIORITY COST SHARE AREAS
YEAR 2001



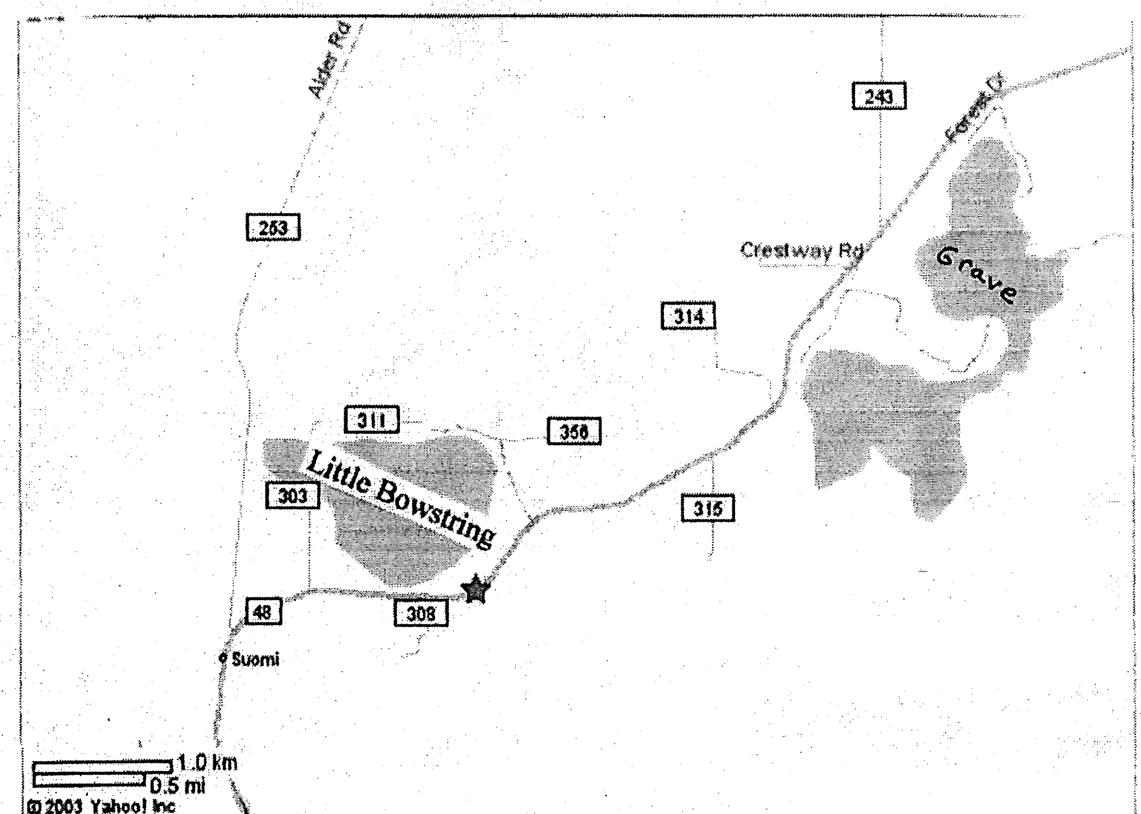
This information is a compilation of data from different sources with varying degrees of accuracy and requires a qualified field survey to verify.

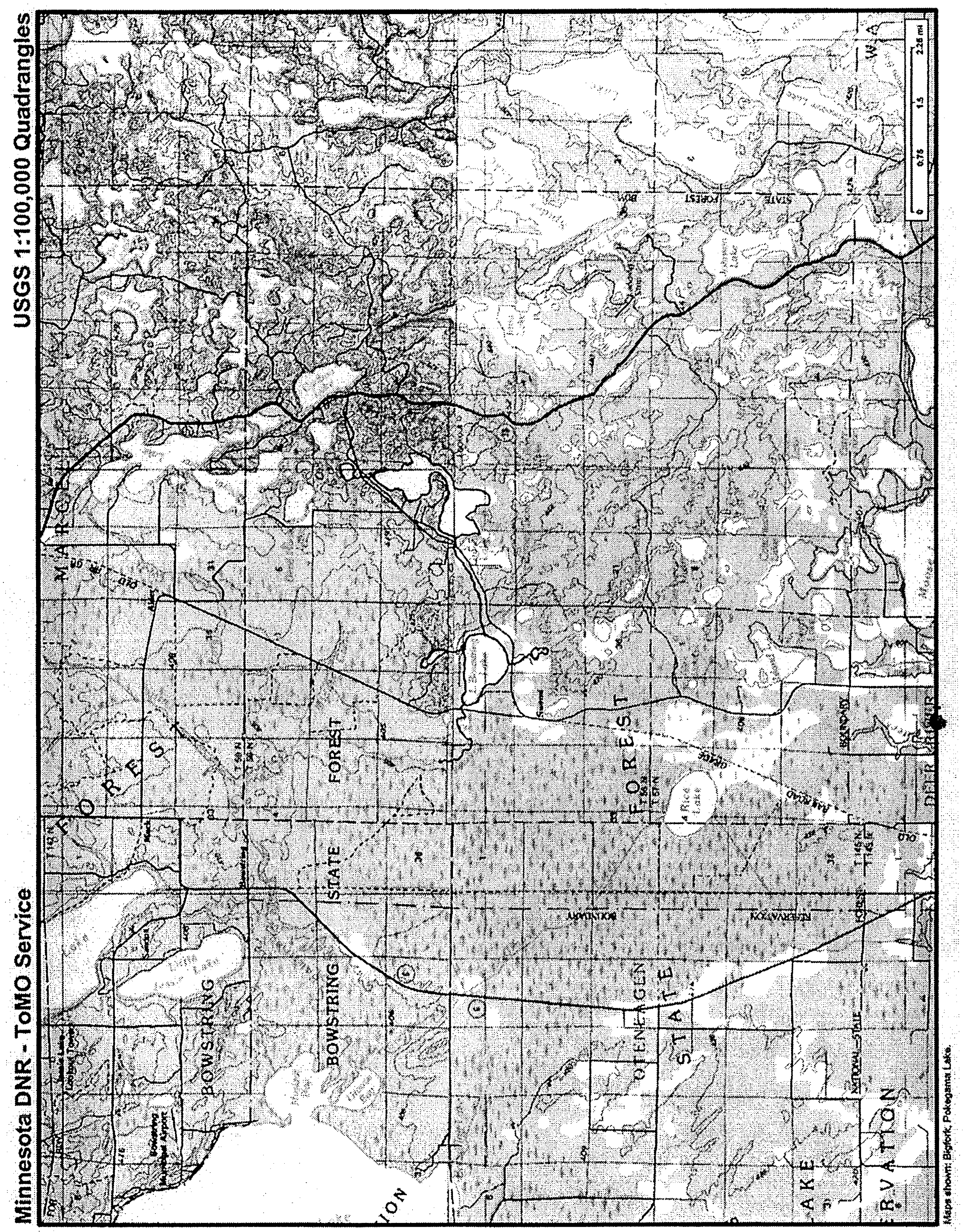
LITTLE BOWSTRING LAKE WATERSHED

Little Bowstring is located 28 miles NW of Grand Rapids and 13 miles N of Deer River.



County Roads in the Little Bowstring Watershed



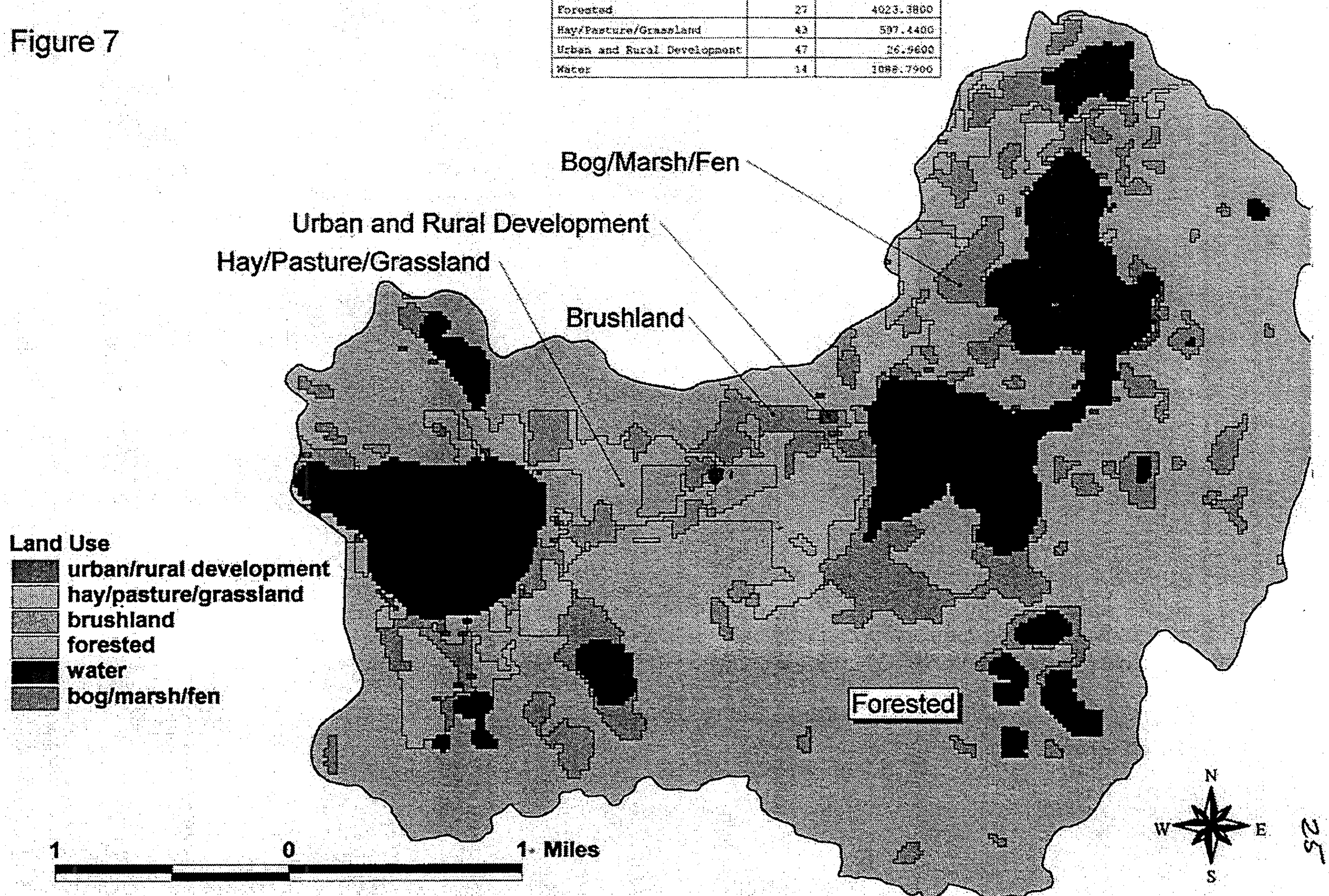

Minnesota DNR - ToMO Service
USGS 1:100,000 Quadrangles
BOWSTRING
STATE
FOREST
OTENEAGEN
Rice Lake
Maps shown: Bigfork, Pokegama Lake.

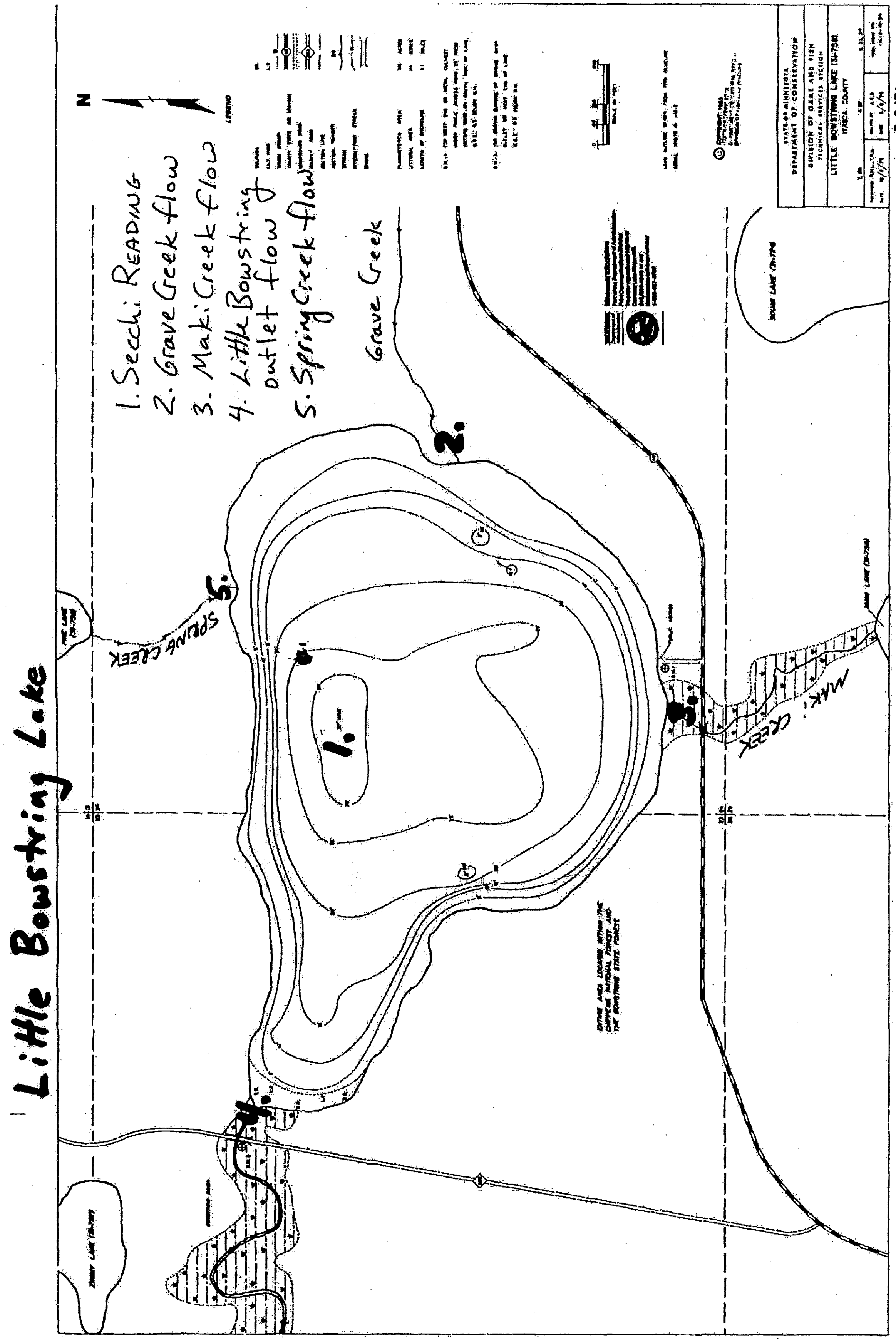
Satellite Map of Little Bowstring Watershed

Little Bowstrng Lake Watershed: Land Use

Figure 7

Land use	Count	Sum Acres
Bog/Marsh/Fen	67	543.5500
Brushland	25	236.3400
Forested	27	4023.3800
Hay/Pasture/Grassland	43	597.4400
Urban and Rural Development	47	26.9600
Water	14	1088.7900





Little Bowstring Lake
1. Secchi Reading
2. Grave Creek flow
3. Maki Creek flow
4. Little Bowstring outlet flow
5. Spring Creek flow
Grave Creek
Spring Creek
Maki Creek
STATE OF MINNESOTA
DEPARTMENT OF CONSERVATION
DIVISION OF GAME AND FISH
TECHNICAL SERVICES SECTION
LITTLE BOWSTRING LAKE (31-758)
ITASCA COUNTY
B-0474

Table I-2. QA/QC Summary Table - Handling and Preservation

Parameter	Minimum Recommended Sample Vol. (Ml or G)	Filtered (Type) or Raw Water	U.S. EPA Recommended Preservation Method [1]	Container Type	Container Preparation	U.S. EPA Recommended Hold Time [1]	NRRI Method	Detection Limit
Physical II								
Color	100	Raw: Apparent GF/C: True	Refrigeration @ 4°C	Plastic	48 hrs. MQW 3x MQW	48 hours	II.0.10 - II.0.11	5 color units
Conductivity	100	Raw	Refrigeration @ 4°C	Plastic	48 hrs. MQW 3x MQW	28 days	II.0.20	
Residue - Filterable (TDS)	200	GF/C	Refrigeration @ 4°C	Plastic	48 hrs. MQW 3x MQW	7 days	II.0.30	0.005 g
Residue - Total Suspended (TSS)	200	Filter on to GF/C	Refrigeration @ 4°C	Plastic	48 hrs. MQW 3x MQW	7 days	II.0.40	0.005 g
Residue - Total	200	Raw	Refrigeration @ 4°C	Plastic	48 hrs. MQW 3x MQW	7 days	II.0.50	0.005 g
Residue - Volatile (VSS)	200 or 2 g	Filter on to GF/C	Refrigeration @ 4°C	Plastic	48 hrs. MQW 3x MQW	7 days	II.0.60	0.005 g
Turbidity	100	Raw	Refrigeration @ 4°C	Cubitainer	48 hrs. MQW 3x MQW	24 hrs.	II.0.70	0.10 NTU
Parameter	Minimum Recommended Sample Vol. (Ml or G)	Filtered (Type) or Raw Water	U.S. EPA Recommended Preservation Method [1]	Container Type	Container Preparation	U.S. EPA Recommended Hold Time [1]	NRRI Method	Detection Limit
SOD			Refrigeration @ 4°C	Plastic	48 hr. MQW 3x MQW	No Holding	IV.0.20	1 mg/L
Biological								
Chlorophyll	1000 [5]	Filter on to	Frozen filter	Foil	48 hr. MQW	14 days	VII.0.10	.001 abs.

Table I-2. Continued.

Parameter	Minimum Recommended Sample Vol. (Ml or G)	Filtered (Type) or Raw Water	U.S. EPA Recommended Preservation Method [1]	Container Type	Container Preparation	U.S. EPA Recommended Hold Time [1]	NRRI Method	Detection Limit
Ortho-Phosphorus (Auto)	100	0.45 µm	Refrigeration @ 4°C	Plastic	48 hr. MQW 3x MQW	48 hr.	IV.3.01	0.005 mg/L
Ortho-Phosphorus (Manual)	100	0.45 µm	Refrigeration @ 4°C	Plastic	48 hr. MQW 3x MQW	48 hr.	IV.3.00	0.002 mg/L
Total Phosphorus (Manual)	100	Raw	Refrigeration @ 4°C	Plastic	48 hr. MQW 3x MQW	24 hr.	IV.3.00	0.002 mg/L
Total Phosphorus (Auto)	100	Raw	Refrigeration @ 4°C	Plastic	48 hr. MQW 3x MQW	24 hr.	IV.3.10	0.005 mg/L
Bio-A-Phosphorus	100g sediment [3] 20 g trap [3]		Refrigeration @ 4°C	Plastic	48 hr. MQW 3x MQW	28 days	IV.3.20	0.002 mg/L
Sediment TP By Digest	100g sediment [3] 20 g trap [3]		Refrigeration @ 4°C	Plastic	48 hr. MQW 3x MQW	28 days	IV.3.21	0.002 mg/L
Sediment TP By Ignition	100g sediment [3] 20 g trap [3]		Refrigeration @ 4°C	Plastic	48 hr. MQW 3x MQW	28 days	IV.3.22	0.002 mg/L
Anions by Dionex V								
Chloride	100	0.45 µm	Refrigeration @ 4°C	Plastic	48 hr. MQW 3x MQW	7 days	V.0.10	.01 mg/L
Nitrate	100	0.45 µm	Refrigeration @ 4°C	Plastic	48 hr. MQW 3x MQW	48 hr.	V.0.10	0.01 mg/L
Nitrate-Nitrite [2]	100	0.45 µm	Refrigeration @ 4°C	Plastic	48 hr. MQW 3x MQW	48 hrs.	IV.1.20	Lachat 0.003 mg/L
Oxygen Dissolved	300	Raw	Determine on-site	Glass	48 hr. MQW 3x MQW	No holding	IV.2.00	Winkler: .025 mg/L
pH - Open	200	Raw	Refrigeration @ 4°C	Plastic	48 hr. MQW 3x MQW	8 hr.	IV.2.10	± 0.1 unit
pH - Closed	200	Raw	Refrigeration @ 4°C	Plastic syringe	48 hr. MQW 3x MQW	8 hr.	IV.2.11	± 0.1 unit

Table I-2. QA/QC Summary Table - Handling and Preservation

Parameter	Minimum Recommended Sample Vol. (Ml or G)	Filtered (Type) or Raw Water	U.S. EPA Recommended Preservation Method [1]	Container Type	Container Preparation	U.S. EPA Recommended Hold Time [1]	NRRI Method	Detection Limit
Physical II								
Color	100	Raw: Apparent GF/C: True	Refrigeration @ 4°C	Plastic	48 hrs. MQW 3x MQW	48 hours	II.0.10 - II.0.11	5 color units
Conductivity	100	Raw	Refrigeration @ 4°C	Plastic	48 hrs. MQW 3x MQW	28 days	II.0.20	
Residue - Filterable (TDS)	200	GF/C	Refrigeration @ 4°C	Plastic	48 hrs. MQW 3x MQW	7 days	II.0.30	0.005 g
Residue - Total Suspended (TSS)	200	Filter on to GF/C	Refrigeration @ 4°C	Plastic	48 hrs. MQW 3x MQW	7 days	II.0.40	0.005 g
Residue - Total	200	Raw	Refrigeration @ 4°C	Plastic	48 hrs. MQW 3x MQW	7 days	II.0.50	0.005 g
Residue - Volatile (VSS)	200 or 2 g	Filter on to GF/C	Refrigeration @ 4°C	Plastic	48 hrs. MQW 3x MQW	7 days	II.0.60	0.005 g
Turbidity	100	Raw	Refrigeration @ 4°C	Cubitainer	48 hrs. MQW 3x MQW	24 hrs.	II.0.70	0.10 NTU
Inorganic, Metallic III								

Table I-2. Continued.

Parameter	Minimum Recommended Sample Vol. (Ml or G)	Filtered (Type) or Raw Water	U.S. EPA Recommended Preservation Method [1]	Container Type	Container Preparation	U.S. EPA Recommended Hold Time [1]	NRRI Method	Detection Limit
Iron (soil)	125	Raw: Total 0.45 µm: Dissolved	0.5% Nitric Acid	Plastic	15% HNO_3 - 24 hrs, 4x MQW, 24 hrs MQW, 2x MQW	6 mo.	III.2.50	0.1 µg/L
Iron (water)	125	Raw: Total [6] 0.45 µm: Dissolved [7]	0.5% Nitric Acid	Plastic	15% HNO_3 - 24 hrs, 4x MQW, 24 hrs MQW, 2x MQW	6 mo.	III.2.51-III.2.52	0.1 µg/L
Inorganic, Non-metalics IV								
Acidity	200	Raw	Refrigeration @ 4°C	Plastic	48 hrs. MQW 3x MQW	24 hrs.	IV.0.10	0.5 mg as $CaCO_3$
Alkalinity (ANC)	200	Raw	Refrigeration @ 4°C	Plastic	48 hrs. MQW 3x MQW	24 hrs.	IV.0.20-IV.0.25	0.5 mg as $CaCO_3$
Dissolved	50	Raw	Refrigeration @	Plastic	48 hrs. MQW	24 hrs.	IV0..30-IV.0.31	0.5 mg/L

Inorganic, Metallic III

Table I-2. Continued.

Parameter	Minimum Recommended Sample Vol. (Ml or G)	Filtered (Type) or Raw Water	U.S. EPA Recommended Preservation Method [1]	Container Type	Container Preparation	U.S. EPA Recommended Hold Time [1]	NRRI Method	Detection Limit
Iron (soil)	125	Raw: Total 0.45 µm: Dissolved	0.5% Nitric Acid	Plastic	15% HNO_3 - 24 hrs, 4x MQW, 24 hrs MQW, 2x MQW	6 mo.	III.2.50	0.1 µg/L
Iron (water)	125	Raw: Total [8] 0.45 µm: Dissolved [7]	0.5% Nitric Acid	Plastic	15% HNO_3 - 24 hrs, 4x MQW, 24 hrs MQW, 2x MQW	6 mo.	III.2.51-III.2.52	0.1 µg/L
Inorganic, Non-metalics IV								
Acidity	200	Raw	Refrigeration @ 4°C	Plastic	48 hrs. MQW 3x MQW	24 hrs.	IV.0.10	0.5 mg as $CaCO_3$
Alkalinity (ANC)	200	Raw	Refrigeration @ 4°C	Plastic	48 hrs. MQW 3x MQW	24 hrs.	IV.0.20-IV.0.25	0.5 mg as $CaCO_3$
Dissolved Inorganic Carbon	50	Raw	Refrigeration @ 4°C	Plastic syringe	48 hrs. MQW 3x MQW	24 hrs.	IV0..30-IV.0.31	0.5 mg/L

Lake/Lake ID: ____________________ Recorders: ____________________

Station/Site: ____________________ Date: __________ Time: __________

Instruments: ____________________ Secchi (ft): ____________________

Air Temp (F): ____________________ Water color/Algae?: ____________________

Wind (mph)/Dir: ____________________ Lake gauge: ____________________

Sky: ____________________ Zmax @ site(m): ____________________

x sample collected ☒ EC Temperatrue Compensated ☐ EC Uncompensated

x	Depth (m)	Temp (C)	pH	DO (mg/l)	DO % SAT	EC25 (uS/cm)	SAMPLE ID/DEPTH		
								Top	Bottom
							TP		
							OP		
							TN		
							NO2NO3		
							NH4		
							CHL-A		
							COLOR		
							ANC		
							CATIONS		
							ANIONS		
							Fe		
							OTHER		

Notes:

STREAM DATA SHEET

SAMPLERS ____________

STREAM				STREAM				STREAM			
DATE		TIME		DATE		TIME		DATE		TIME	
NO.	LEVEL	F/S	MAX FT	NO.	LEVEL	F/S	MAX FT	NO.	LEVEL	F/S	MAX FT
1	0.2			1	0.2			1	0.2		
	0.6				0.6				0.6		
	0.8				0.8				0.8		
2	0.2			2	0.2			2	0.2		
	0.6				0.6				0.6		
	0.8				0.8				0.8		
3	0.2			3	0.2			3	0.2		
	0.6				0.6				0.6		
	0.8				0.8				0.8		
4	0.2			4	0.2			4	0.2		
	0.6				0.6				0.6		
	0.8				0.8				0.8		
5	0.2			5	0.2			5	0.2		
	0.6				0.6				0.6		
	0.8				0.8				0.8		
6	0.2			6	0.2			6	0.2		
	0.6				0.6				0.6		
	0.8				0.8				0.8		
7	0.2			7	0.2			7	0.2		
	0.6				0.6				0.6		
	0.8				0.8				0.8		
8	0.2			8	0.2			8	0.2		
	0.6				0.6				0.6		
	0.8				0.8				0.8		
9	0.2			9	0.2			9	0.2		
	0.6				0.6				0.6		
	0.8				0.8				0.8		

Average

FLOW DETERMINATION		FLOW DETERMINATION		FLOW DETERMINATION	
INCREMENTS		INCREMENTS		INCREMENTS	
STRM WDTH (FT)		STRM WDTH (FT)		STRM WDTH (FT)	
AVG DEPTH (FT)		AVG DEPTH (FT)		AVG DEPTH (FT)	
AREA (FT2)		AREA (FT2)		AREA (FT2)	
VELOCITY (FT/S)		VELOCITY (FT/S)		VELOCITY (FT/S)	
FLW FT3/S (VEL X AREA)		FLW FT3/S (VEL X AREA)		FLW FT3/S (VEL X AREA)	

PARAMETERS			PARAMETERS			PARAMETERS		
COND/pH			COND/pH			COND/pH		
D.O./TEMP			D.O./TEMP			D.O./TEMP		
TP			TP			TP		
OTHER			OTHER			OTHER		
STAFF GAUGE LEVEL			STAFF GAUGE LEVEL			STAFF GAUGE LEVEL		

Request for Implementation Funding

Congratulations on finishing your monitoring plan. We hope to make this next phase as painless as possible. Please submit your funding request using the form below as soon as possible. The request may be for up to $3000.

A. **Name and contact information** (checks will be made out to your organization, - please note if the check should be sent with attention to another person, if different from the contact:)

   Norman Ford - President Suomi Area Lakes Association
   42307 County Road 48
   Deer River, MN 56636

B. Write a Brief Description of your citizen-monitoring project (You should be able to take this out of your Introduction Narrative in the monitoring plan – 1 paragraph maximum.)

Suomi Area Lakes Association will monitor the waters of the Little Bowstring Watershed. This will include the lake and its feeder streams (Grave, Spring and Maki Creek), as well as the lake's outlet to the Bowstring River. Six monitoring sites will be used to collect TP and stream flow to determine mass budget for Little Bowstring. Little Bowstring will be monitored for chemical and physical properties. At issue is the water quality of the watershed based on historical nutrient input and current influence of cattle within the watershed.

C. Total Amount requested (up to $3000): $3000.00

D. Budget from Step 11: (Please attached the table of your budget, highlighting the budget items that will be covered by this grant, with estimates of what specific items will cost. If not specified in the budget, please listed what specific items will be funded by this grant) Please also attach your In-kind/ Other contributions. **See next page.**

E. Expected date that funds will be used (month/year) – (We are encouraging funds to be spent by March 30, 2005 to align with our reporting requirements for these funds).

Date: February 1, 2005

BUDGET

11.4 Over-all Budget

Revenues:

Item	Description	Budget
Healthy Lakes grant	One time only	$ **1884.00**
RCM/MLA grant	One time only	$ **3000.00**
Lake Association dues	Each year	$ **1275.00**
TOTAL REVENUE		**$ 6159.00**

Expenses:

Type of Expense	(unit price)	(number of units)	Budget	
Sampling = 1 lake site				
Chlorophyll-a & phaeophytin	33.10	10	**$ 331.00**	RCM/MLA
Hypolymnetic total phosphorus	15.30	9	**$ 137.70**	RCM/MLA
TKN & TP (Upper layer)	26.90	5	**$ 134.50**	RCM/MLA
Additional TP (Upper layer)	26.90	5	**$ 134.50**	RCM/MLA
Ammonia	10.80	3	**$ 32.40**	RCM/MLA
Nitrate + Nitrite	11.80	3	**$ 35.40**	RCM/MLA
Total suspended solids	15.90	3	**$ 47.70**	RCM/MLA
Sampling 6 stream site				
TP (12 times each)	15.30	(6sites x 12 = 70)	**$ 1071.00**	RCM/MLA
TP (4 Storm events)	15.30	(6sites x 4) = 24	**$ 367.20**	RCM/MLA
Other Costs				
Record Keeping - Software; Report Printing; Print Supplies	286.00 10.00 50.00	1 10 1	**$ 436.00**	HLP
Volunteer Training (SWCD)			**$ 300.00**	RCM/MLA
Equipment Rental (SWCD for DO, pH, Conductivity)			**$ 300.00**	RCM/MLA
Report Writing (SWCD)			**$ 108.60** **300.00**	RCM/MLA HLP
Manual Stream Flows (SWCD)			**$ 600.00**	HLP
Lake Modeling/Stream Rating Curves (SWCD)			**$ 400.00**	HLP
TOTAL EXPENSES 2004			**$ 4727.40**	

BALANCE (revenue minus expense): ***$1431.60***

In-Kind Contributions:

Item	Description	Value
Volunteer Mileage (2200 miles at $.36)	Sampling / Stream Gauge; Secchi Reading Training; Planning Sessions; Reporting	**$ 792.00**
Volunteer (200 Hours at $16.00)	Sampling / Stream Gauge; Secchi Reading	**$ 3200.00**
Volunteer (90Hours at $16.00)	2 people monitoring 2 rain gauges daily, April - September	**$ 1440.00**
SWCD	Technical Assist / Report	**$ 3125.00**
TOTAL IN-KIND VALUE		**$8557.00**

River Council of Minnesota
Minnesota Lakes Association
June 5, 2005

Little Bowstring Lake Watershed

Lake Monitoring Plan

The stated goal of the Watershed Study was:

> Suomi Area Lakes Association will monitor the waters of the Little Bowstring Watershed. This will include the lake and its feeder streams (Grave, Spring and Maki Creek), as well as the lake's outlet to the Bowstring River. Six monitoring sites will be used to collect TP and stream flow to determine mass budget for Little Bowstring. Little Bowstring will be monitored for chemical and physical properties. At issue is the water quality of the watershed based on historical nutrient input and current influence of cattle within the watershed.

In cooperation with Itasca County Soil and Water District Water Specialist Noel Griese ten sampling sessions were conducted on Little Bowstring Lake and Grave, Spring and Maki Creeks. Four members of SUOMI AREA LAKES ASSOCIATION recorded 340 stream gauge readings between March 28 and December 1, 2004. Additionally, rain gauge readings were taken during the same time period.

The NRRI Lab in Duluth conducted the analysis of samples taken from Little Bowstring and the three feeder creeks. The parameter and samples were: Chl (10), Phaeo (10), TP (120), TPTN (6), NH4-N (3), NO2/NO3-N (3), ANC (1), color (2), TSS (2). Seven members of SALA assisted in the collection of samples over the course of the study. At present Water Specialist Noel Griese and DNR Specialist Rian Reed are preparing an interpretive report based on the analysis of the collected data.

Stream flow was of interest as each stream provides water from dissimilar minor watersheds. Grave Creek carries water from a two basin 503 acre lake that flows through cattle grazing lands. TP sampling was conducted at three sites; before the pasture, below the pasture, and below a series of springs prior to entry into Little Bowstring. This provided a complex question: what was the water quality leaving Grave Lake, what affect does runoff from pasture have on water quality, and what changes occur with the water quality when it flows over a series of rock and gravel outcroppings laced with a heavy flow of spring water before entering the lake. In other words, do these natural features reduce the impact of agricultural runoff?

Spring Creek carries water from the 33 acre Pike Lake. This lake is entirely surrounded by forest and is spring fed. Secchi disc readings change considerable during heavy precipitation. The lake is surrounded by long steep slopes and a long wetland valley. During heavy runoff sand and gravel are discharged into the lake from a seam halfway up the side of an eastern slope.

Maki Creek drains the 41 acre Maki Lake. It has a very long narrow wetland with the long slopes of Suomi Hills. The Suomi Hills are the divide between the Mississippi and Rainy River drainage basins. The area of the south side of Maki Lake was logged a few years ago resulting in an increase in runoff and a decrease in Secchi disc readings. Maki Lake experiences rapids changes with heavy runoff. Stream flow is maintained year around as many springs are active on the east and south section of the lake. Once the water leaves Maki Lake it passes through bog lands to Little Bowstring. Maki Creek is impounded by two undersized culverts which are placed too high in roadbeds. During heavy runoff bog material is flushed into Little Bowstring.

During the heat of summer the water level of the 314 acre Little Bowstring continued to rise with very little rainfall. Grave, Pike and Maki Lakes have many springs which provide a continuous supply of water for stream flow. As summer progresses beaver in the Bowstring River add to the height of their dams therefore increasing the lake level. By removing beavers and dams we have reduced algal concentrations in late summer. Secchi disk readings improve with unrestricted flow of the Bowstring River.

SUOMI AREA LAKES ASSOCIATION undertook this study to gather "the facts" as to why Little Bowstring Lake had lower Secchi readings than Grave, Pike and Maki Lake. A number of people attributed the "pollution" to cattle in the watershed. The pasture lands in question belonged to members of the Lake Association. Bad feelings developed in the community. It was the goal of the SALA Board to conduct a scientific study and present the findings to the community and SALA members. The goal was to get everyone on the same page and go from knowledge, not emotion and falsehood. What have been the results? We have won some, and lost others. Many that joined the Lake Association did so to be a part of a community social organization; not an environmental watchdog.

What was a fun group has now become a divided suspicious organization with reduced participation even in social events. I personally feel the $3000 grant has been very costly to SUOMI AREA LAKES ASSOCIATION.

When Noel Griese and Rian Reed complete the Watershed Study a report will be made available for SALA and ICSWCD. A copy will be sent to Sandra Holm of Minnesota Lakes Association.

Norman Ford – President SUOMI AREA LAKES ASSOCIATION