TAMBLING LAKE
VILAS COUNTY

PHASE 2
LAKE PLANNING GRANT REPORT

DECEMBER 2001

completed by

TAMBLING LAKE ASSOCIATION

AND

RAND ATKINSON
AQUATIC RESOURCES, INC.

in cooperation with

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
LAKE PLANNING GRANT PROGRAM

Introduction

Tambling Lake is a 174 acre lake with an outflow that creates Tamblin Creek. Tamblin Creek flows 1/4 mile to Voyageur Lake of the Eagle River Chain in southeastern Vilas County, Wisconsin. Tambling Lake's maximum depth is 14' with an average depth of 7 feet. The shallow water shoreline area is primarily sand with the entire deep water bottom area covered with muck. Tambling Lake has relatively soft water with a very light brown water color.

The watershed is mainly forested with second growth northern hardwoods, but some of the shoreline has shrub-conifer bog areas. The direct drainage area is approximately 330 acres, while steep to moderately steep sandy hills dominate the surrounding landscape. There are currently 73 landowners with shoreline property. Dwellings are found on almost every property. Public access is from Rangeline Road which borders the lake on the southwest corner where Tamblin Creek exits the lake.

The shallowness and muck bottom areas of the lake have affected the use and management of the lake. Tambling Lake has an abundance of aquatic vegetation. It has had several periodic fish kills in the past.

In the 1995 and 1996 Tambling Lake Association, Inc. with it's consultant, Rand Atkinson of Aquatic Resources completed Phase 1 of the planning grant process. During this phase the resource history and the current conditions of the lake community of Tambling Lake were described . This inventory was used to develop recommendations for a comprehensive lake management plan. The goal of the Phase 2 proposal, was to take actions on the recommendations identified, and initiate further development of a comprehensive plan that enhances and restores the ecosystem of Tambling Lake.

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ACKNOWLEDGEMENTS

A special thanks to TIM MARISCH, lake association president, whose has ushered association members into the action phases of lake community management. He has hosted lake community get togethers, gathered water level information, conducted meetings, and directed the installation of the aeration system.

A thanks also must go out to JERRY BEHNKE who have taken a leadership position as treasurer and did a fine job of keeping grant and project budgets in line. Also he and his wife, JUDY, have taken the initiative to alter their shoreline to a more natural appearance as a example to other shoreline owners,. Also, thanks to GEORGE KALT whose editing abilities and tongue and cheek humor has created a great newsletter to keep all informed and laughing.

Another special thanks must go to the landowners and crews that have installed the first aeration system for Tambling Lake: To JOHN and ANNEGRET SWINGLE for there donation of money and a site for the first aeration system. To CHUCK GILMAN for his pledge for the use of his land for the second aeration system. To the fine crews that built the shelter for the compressor, organized the electrical service installment, donated boats and labor for the installation, and provided a comradeship that got things done! An acknowledgement to STEVE and MARLENE HODGDON for donating the cost of renting our mini backhoe to make installation a bit easier, so the crew could take the rest of the day off!

Rand Atkinson, Aquatic Resources, Inc. December 2001

INFORMATION AND EDUCATION

The development and use of effective information and education techniques are essential to the success of completing a lake management plan. Experience has shown that a project's success is not only dependent on a well- informed public but also on achieving public interest and involvement in carrying out the lake plan.

This Phase 2 planning grant proposal was discussed and voted on for submittal at the June 13, 1998 annual meeting. The grant was intended to facilitate the implementation of the recommendations made in Phase 1.

An overview of the planning grant proposal was presented to the Tambling Lake Association in the January 2000 newsletter TAMBLING LAKE NEWS in Volume 8, Issue 2 of January 2000 edited by George Kalt. This biannual newsletter includes a calender of lake events and information on lake ecology with articles written by the consultant and Vilas County Land & Water Conservation Department.

Activities of the Phase 2 planning grant were well underway by the annual Tambling Lake Association meeting on June 10, 2000. Low winter oxygen levels below the ice identified in the grant process prompted donations to try and get an aeration system in by the winter of 2000. The shoreline restoration demonstration plan was completed and presented to the Association members. A property owner's survey was also presented at this time to gather opinions on funding and implementing the lake plan. Diagrams detailing elevations and new configuration of the Tamblin Creek outlet were also presented.

The annual fishery and picnic was held on July 1, 2000 at the Tim Marisch residence, adjacent to the restoration site, to further facilitate planning grant activities and increase awareness of the lake's ecosystem.

Several planning grant activity articles were included in the TAMBLING LAKE NEWS October 2000, Volume 8, Issue 3. The process of installation of the aeration system was detailed and included a call for volunteers. An article on the results of the property owner's survey was also a component of this newsletter.

On November 25, 2000, a letter was sent by the president Tim Marisch to the property owner's explaining that early winter weather and permitting delays had postponed installation of the aeration system that fall. An emergency plan was considered and lake oxygen content was monitored,documented, and compared to winter and fish kill conditions of the past. The outlet areas- that had been cleaned out annually since the last fish kill five years ago- were also monitored for oxygen levels.

The annual Tambling Lake Association meeting on June 9, 2001 was focused on the planning grant activities with updates on the outlet restoration, planning for the aeration system, #1, and #2, installation and funding. The property owner's survey was discussed and direction was given for further management activities as related to the comprehensive plan. It was voted on, and approved to apply for a protection grant to partially fund plan activities which would include the second aeration system and fish stocking.

The annual fishery and picnic was held on July 7, 2001 at the Tim Marisch residence adjacent to the restoration site to further facilitate communication on planning grant activities and increase awareness of the lake's ecosystem.

The August 2001 edition of TAMBLING LAKE NEWS, Volume 10, Issue 1 detailed the aeration system installation at Site #1, introduced the Vilas County shoreline buffer restoration cost sharing program, published Vilas County's Lake Courtesy code, as well as provided a calendar of events for the 2001 and 2002 seasons.

A fall Tambling Lake Association board meeting was held on October 6,2001 following the clean out of the outlet. The meeting discussed planning grant activities including areas that follow: financing of lake plan, the installation of a legal barrier around the aeration hole, the final lake planning report, and the protection grant application.

A town board meeting was attended during the early grant process to explain the outlet restoration to the town. A town board member who lives on the lake received further communications through the newsletter, meetings, and other get together.

WATER RESOURCE RESTORATION AND APPRAISAL

Aeration System Planning

Introduction

Periodic fish winter kills are a documented problem in Tambling Lake. The resource inventory completed as part of the Phase 1 planning grant was able to assess the conditions of 1996 fish kill. It also found data that documented an outstanding fisheries resources exist between these periodic winter kill situations. The water chemistry evaluation and physical studies from the Phase 1 grant documented how low or no oxygen conditions under the ice have detrimental effects on recirculating nutrients into the food chain. All these facts pointed to a need for an oxygen circulation system for Tambling Lake under the ice.

New technologies in oxygen transfer and delivery as well as a new understanding of lake circulation makes aeration an economical and valuable lake restoration technique. The importance of dissolved oxygen to the aquatic community of fish, plankton, and plants and animals living in and on the bottom, is well documented. Aeration is an effective means of improving dissolved oxygen levels. In addition, aeration can lead to improved water quality by eliminating chemicals such as ammonia, hydrogen sulfide, manganese, and ferrous iron which currently accumulate in Tambling Lake. Although aeration has little direct effect on aquatic plants, it can lead to reduction and channeling of phosphorus, a critical plant nutrient , away from aquatic plants to other living organisms. The prevention of periodic fish winter kills is the first step in channeling much needed nutrients from bottom sediments to other living organisms, including fish and the live organisms they feed on.

The geological features identified in the inventory, the presence of spring seepage and flow towards the outlet, suggests that aeration can be an effective management tool in Tambling Lake. A sediment profile conducted in the Phase 1 inventory located two hard bottom seepage areas, below flocculent muck, where an aeration system might best be placed. One of these gravel areas is in the north bay of the lake and the second is in the southeast corner. These are major seepage areas beneath the lake bottom and introduction of oxygen should circulate the effects of the added oxygen beyond the immediate area.

Procedure

During this phase of the planning process, aeration system installation at the north location was planned and completed. The second system installation was planned. A diffuser/compressor system was installed at the north site and a second system is planned at the south site in 2002.

Oxygen levels, temperatures, ice cover periods, and ice and snow depths were monitored in during the winters of 1999-2000 and 2000-2001 at the aeration site locations, the deepest area of the lake, and at the outlet. The results are found in **Table 1a-c & Table 2 a -c**.

Results

January 13, 2000 In 1999 Tambling Lake did not freeze over until December 1. There was little snow cover and many days above freezing from December 1st until the date of the1st sampling. A thaw occurred the weekend before sampling but, for the three days immediately prior to sampling cold nights and high winds dropped temperatures to less than 15 oF. The deepest location in Tambling Lake had 8 inches of ice and 4" of wet snow. The data collected showed oxygen above 5 mg/l from top to bottom with percent of oxygen saturation ranging from 93 % just under the ice, to 43% at a depth of 12 feet. See **Table 1a**.

Near the northeast proposed aeration site there was 6" of poor slushy ice with 2" snow. This area of the lake is usually last to freeze in the fall and the first to thaw in the spring. A open seepage hole was within 10 feet of sampling hole. Oxygen below the ice was 11.29 mg/l at 79.2% saturation and fell to 5.1 mg/l and 41% saturation at 2' below the ice. Green elodea was found in the sample hole. With the thin ice and little snow cover photosynthesis from these plants was probably contributing to the oxygen level.

At the southeast proposed aeration site there was 8" of poor slushy ice covered by 2" of snow. This area is also one of the last areas to freeze and first to thaw. Oxygen below the ice was 15.45 mg/l and 108.8% saturation and dropped to 4.73 mg/l and 35.6% saturation at a depth of 4 feet.

At the outlet to Tamblin Creek an open channel was found both above and below the culvert under Rangeline Road. Dissolved oxygen was 12.61 mg/l and there was a saturation of 90.5%.

February 16, 2000 The air temperature during sampling was 20 oF. Eight inches of snowfall fell during the 24 hours prior to sampling. The deepest location in Tambling now had 16" inches of ice and 7" of wet snow with oxygen at 10.31 mg/l with 73% saturation just below the ice. Dissolved oxygen quickly dropped to 2.53 mg/l at 4' and continued to drop to 0.67 mg/l at 10 feet. See **Table 1b**.

Near the northeast proposed aeration site there was now 15" of poor ice with 11" of snow. Meter readings were hard to stabilize, it was observed that spring seepage could be effecting a steady reading. The range below the ice ran from 6.47 mg/ l dissolved oxygen at 45,5% saturation to 0.36 mg/ l and 2.3% saturation with temperatures only varying from 1.6 to 1.0 oC, respectively. At the top of the muck, at about 3', the temperature increased to 2.7 oC w/ 0.43 mg/l dissolved oxygen at 3.2% saturation.

At the southeast proposed aeration site there was 14" of ice covered by 8" of snow. Dissolved oxygen below the ice was 9.55 mg/l at 69.6% saturation and it dropped to 0.68 mg/ l and 5.3 % saturation at 6 feet. At the outlet to Tamblin Creek an open channel was found both above and below the culvert under Rangeline Road. Dissolved oxygen was 9.67 mg/l and the channel had a saturation of 68.4%.

March 14, 2000 An early thaw and unsafe ice prevented measurement of oxygen levels through the ice on this date. Air Temperature was 36 oF at the time sampling the outlet. The ice was covered by a a light coating of snow but clear ice from previous weeks of melting and freezing were evident. Dissolved oxygen at the exit from Tambling Lake was 12.93 mg/l at 97.4 % saturation. See **Table 1c**.

Table 1a. Tambling Lake Temperature & Oxygen Profiles 2000

Tambling Lake 1/13/2000 Lake Monitoring Sites		Temperature oC	Temperature oF	Dis. Oxygen mg/l	Saturation %	Conditions
SITE # 1						8" ice
Deep Spot	S'	0.8	33.4	13.3	92.7	4" snow
	2'	2.9	37.2	9.56	70.8	
	4'	3.8	38.8	8.1	61.3	
	6'	4.3	39.8	6.36	48.9	
	8'	4.4	40	5.93	45.8	
	10'	4.4	40	5.67	43.7	
	12'	4.4	40	5.63	43.3	
	13'Bottom					

Site#2- SE		Temperature oC	Temperature oF	Dis. Oxygen mg/l	Saturation %	Conditions
Proposed Aera-	S'	0.8	33.4	15.45	108.8	8"poor ice
tion Site	2'	2.5	35.8	11.45	84.2	-Slush on
	4'	4.4	40	4.73	35.6	surface
	4.5'B					2" snow

Notes: -Last freeze & first to thaw.
-Location verified in sediment profile, geology & soil investigations of Phase 1 Report

Site#3- NE		Temperature oC	Temperature oF	Dis. Oxygen mg/l	Saturation %	Conditions
Proposed Aera-	S'	0.6	33.2	11.29	79.2	6" poor ice
tion Site	2'	1.6	34.4	5.1	41	-Slush on
	3'B					surface
						2" snow

Notes: Last freeze & first to thaw.
-Location verified in sediment profile, geology & soil investigations of Phase 1 report.
- Open Seepage Hole w/in 10 feet of sampling hole, deer tracks leading to & away(used for drinking)
-Green Elodea in hole

Site#4-Outlet		Temperature oC	Temperature oF	Dis. Oxygen mg/l	Saturation %	Conditions
Above Culvert Tamblin Creek	1'	1.7	34.2	12.61	90.5	Open,Flowing

Notes: - Open water in channel above & below culvert

Weather: Air Temp: 15oF
Wind: 0-5mph
Cloud Cover: 100% but light
-Cold nights & below freezing windchill three days prior
-Thaw Weekend before
-Freeze up did not occur until December 1,1999

Samplers: Rand Atkinson
Tim Marisch

Table 1b. Tambling Lake Temperature & Oxygen Profiles 2000

Tambling Lake 2/16/2000 Lake Monitoring Sites		Temperature oC	Temperature oF	Dis. Oxygen mg/l	Saturation %	Conditions
SITE # 1						16" ice
Deep Spot	2'	1.2	34	10.31	73	7" snow
	4'	4	39	2.53	19.1	
	6'	4.2	40	1.5	11.3	
	8'	4.2	40	1.34	10.2	
	10'	4.5	40	0.67	5.1	
	11'B					
	13'Bottom					

		Temperature oC	Temperature oF	Dis. Oxygen mg/l	Saturation %	Conditions
Site#2- SE						
Proposed Aera-	2'	1.5		9.55	69.6	14" ice
tion Site	4'	3.7		1.43	10.9	8" snow
	6'	4		0.68	5.3	
	7'B					

Notes: -Last freeze & first to thaw.
-Location verified in sediment profile, geology & soil investigations of Phase 1 Report

		Temperature oC	Temperature oF	Dis. Oxygen mg/l	Saturation %	Conditions
Site#3- NE						
Proposed Aera-	2'	1 *		6.47*	45.5*	15" ice
tion Site	3'B	2.7		0.43	3.2	11" snow

*-would not stabilize for long: extremes 1.6oC,0.36 DO,2.3%Sat, spring seepage current thru muck

2'	1.2		10.31	73	
4'	4		2.53	19.1	
6'	4.2		1.5	11.3	
8'	4.2		1.34	10.2	
10'	4.5		0.67	5.1	
11'B					

		Temperature oC	Temperature oF	Dis. Oxygen mg/l	Saturation %	Conditions
Site#4-Outlet						
Above Culvert Tamblin Creek	1'	1.1		9.67	68.4	Open,Flowing

Notes: - Open water in channel above & below culvert

Weather: Air Temp: 20oF
Wind: 0-10 mph gusty
Cloud Cover: None
-8" snow 24 hrs prior

Samplers: Rand Atkinson
Shore Support: George Kalt

Table 1c. Tambling Lake Temperature & Oxygen Profiles 2000

Tambling Lake 3/14/2000 Lake Monitoring Sites		Temperature oC	Temperature oF	Dis. Oxygen mg/l	Saturation %	Conditions
SITE # 1		Bad Ice				
Deep Spot	2'					
	4'					
	6'					
	8'					
	10'					
	11'B					
	13'Bottom					

		Temperature oC	Temperature oF	Dis. Oxygen mg/l	Saturation %	Conditions
Site#2- SE						
Proposed Aeration Site	2'	Bad Ice				
	4'					
	6'					
	7'B					

Notes: -Last freeze & first to thaw.
-Location verified in sediment profile, geology & soil investigations of Phase 1 Report

		Temperature oC	Temperature oF	Dis. Oxygen mg/l	Saturation %	Conditions
Site#3- NE						
Proposed Aeration Site	2'					
	3'B	Bad Ice				
	2'					
	4'					
	6'					
	8'					
	10'					
	11'B					

		Temperature oC	Temperature oF	Dis. Oxygen mg/l	Saturation %	Conditions
Site#4-Outlet						
Above Culvert Tamblin Creek	1'	3.6		12.93	97.4	Open,Flowing

Notes: - Open water in channel above & below culvert

Weather: Air Temp: 36oF
Wind: 0-10 mph gusty
Cloud Cover: 100%
-Light Snow in night,3" over last few days
-ice clear from thaw prior

Samplers: Rand Atkinson & Nelli Atkinson

Aeration system locations were based on information gathered in the Phase 1 lake planning grant process. Soil surveys and sediment profiling located areas where glacial gravel outwash contacts the bottom of Tambling Lake. This are likely areas where spring seepage would be the greatest. Locating airlift systems at these specific spots will not only provide an oxygen refuge during winter kill situations but could also increase oxygen circulation.

Shoreline riparian zone owners closest to the proposed aeration sites were contacted, and electrical and operating requirements were explained. The exact locations of the compressor systems and shelters were identified based on the shoreline owner's concerns of easements, noise, esthetics, and shoreline use. Placement also considered the possibility of ice pushup mounding and shoreline wind and wave action. Two owners stepped forward to provide a location for the shoreline compressors.

Zoning permits were applied for and requirements were met in the placement of the first compressor unit. After meeting with Wisconsin Public Service representative, service was extended to the site after an electrician provided a meter base and electrical services to the compressor. A shelter design was created to protect the compressor from the elements, provide free circulation of air around the compressor, and meet the aesthetic requirements of the site.

A Department of Natural Resources permit was applied for on September 5, 2000 which included a description of the project and aeration system plan. More information was requested and the information was provided. The provided information can be found in **APPENDIX 1**. A permit was issued on November 22,2000, too late for installation in 2000 as ice up occurred the second week of November.

Water conditions under the ice were monitored monthly to assess the winter conditions of 2000-2001. Early and extended ice cover and heavy snowfall are usual conditions that lead to fish winter kill. The deepest area of the lake, the outlet , and the shoreline aeration areas were monitored.

January 16,2001 By this date 15" of ice and 6" snow had accumulated over the deepest water of Tambling Lake. Already oxygen was limited to just under the ice with 7.1 mg/ l at 2 feet and only 0.76 mg/ l at 4 feet. Outlet temperature and oxygen were both colder and higher respectively at 1.3 oC and 9.31 mg/ l of dissolved oxygen with a saturation of 66.1%. See**Table 2a**.

February 19, 2001 Ice increased to 17" and snow cover increased to 9" which was close conditions of the prior winter. Oxygen was much less, falling to 4.28 mg/l just below the surface and dropped sharply to the 9 foot bottom. Light ice covered the area directly upstream of the outlet culvert. Dissolved oxygen had decreased to 4.85 mg/ l at 34% saturation above the outlet culvert. See **Table 2 b**.

March 14, 2001 By this date there was 19" of ice and 4" of wet snow as late winter daily temperatures climbed above freezing. Dissolved oxygen levels just below the ice in the deepest spot now were at 3.69 mg/ l. In the rest of the water column oxygen levels decrease from 0.62 to 0.05 mg/ l from 4 to 11.8 feet. The outlet channel above the culvert was now open and 5.7 mg/ l of dissolved oxygen was found above the culvert. See **Table 2c.** Ice out occurred on April 20 & 21.

Table 2.a-c Tambling Lake Temperature Oxygen Profiles Winter2001

Tambling Lake Lake Monitoring Sites	1/16/2001	Temperature oC	Temperature oF	Dis. Oxygen mg/l	Saturation %	Conditions
Site # 1						
Deep Spot	2'	4	39	7.1	57	15" ice
	4'	4	39	0.76	5.7	6" snow
	6'	4.3	40	0.76	5.3	
	8'B					

		Temperature oC	Temperature oF	Dis. Oxygen mg/l	Saturation %	Conditions
Site#4-Outlet						
Above Culvert Tamblin Creek	1'	1.3	34	9.31	66.1	Open,Flowing

Notes: - Open water in channel above & below culvert

Weather: Air Temp: 10oF
Wind: 0-5mph
Cloud Cover: 100% but light
- No Fish in Dock Aeration Area
-Early Freeze up- Second Week in November

Samplers: Rand Atkinson

Table 2.a-c Tambling Lake Temperature Oxygen Profiles Winter2001

Tambling Lake Lake Monitoring Sites	2/19/2001	Temperature oC	Temperature oF	Dis. Oxygen mg/l	Saturation %	Conditions
Site # 1						17" ice
Deep Spot	2'	1.7	35	4.28	29.3	9" snow
	4'	3.3	38	0.42	3	
	6'	4.1	39	0.13	0.9	
	8'	4.5	40	0.06	0.5	
	9'B					
Site#4-Outlet						
Above Culvert Tamblin Creek	1'	1	34	4.85	34.1	Light Ice Above

Marisch		Temperature oC	Temperature oF	Dis. Oxygen mg/l	Saturation %	Conditions
Aerated Dock	1.5'	1.9	36	5.03*	36.1	Aerator on few minutes before

Weather: Air Temp: 20oF
Wind: West 0-5mph
Cloud Cover: 100%
- No Fish in Dock Aeration Area
-Early Freeze up- Second Week in November

Samplers: Rand Atkinson

Table 2.a-c Tambling Lake Temperature Oxygen Profiles Winter2001

Tambling Lake Lake Monitoring	3/14/2001 Sites	Temperature oC	Temperature oF	Dis. Oxygen mg/l	Saturation %	Conditions
Site # 1						19" ice
Deep Spot	2'	1.3	33	3.69	26.2	4"wet snow
	4'	3.1	38	0.62	4.6	
	6'	4.5	40	0.13	1	
	8'	4.8	40	0.08	0.6	
	10'	5.1	41	0.07	0.5	
	11.8'	5.5	41	0.05	0.4	
	12'8"B					
Site#4-Outlet		13:30				
Above Culvert Tamblin Creek	1'	33	5.2	5.2	37	Channel open

Marisch		Temperature oC	Temperature oF	Dis. Oxygen mg/l	Saturation %	Conditions
Aerated Dock	1.5'	1.8	35	3.13	22.6	Aerator on few minutes before

Weather: Air Temp: 35oF
Wind: calm
Cloud Cover: 50%
- No Fish in Dock Aeration Area
-Early Freeze up- Second Week in November

Samplers: Rand Atkinson

At the June 9, 2001 annual meeting a work schedule was set to install the aeration system on June 13th. On June 13th, the aeration lines and diffusers were installed and attached to the compressor. Compressor lines were buried beneath the shoreline and bed with the aid of a small tracked backhoe.

The installation of the second system has been delayed until 2002 as a Lake Protection Grant will be used to install the southeast aeration system. Cost of the installation was included in the DNR permit application and in the property owner's survey.

Tamblin Creek Outlet Restoration Planning

Introduction

At one time game fish, pan fish and minnows moved freely from Voyageur Lake of the Eagle River chain into Tambling Lake via Tamblin Creek. During winter oxygen depletion in 1995-96 fish were drawn to the outlet area but were kept from exiting the lake by several disturbances in that area including: shoreline fills that adversely effected shallow water lakeshore hydraulics and filled in the channel, periodic ice pushup mounds from easterly winds during spring ice out that also blocked the outlet, and a poorly placed, undersized culvert under the town road that collected sediment on the lake(upstream) side and prevented fish and forage fish from entering the lake on the downstream side. Historical records document that at one time walleye used the outlet area of Tambling Lake for spawning and migrations runs from the Eagle River Chain to this outlet area occurred every spring.

Also, Tamblin Creek, from Tambling Lake to it's outlet at Voyageur Lake, had become wider and shallower caused by the fallen woody debris in the second growth hardwood that it passes through. Lake association members have been successful in maintaining a deep central channel in Tamblin Creek by removal of this fallen debris every fall since 1996. They also have cleaned the area above the culvert to maintain a free flow from the lake during winter months.

The existing culvert has a plunge pool on the downstream side that prevents migration of fish into Tambling Lake. The culvert also appears to be in need of repair. The culvert has collapsed. The replacement of the outlet culvert, properly placed, would help the lake ecosystem in many ways.

Benefits to the fisheries would be a direct result of the replacement of this culvert therefore removing this present barrier to fish migration. It would allow the movement of both game and forage fish in and out of Tambling Lake. In combination with the proposed aeration system restoration project that would provide continuous oxygen levels, this management practice would increase the production of minnows and other aquatic organisms that game and pan fish feed on. With an unobstructed channel upstream and downstream from the culvert restoration area, and possible increased flows at the outlet, walleye spawning should once again occur in the outlet area. The excellent fisheries that existed in the 1975 could return again.

Water level restoration would benefit from a properly placed culvert by dropping water levels in the lake approximately 6 to 12 inches. This would reduce the hydrostatic head pressure on the spring seepage areas and should increase the flow and improve the water quality in Tambling Lake. Sandy shoreline areas important for fisheries habitat and recreational uses would likely increase as wave action and shoreline hydraulics would

change in these areas. The effects of periodic ice pushup mounds on the west and southeast shorelines should decrease.

The aquatic plant community could change back to a more diverse community that was present in 1975. The sandy areas would increase, causing an increase in emergent vegetation, which is important for fish spawning habitat and food organisms.

Results

On May 4, 2000 in cooperation with the Town of Washington, the existing roadbed, culvert, stream and lake bed elevations were profiled. **Table 3** describes outlet elevations beginning at the lake and extending to the Tamblin Creek bed below the culvert. The center of Rangeline Road assumed the elevation of 100.00 and all elevations corresponded to this point. The lake bottom just before entering the outlet channel at two locations was at 93.81 and 93.15. The inlet channel bottom elevations were as follows; approximately 75 feet upstream was at elevation 94.8; 50 feet upstream was at 96.02; 25 feet upstream was at 94.8; 10 feet upstream and at the inlet of the culvert was at 94.6. Therefore, the lake bottom actually rises to 96.02 feet elevation 50 feet upstream of culvert and drops to an elevation of 94.6 feet at the inlet to the culvert, which is 1.92 feet below the invert of the culvert (96.52). Water level of the lake, as measured from the invert of the culvert, was at 97.15.

Several obstructions were found in the inlet channel, a buried log 75' upstream and a concrete structure approximately 40 feet upstream. The top of each obstruction was at 95.73 and 96.48 feet respectively. Neither structure completely crossed the channel. The channel bottom between the log and concrete structure was matted with arrowhead root. It appeared that these obstructions maintain the water elevation of the lake.

The channel between the concrete structure and the outlet culvert is silted in with a flocullent soft silt. The maximum depth of the silt is 1.5 feet. It appears that the this area acts as a settling pool for organic matter leaving the lake.

On this same date a water level gauge was set up on the Marisch pier on the north side of Tambling Lake to monitor the normal fluctuations in Tambling Lake's water level during the open water period of Tambling Lake. In 2000 and 2001 lake levels were periodically recorded. Rain data from the Eagle River DNR ranger station was correlated with the water level data for analysis.

Question 4 of the Tambling Lake Property Owner's Survey explained the benefits of modifying the outlet and then asked, ""Would you favor modifying the outlet to drop the lake level approximately one foot?" " With a 49% response, 74% of the property owner's did not want the lake outlet restoration to lower the lake. With this understanding, the hydraulics of the present outlet, and it's response to lake and watershed precipitation and evaporation, was evaluated further so the restoration would not effect current lake levels.

In 2000, the water level of Tambling Lake varied from a minimum of 96.96 on June 16 to a maximum of 97.65 on July 10. See **Figures 1**. The rise to this maximum lake level corresponded to three successional weeks where rainfall ranged from 2 to 4 inches. See **Figure 2**. Tambling Lake has a fairly small surface area (174 acres) and nominal protected watershed with sandy soils(direct drainage area of 330 acres) which would coincide to the small fluctuation of water level of only 8" in 2000.

Table 3. Tambling Lake Outlet Elevations 5-4-2000

DESCRIPTION	TRANSECT READING		
	Actual	Conv.to Metric Ass.	Data**
1. Lake Sand Bottom, 30' East of Point #2.	7' 0"	7.000'	93.81
2.. Lake,Snd Bottom, perpend. to Channel & N. Pier(2-8'Secs.)	7' 8"	7.667'	93.15
3.. Inlet Channel,Top of Log,~75' Upstream(Tag Alder N. Bank)	5' 1"	5.083'	95.73
4..Inlet Channel,Snd Bottom,~75' Upstream(Tag Alder N. Bank)	6' 0"	6.000'	94.81
5. Inlet Channel,Snd Bottom 50' Upstream	4' 9.5"	4.792'	96.02
6.Top of Submerged Concrete Structure*	4' 4"	4.333'	96.48
7. Inlet Channel Bottom 25' Upstream	5' 10"	5.833'	94.8
8. Inlet Channel Bottom 10' Upstream	6' 2.5"	6.209'	94.6
9. Inlet Channel Bottom @ Culvert	6' 2.5"	6.209'	94.6
10. Invert of Culvert- Upstream	4' 3.5"	4.292'	96.52
11. Water Level Lake @ Culvert-Upstream	3' 8"	3.667'	97.15
12. Top of Culvert- Upstream	2' 11.5"	2.959'	97.85
13. Center of Road, Over Culvert	0' 9.75"	0.812'	100
14. Top of Culvert- Downstream	4' 2"	4.167'	96.65
15. Invert of Culvert-Downstream	5' 5.25"	5..428'	95.38
16. Plunge Pool- Downstream	5' 11"	5.917'	94.9
17. Rocked Outfall, 7' Downstream	5' 10.75"	5.895'	94.92
18. Gravel Riffle, 15' downstream	6' 0.5"	6.042'	94.77
19. Gravel Riffle 20' Downstream	6' 4.5"	6.375'	94.47
20. Gravel Riffle, 30' Downstream	6' 9.5"	6.792'	94.02
21. Ist Pool, ~ 50' Downstream	7' 0.75"	7.623'	93.19

** Assume Center of Road Elevation of 100.00
*Dimensions: ~ 10' x 12" x 14"

NOTES
Channel Width 10 to 40'
Present Squash Culvert Dimensions: 15" x 25" x 44' (18")

Culvert Options: H x W x L		Wausau Concrete: Steve Hackworth(6/5/2000)	
Dimensions	24" x 35" x 44' (30")	$26.25/foot	$1155.00
	29" x 42" x 44' (36")	$31.28/foot	$1376.32

Figure 1. Tambling Lake Water Elevations in 2000.

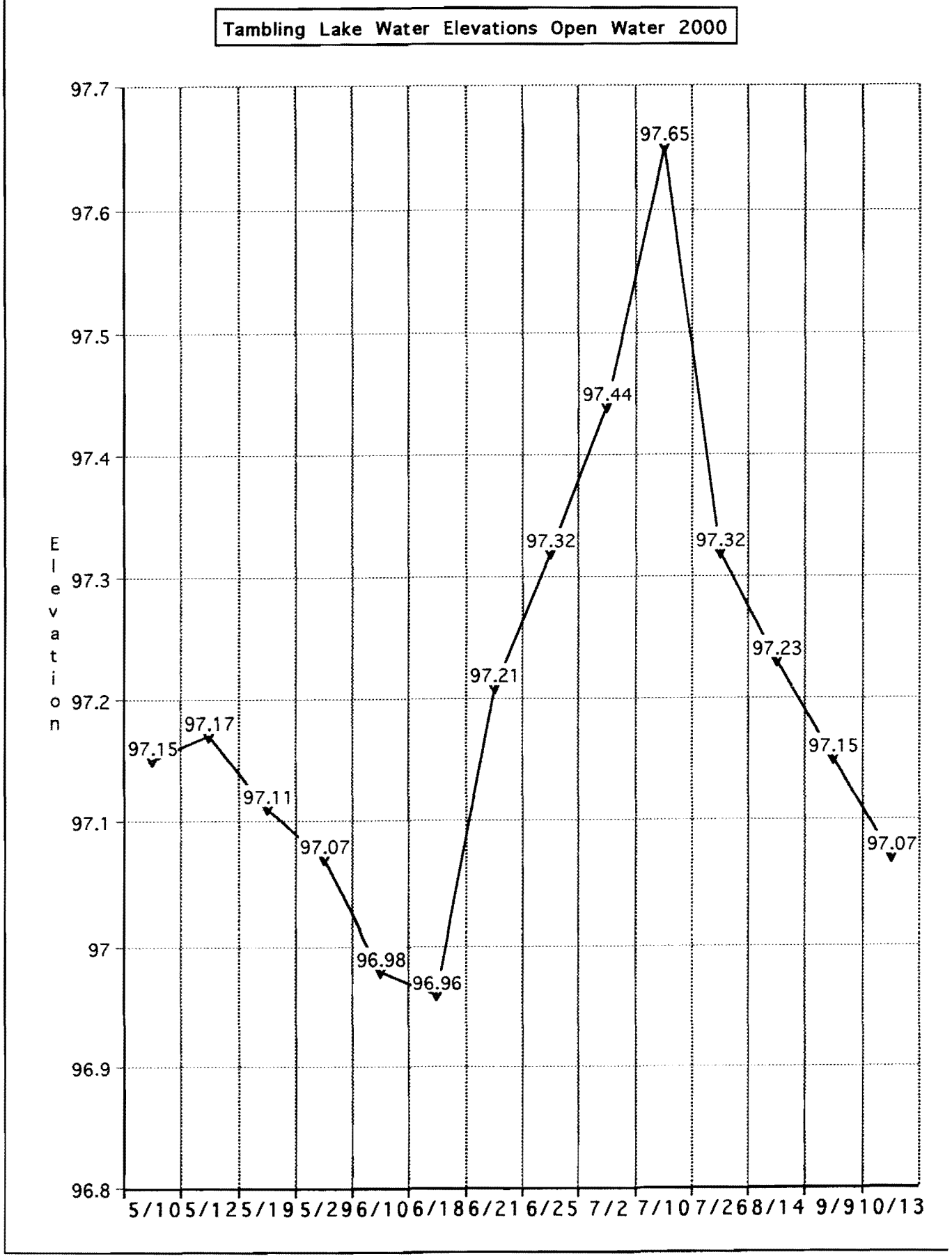


Figure 2. Tambling Lake's Weekly Open Water Precipitation in 2000.

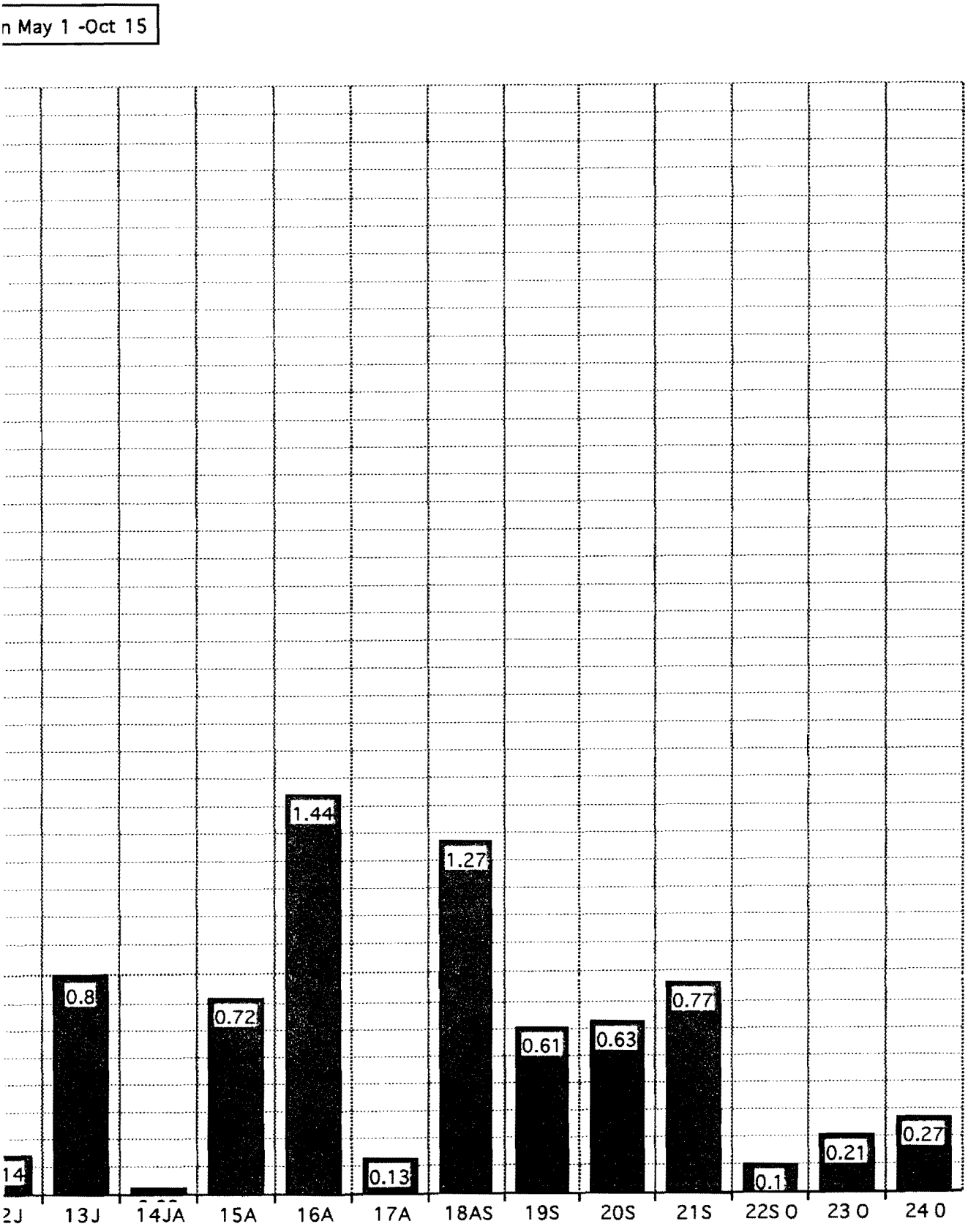


Figure 3. Tambling Lake Water Elevations 2001

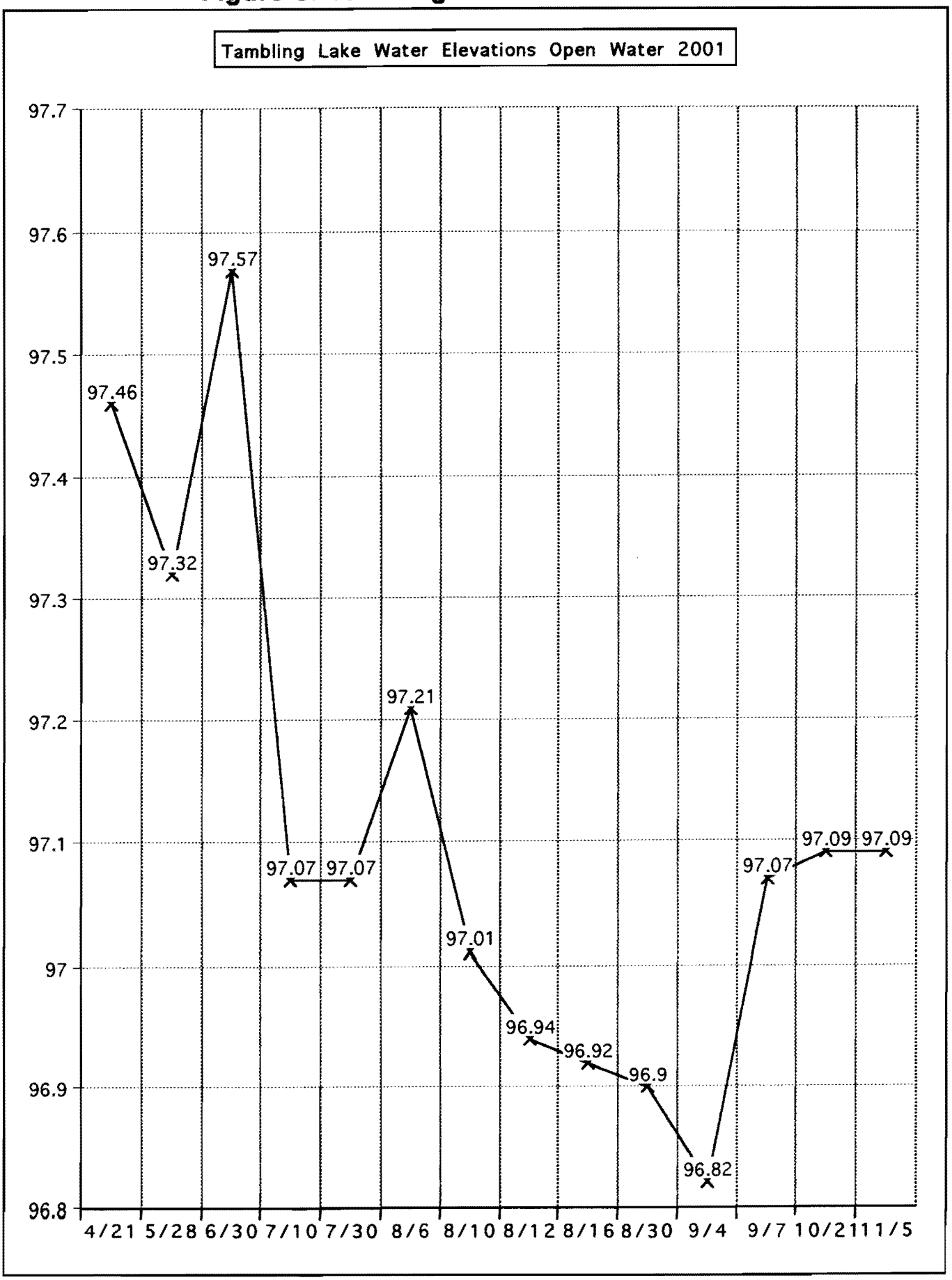
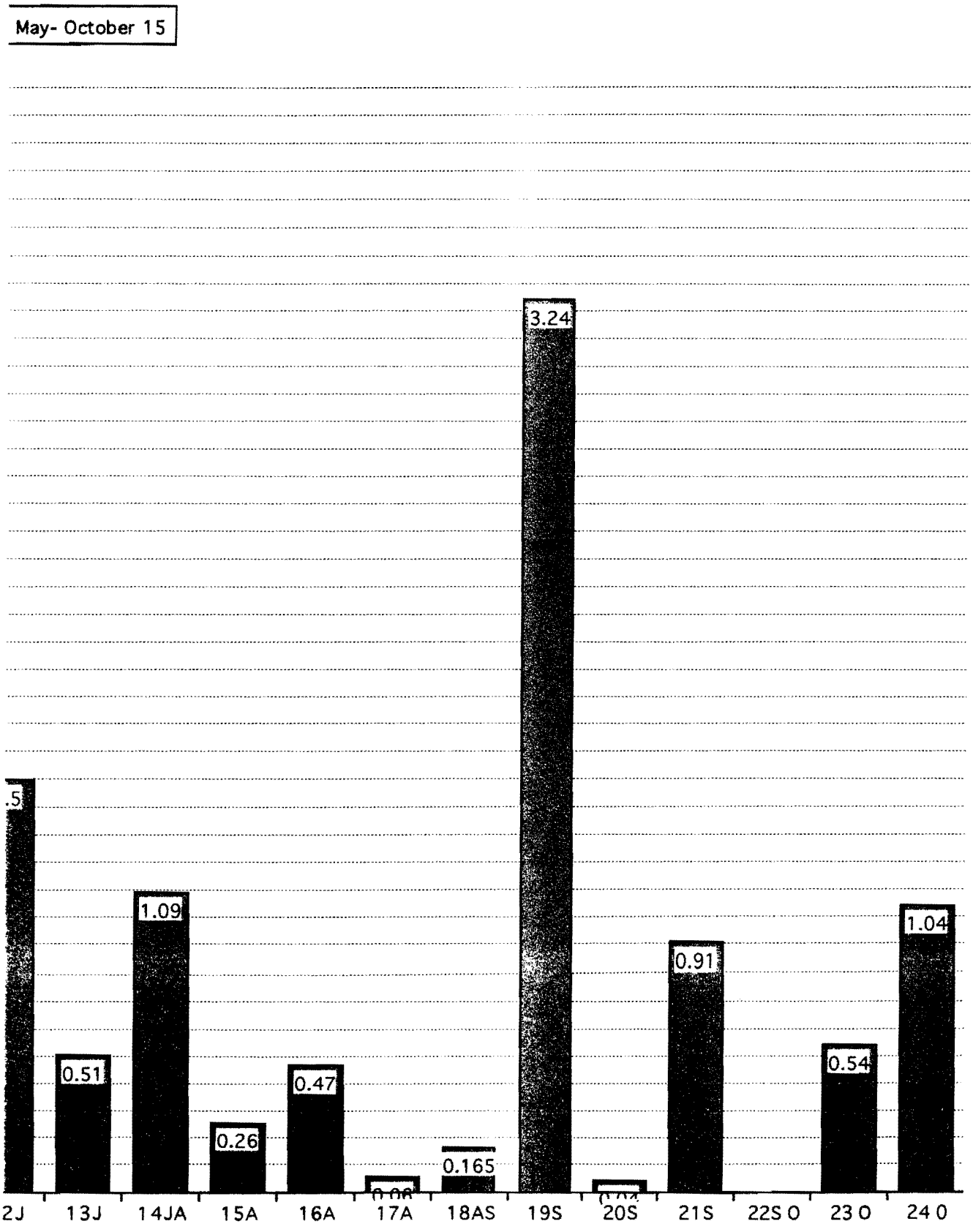


Figure 4. Tambling Lake's Open Water Precipitation in 2001



In 2001, the water level of Tambling Lake fluctuated only 9 ", from minimum of 96.82 to a maximum of 97.57. See **Figure 3**. This fluctuation varied from the 2000 water levels by less than an inch. Late May and June precipitation raised Tambling Lake to it's maximum 2001 water level which was recorded on June 30, 2001. See **Figure 4**.

On November 30, 2001 cross sectional profiles of the outlet area were completed to determine if the present obstructions and hydraulic conditions above the culvert are responsible for maintaining the present lake levels.

It was determined that the bottom of the upstream end of culvert is the lowest elevation in the bottom of the inlet channel. To maintain the present lake level when replacing the culvert the bed of the upstream at adjacent to the concrete pier needs to bed raised 0.5 feet to the present elevation of the inlet culvert bottom.

The existing culvert has several problems that inhibit fish passage. First the culvert which was installed as two sections has now bowed in the middle. The resulting slope, from bottom of the inlet to the bottom of the outlet is 2.8%. This flow created by this slope increases the flow in the culvert in excess of 2-3 ft/sec that prohibits fish passage. It also prevents any type of sediment from settling in the culvert that would provide a natural hydraulic condition resembling a stream bed.

The placement of a larger (29" x 42" elliptical - 36" standard) galvanized or cement culvert at a 1% slope with the top of the culvert at the same relative elevation as the present culvert would maintain the present road level. At the same time the bottom elevation at the downstream would coincide with the elevation of the first natural pool downstream. The plunge pool that now exists below the culvert that blocks fish migration through the culvert would then be eliminated. Upstream, the silt filled pool in front of the culvert would be now be shallower. With the raising of the upstream bed adjacent to concrete pier six inches the changes in the stream hydraulics will probably eliminate settling of silt in the pool below. Rock rubble and an apron extension should be considered in this pool and at the inlet to the new culvert to prevent storm water from altering the hydraulics of the inlet. The larger elliptical culvert will allow some sediment to collect in the culvert and provide a slower current for fish passage.

LAND AND WATER RESOURCE DEVELOPMENT

Resource Management Assessment

Phase 1 planning identified several alternatives in managing and funding lake projects. Swimming, pleasure boating, and fishing were all high priorities for lake residents as indicated in the Phase 1 planning survey. Options were presented in the grant report with recommendations that included possible time and location partitioning of the lake, as well as horsepower restrictions. One of the alternatives for funding lake management projects and/or creating a lake use plan was the formation of a lake district with taxing authority for specific projects or budget.

In Phase 2 of the planning process a new lake property owner's survey was conducted to determine the acceptance of the formation of a lake district to provide funding and guidance for lake restoration projects. The survey provided information and questions regarding the outlet restoration and proposed changing of water levels, as well as the installation of the aeration system. This survey also determine if there was interest in shoreline preservation and restoration and a need for a lake use plan.

Property Owner's Survey and Results

A property owner's survey was presented at the Tambling Lake Association, Inc. at their annual meeting on June 10, 2000 to determine the acceptance of the formation of a lake district and to provide funding and guidance for lake restoration projects. The survey can be found in in **Appendix II**.

The survey was presented and discussed at the meeting and all property owners received a survey by mail. Out of 77 surveys distributed 40 or 52% responded to the survey.

Question 1 related to the financing of restoration projects and operation of the association. The question was asked, "**Would you be in favor of collecting dues and continuing to make special assessments to cover the cost of the future projects and operations?**" 78% of the respondents were in favor of making special assessments to cover these cost.

The second part of question 1 also approached the residents with an option to fund and install an aeration system before the winter of 2000. The question asked, "**Would you contribute to a special assessment this year for an aeration system to be installed before winter? The total cost of installing the two aeration systems is approximately $3366.00. This timing would not allow reimbursement through a grant program.**" 81% of the respondents were in favor of installing an aeration system before the winter of 2000-2001. Several lake residents stepped forward with donations for the purchase and installation of one aeration system. The permit to install came too late for installation and luckily a fish kill was avoided during the winter of 2000-2001. The first aeration system is now in place for winter of 2001-2002 operation. Protection grant funds will be applied for the second aeration system purchase & installation.

Question 2 addressed the possible funding of costly lake management priorities to solve problems identified in the Phase 1 planning grant questionnaire. The formation of a lake district and legal allowable assessment parameters were explained. The question stated, "**Looking at long term planning, would you consider the formation of a lake district that would have the power to assess every lake property owner for lake projects and operations.**" 64% of the respondents were not in favor of forming a lake district to fund restoration of the lake. There were many comments that all property owner's should contribute to the projects; yet comments supporting the formation of a legal taxing authority was lacking or indicated strong opposition.

Question 3 addressed the need to form rules to manage the multiple use of the waters of Tambling Lake. The question was asked, "**At this time do you feel that there is a need to address restrictions such as: time of operation of certain water crafts, protection or creation of sensitive areas of the lake, or size restrictions on horsepower?**" 75% felt there was no need for further restrictions at this time. Many commented on a need for a ban on personal water craft and favored reduced horsepower and water skiing activity.

Question 4 gave a description of the benefits of the outlet restoration. It also discussed the negative aspects of the restoration. The question stated, " **Would you favor modifying the outlet to drop the lake level approximately one foot?** 76% of the respondents were opposed to dropping the lake level with the outlet restoration. Several comments were made that a 1 foot drop would hamper navigation and require them to lengthened their pier for access. Others commented on the resulting increase in aquatic vegetation. Presently, without any restoration, Tambling Lake's open water level fluctuated in elevation a maximum of 8 " in 2000 and 9" in 2001.

Question 5 inquired about any interest in shoreline restoration. This question asked, "**If needed on your shoreline, would you be interested in the restoration of your shoreline in the future?**" 71% were not interested in restoration on their shoreline. For those people interested in shoreline restoration since this survey, Vilas County Lake's Program has come up with a cost share program for shoreline restoration.

Shoreline Restoration Demonstration Project

The soils and slopes surrounding Tambling Lake are susceptible to erosion and are not adequate for wastewater treatment. All of the shoreline of Tambling Lake is privately owned and susceptible to further development. Tambling Lake's shoreline was evaluated in a DNR research shoreline habitat study as a "developed shoreline lake". Phase 1 planning grant report recognizes the value and a need for shoreline buffer strips on Tambling Lake.

Buffer strips prevent surface water runoff from short grass areas, driveways, walkways, and roadways from entering the lake. They also act as a filter of sediment, salts, and fertilizers that would come from these drainage areas. When planted with flowering plants and native grasses, these plants' extensive root systems can intercept ground water from the upland above. This ground water could contain nutrients from upland wastewater seepage beds.

The most important feature of owning lake front property, according to the Phase 1 property owner's survey, was scenic beauty and tranquility. The esthetic value of the buffer strip is also important. Using a variety of plant species of different heights will not restrict

the view from the residence, or from the water. Rather, it would provide an esthetically pleasing landscape frame. Shoreline vegetation can also add to privacy to the lake shore by acting as a sound barrier from noisy lake and lakeshore activities.

Maintaining a tree canopy is also very important in the watershed of Tambling Lake and it's bordering wetlands. This practice is particularly important in short grassy areas to slow the runoff during heavy rains. The greater the slope the more important a tree canopy is in preventing erosion during storm runoff. Select cutting, wise lot development, and good road building techniques that consider erosion, will go along way in protecting Tambling Lake. Mature trees can provide nesting sites for birds, including sites for wood duck nests. Wildlife viewing was high on the property owner's list of lake values; trees provide wildlife habitat. Trees also help maintain cool temperatures not only on the land but also in the lake adjacent to the land. Remember, that aquatic plant growth is temperature dependent .

In Phase 2, a shoreline demonstration project was planned and restoration began. The plans and methods for this shoreline buffer were presented to the lake association at it's annual meeting on June 10, 2000.

The shoreline restoration demonstration project is located on the northeast corner of Tambling Lake at the Jerry & Judy Behnke property. This property is near a forested wetland, located one lot to the west. It appears that this shoreline, prior to subdivision and development, was probably a part of this forested wetland. It also appears that the upland adjacent soils were used to level the lot and shape the shoreline for better development suitability.

On May 4, 2000 the present Behnke lot and shoreline was mapped- identifying present vegetation, shoreline structures, and building locations. The Behnke lot is a narrow, 50 foot wide lot, with little elevation change from the buildings to the lakeshore. The lake shoreline drops one to two feet to water level. The residence, deck, and gazebo are slightly elevated to facilitate view of the lake and set well back from the restoration area.

The soil in the area of restoration consists of about 2 feet of drought Ribicon sand over a mixture of peat and muck with the water table about 2 feet from the surface. There a several native trees already present in the proposed restoration area. They include tamarack, tag alder,weeping willow, balsam fir, white spruce, red pine, and white spruce. Both soil and hydric conditions of the site support the growth of these tree species. A few wetland forbes and sedges could be found on the bank and adjacent upland. Most of the area had been mowed to the bank edge with the eastern edge developed into a dock for access to a power boat and swimming.

The restoration plan, because of the present use and prior filling, did not try to restore the shoreline to it's original condition. Native species of trees, flowers and sedges that were already present were included in the plan and those repressed by mowing were allowed to grow once again. The plan included an area the width of the lot and 20 feet land ward.

The species chosen in the restoration focused on esthetics, adaptability to the site, and landscape viewing from both the lake and upland. Wisconsin native prairie flowers and grasses were planned to be added to those already present to provide a "natural" shoreline and meet the aesthetic needs of the Behnkes. These species were chosen for their hardiness in quickly putting down root to the water table through the drought sandy soils. Planting arrangements where based on color and height to accommodate viewing from the structures and a lakeside swing. Paths to the dock and swing area through the

restoration site meandered to hide them the lakeside view. Grasses were selected for the area where winter storage of the boat lift and canopy occurs.

The littoral zone in front of the restoration was also modified in the plan. The area is composed of sand adjacent to the bank and quickly changes to detritus lake ward. At one time a much larger area for swimming and boat access was kept clear. This maintenance area was reduced and the littoral area responded with the growth of watershield and bulrush.

The Behnke's have modified the plan narrowing the buffer strip restoration to 10 to 12 feet and are incorporating native plantings as their budget allows.

APPENDIX 1

TAMBLING LAKE AERATION SYSTEM

Project Description

This project will install two aeration units at two locations in Tambling Lake. Compressed air will be diffused at two locations below the bottom sediment where glacial out wash gravel areas enter the lake in the northeast and southeast corners. See FIGURE 14. This system is designed to alleviate the periodic winter kill of the fisheries by creating two oxygen refuges, increase ground water spring flow and circulate water from aeration sites towards the outlet stream.

These systems were recommended in the Phase 1 Tambling Lake Planning Grant Report in 1996. The plan is to install at least one unit prior to freeze up 2000 to prevent possible winter kill this winter. The second aeration unit will follow by October 2001. The last winter kill was in 1995-96. Past winter kills, water quality testing, and related information supporting this installation is documented in this report submitted to the DNR at that time.

Materials & Methods

Identical compressed air systems will be used at both locations. Each will include a 3/4 hp compressor with three valve outlets mounted near the shoreline to provide compressed air through weighted tubing to three distributor units. The distributor assemblies will be placed on gravel out wash sediment beneath 5 & 7' of water and 9 and 20' of loose muck, respectively (Figure 14).

The compressor unit, valve outlets, and meter base will be located in a small vented enclosure near the shoreline and comply with shoreline zoning ordinances. Poly tubing extending from the compressor units will be buried beneath the bank & shallow water shoreline until weighted down at deeper depths to prevent interference with navigation and fishing activities. The tubing will be attached to three diffuser assemblies that will release compressed air to the water column. The northern unit will be located in a mowed grassy area at the base of the hill in the NE corner of the lot. The southern unit will be located in a coniferous woods behind an ice pushup mound in the NE corner of the lot (Figure 13).

Environmental Impact

The installation of unit will have minimal impact on shoreline esthetics. The vented enclosure dimensions will be approximately 4 feet long, 2 feet high and 2 feet wide. It will be sided with earth tone materials to blend in with surrounding landscape. The electrical line on shore and aeration tubing near the shoreline will be trenched for minimal erosion and lake shore impacts.

Equipment and Locations:

- Description is attached entitled "Tambling Lake 2000 Aeration System Cost"
- Compressors will be located as described under "Materials & Methods" on original application, Both are located 15 to 30' from the shoreline and the same distance from the north property line of owner listed on form 3500-53. Locations have been flagged by the power company. Compressor building permits have been granted by Vilas County Zoning and meet zoning specs.

- There will be no disturbance of the lake bed during installation.

- The time frame for installation as described in "Project Description" on original application is October 2000 for the northeast location and October 2001 for the southeast location.

System Operation

- each 3/4 hp compressor, 115v, 1 phase compressor will produce 8.8 CFM @ 10psi.

- air will be deliver to 4 distributor units arranged in a T- pattern for maximum lift . Aeration hole size is expected to be minimal but unknown and will depend on air temperature. Unit will provide oxygen through delivery of 1-3mm bubbles not by providing open water and wind driven aeration. The intent is to provide a fish refuge area during anoxic conditions and circulate ground water entering above oxygen-demanding sediment .

- Planned operation for the system is from November 15 to March 15 or open water

The 1996 copy of the Planning Grant Report will be sent to you under a separate mailing tomorrow, September 22 from the Lake Association.

This project has been approved and supported by lake residents as polled in a recent property owner's survey. There is an urgency to installing at least one unit as even with a mild winter last year oxygen levels dropped to stressful levels. Please give this review immediate attention so we can move forward.

6/5/2000

TAMBLING LAKE 2000
AERATION SYSTEM COSTS

ITEM DESCRIPTION			COST
AERATION SYSTEM INSTALLATION			
2- 3/4 hp Carbon Vane Rotary Compressors	@ $542.00 ea		$1084.00
2- 3 Valve Outlets w/ Pressure Relief Valves.....	@ 72.00 ea		144.00
8 - Diffuser Assemblies	@ 56.25 ea		450.00
5- 400' rolls of 1/2" HD Black Polyethylene Tubing	@ 39.50 ea		197.50
300- Cable Ties	@	.18 ea	54.00
6- 1/2" Couplings	@	.35 ea	2.10
28- 1/2" SS Hose Clamps	@	.38 ea	10.64
2-Air Filter & Elements	@	12.50 ea	25.00
2-Pressure Gauges	@	20.85 ea	41.70
2-Electric Extensions from Power Poll to Shoreline Compressor Sites			
2-Meter Bases	@ $117.00 ea.....		$234.00
Pole to Meter Base (250' free) ~ 100' max	@ $2.23/ ft		223.00
Miscellaneous Cost (Tax, Freight, Installation, Bricks, and Cabinet Construction)			400.00
Wood Posts, Roping, and Reflectors to Surround Two Aeration Holes			500.00
Estimated Total Aeration System Cost			**3,365.94**

Maintenance

Replace Air Filters Element Annually	$25.00
Replace Carbon Vanes Biannually ($100.50)	50.25
Replace pressure Relief Valves Possibly after 5-10 years ($33.00)	3.30
Estimated Annual Maintenance Cost	**$ 78.55**

Operation

2- 3/4 hp compressors at 750 watts each, draw approx. 1500 watts.
1500 watts = 1.500 kilowatts: therefore uses > 1.5 KWH

1.5KW x 24 hrs x 30 days x $ $.06164(cost /KWH)	$66.57
Monthly Customer Charge	17.00
Total Monthly Cost	$84.57
Cost to run Nov 15 to March 15 (4 months)	**$338.28**
Estimated Annual Operation & Maintenance Cost	**$416.83**

APPENDIX II
TAMBLING LAKE PROPERTY OWNERS SURVEY 2000

Name,Tambling Address: _____

1. Tambling Lake's restoration plan is moving forward with three projects scheduled over the next several years. 75% of the cost of these projects will be covered by a restoration grant. . The lake's share of this restoration work would cost approximately $2700.00. SEE ATTACHMENT The initial expense of each phase of the restoration work would have to be completed before the state would reimburse their 75%. Other expenses that also needed to be funded include: 1) operation, and maintenance of the proposed aeration system in the future, 2) application cost for the restoration grant, and 3) and other expenses of operating the association (county lake association dues, insurance,newsletters, & mailings). In the past Tambling Lake Association share of the planning grant cost came from annual dues and a special assessment. In 1999 61% (47 out of 77) Tambling Lake's property owners paid dues to the association. The special assessment for the Phase 2 planning grant in 1999 was paid by 43%(33 out of 77) of the Lake's property owners. At this time we would like to ask you your opinion on how to finance these future costs.
Would you be in favor of collecting dues and continuing to make special assessments to cover the cost of the future projects and operations?
Yes ____ No ____

In February oxygen below the ice was quite low - even though it was a mild and short winter. It is likely that this next winter will be longer, have more snow cover, and could cause a winter fish kill similar to 1995-96.
Would you contribute to a special assessment this year for an aeration system to be installed before winter? The total cost of installing the two aeration systems is approximately $3366.00. This timing would not allow reimbursement through a grant program. Yes ____ No ____

2. During Phase 1 planning property owner's survey people responded that the top three problems on Tambling Lake were too many weeds, the lake's muck or shallow depth, and low oxygen/winter fish kill. The biggest priority selected to solve the problem was to dredge the lake. Another option supported was to harvested the plants. One way to cover the cost of these operations and other lake projects would be the formation of a lake district . By state law the maximum allowed assessment by a lake district would be $2.50 per thousand dollars of assessed value.
Looking at long term planning, would you consider the formation of a Lake District that would have the power to assess every lake property owner for lake projects and operations? Yes ____ No ____

Comments for Questions 1&2

_____

_____

_____

_____

Tambling Lake Property Owner's Survey 2000
Page 2

3. Phase 1 planning listed swimming, pleasure boating, and fishing as high priorities. **At this time do you feel that there is a need to address restrictions such as: time of operation of certain water crafts, protection or creation of sensitive areas of the lake, or size restrictions on horsepower? Yes ____ No____. If yes, what are your concerns?**

Comments:_____

_____

_____

_____

4. Phase 1 Planning also recognized the present outlet culvert and stream have created several problems for Tambling Lake. The problems include the restricted movement of fish in and out of lake for spawning and during periods of low oxygen. The blockage of the outlet may also at this time be creating a head pressure that restricts spring seepage flow into the lake. Plans are now under way to replace the culvert and correct the outlet stream problems. One option would to place the culvert or modify the outlet stream to create an elevation that could drop the lake level about one foot. This would expose deeper water areas adjacent to shoreline to wind and wave action providing increased "beach" area and cleaner bottom areas farther into the lake. It also could - with increased water flow - improve water quality resulting in changing the plant community to better plants. A decrease in water depth of 1 foot could also make it difficult to boat through aquatic plants during parts of the growing season.

Would you favor modifying the outlet to drop the lake level approximately one foot? Yes ____ No ____
Comments_____

_____

_____

5. Currently we are working on the restoration of the Judy & Jerry Behnke shoreline in the northwest corner of the lake to create a buffer zone and improve wildlife habitat along the shoreline. It will take two to three growing seasons before the full effects of the restoration will be observable.

If needed on your shoreline, would you be interested in the restoration of your shoreline in the future?
Yes ____ No ____ Comments

_____

_____

PLEASE RETURN THIS QUESTIONNAIRE WITHIN 10 DAYS to Aquatic Resources,N4546 Butternut Lane, Birnamwood,WI 54403.