Anvil Lake Association, Inc.
Anvil Lake Aquatic Macrophyte Baseline Survey 2004-2006
SPL-090-05
Final Project Report *(Revised 3/2007)*

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Project Report:
This report describes the final results of the Anvil Lake Aquatic Macrophyte Baseline Survey Project. The project was initiated in 2004 and concluded in 2006.

The goal of the project was to conduct an aquatic macrophyte survey and inventory for Anvil Lake.

Project objectives include the following:

1) To develop a base map and database of Anvil Lake sampling points for GPS locations throughout the littoral zone.
2) To conduct a point-intercept sampling survey of aquatic macrophytes using rake sampling techniques.
3) To inventory/identify the existing aquatic macrophyte species and collect and prepare herbarium samples of the species collected.
4) To map critical macrophyte beds with supplemental scuba diving linked to GPS readings.
5) To develop long-term lake management planning recommendations and strategies for aquatic macrophytes.

Potamogeton pusillus
(Small pondweed)

Background for the Aquatic Macrophyte Baseline Survey:
The Anvil Lake Association, Inc. (ALA) first incorporated as a qualified and registered corporation under the name Anvil Lake Improvement Club, Incorporated on March 31, 1965. On December 27, 1993, this organization amended its registered name to Anvil Lake Association, Incorporated. The Association is a Non Stock Corporation under Chapter 181 of the Wisconsin Statutes.

The ALA remains in existence for the benefit of the general public. ALA works to protect the quality of Anvil Lake by participating in activities such as comprehensive lake management planning, volunteer water sample collection for water quality analysis, fisheries habitat improvement, and loon habitat enhancement, a project in cooperation with the U.S. Forest Service (Eagle River Ranger Station). Association members also

participate in the LoonWatch program of the Sigurd Olson Environmental Institute, Northland College, Ashland, Wisconsin.

The purpose of ALA is to educate property owners, represent the interest of property owners and the general public, maintain a working relationship with governmental bodies, create a sense of community among property owners, and provide leadership that can receive and give suggestions regarding the protection of Anvil Lake. ALA has approximately 80 members, many of whom take an active role in Association activities.

Anvil Lake is located in the Town of Washington in eastern Vilas County. Vilas County features the largest number of lakes of any county in the state. Development pressures are very high throughout the County, resulting in concerns for water quality and other development impacts.

Anvil Lake has a surface area of 398 acres. There are two public and one private boat landing on the lake. One is a U.S. Forest Service landing that includes parking, a public pier, restroom facilities, a public picnic shelter, campground and beach. The other public access is an unpaved landing owned by the Town of Washington. The private landing is located at Zaugg's Resort. (Note: according to Chuck Zaugg, it is anticipated that this private boat landing will be eliminated in the future as the resort is split up and sold for single family residences.)

Anvil Lake offers a high quality experience to lake visitors and property owners. Lake resources include moderate-to-good water quality (as per data from the Volunteer Self-Help Water Monitoring Program), good lake aesthetics, historically good walleye, small-mouth bass and panfish fisheries, and high quality recreational opportunities. This lake is important to lake property owners, visitors and the general public.

Because of the quality and popularity of Anvil Lake, its shoreline is very desirable for residential sites and its surface area for recreational activities. Increased use of the lake and development in its watershed has the potential to diminish many of its high quality characteristics. ALA recognizes that this lake may be threatened and wishes to continue work on a comprehensive lake management plan by completing a baseline survey and inventory of the aquatic macrophytes.

ALA has had an active, continuous volunteer self-help monitoring program for about 18 years. Historic and current Secchi disk readings are now being supplemented with water chemistry data collected through the Self-Help Volunteer Monitoring Program.

An expanded water quality study was initiated in 2003. In the *Preliminary Results of Sediment Core Taken From Anvil Lake, Vilas County, Wisconsin*, researcher Paul Garrison, Wisconsin Department of Natural Resources, reviewed the historic diatom community of Anvil Lake. Garrison noted the following concern:

> "The diatom community does indicate that there has been a significant increase in the macrophyte community in the lake. The decline in planktonic diatoms (e.g. *Aulacoseira ambigua* and *Cyclotella*) and an increase in benthic *Fragilaria*

indicate this… Diatoms belonging to the latter group typically grow in filaments attached to substrates such as aquatic plants… This increase in macrophytes has been found in other northern Wisconsin lakes with shoreland development. Studies have shown that one of the first indicators of increased nutrient input to a lake is increased plant growth."

Garrison summarized the results:

"There has been an increase in the macrophyte community. This increase could be manifested in wider distribution of plants or an increase in density. This increase in the plant community is an early sign of increased delivery of phosphorus from the watershed. The littoral zone is the first area that is impacted by the increased phosphorus levels. If phosphorus input continues to increase, eventually there will be increased growth of algae in the open water of the lake. The increased phosphorus entering the lake is most likely the result of shoreland development."

Elodea canadensis
(Common waterweed)

It is interesting to note that scuba divers Nils Holmgren and Bill Reardon, who have conducted dives in Anvil Lake in the past, have noted personal observations that substantiate Garrison's results. Holmgren has volunteered his time to conduct supplemental diving to assist with mapping the extent of macrophyte beds in 2004 and 2005.

Other concerns regarding aquatic macrophytes relate to the potential damage that could be caused to the aquatic ecosystem due to the infestation of aquatic invasive species. Anvil Lake Association volunteers have been actively monitoring sites throughout the lake to detect any infestations of Eurasian Watermilfoil and other aquataic invasives. Volunteers have also been trained and are actively working to conduct "Clean Boats-Clean Waters" inspections at the boat landings, especially during peak usage times at the Forest Service boat landing. In addition to macrophyte distribution and density increases, the baseline inventory was used to indicate the current presence or absence of invasive species in Anvil Lake, and will provide essential data for management of any infestations if or when they occur.

In order to effectively document increases in either macrophyte distribution or density, and to conduct a comprehensive assessment of the status of any aquatic invasive species, this statistically-valid survey of the existing macrophytes was conducted. This survey will now serve as a baseline for future surveys and other monitoring activities. The Anvil Lake Association intends to periodically repeat the methodology over time, and will be better able to determine the extent of macrophyte species and density changes over time.

Description of methodology:
The aquatic macrophyte survey was conducted according to the Point Intercept Sampling Method as described by Jennifer Hauxwell, Wisconsin Department of Natural Resources, Bureau of Integrated Science Services in "Appendix 1: Recommended Baseline Monitoring of Aquatic Macrophytes."

The base map of Anvil Lake was prepared by Nordin-Pedersen Associates, LTD consulting engineers using the ArcView Method of determining the area of the littoral zone (the area of the lake that is less than 20 feet in depth). Existing lake maps were digitized and then field checked with supplemental GPS and survey to determine littoral zone depth contours. Nordin-Pedersen conducted supplemental GPS mapping in 2004 to more accurately determine the 20-foot depth contour of Anvil Lake.

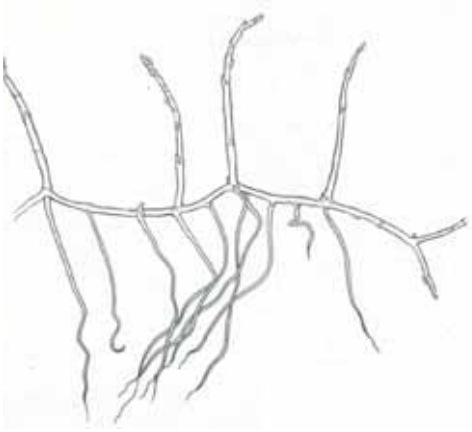
The locations of sampling points were then identified/generated utilizing the ArcView method (Nick Nordin & Karen). Lattitude and longitude coordinates for the sampling points are listed on the attached data sheet. The littoral zone sampling points are also illustrated on the attached lake map. Sampling points within the littoral zone were placed on a 75-meter grid. A total of 151 sampling points were identified and mapped.

A highly-accurate (+/- 1 meter) Real Time Kinematic (RTK) GPS system was utilized to locate each of the sampling points for the aquatic macrophyte survey. The use of the system was contributed as an in-kind match courtesy of Nordin-Pedersen Associates, LTD. Originally, the sample points were also intended to be captured on water with Differential GPS. However, Nordin-Pedersen Associates, LTD provided the more accurate RTK GPS system for all of the field sampling.

A survey monument was established near the Forest Service boat landing on Anvil Lake to serve as a permanent reference point for the RTK system. All sample points and macrophyte mapping were referenced to the Vilas County coordinate system.

Rake sampling techniques were utilized at each of the sampling points. An extended-handle sampling rake (15 feet of total length) was purchased by the project and utilized for the sampling. For depths in reach of the rake handle, the rake was dragged along the bottom over the sample point for approximately 2.5 feet, then flipped 180 degrees to ensure that plants snagged on the teeth of the rake were not lost. An abundance rating based on a semi-quantitative estimate of biomass of material within the rake teeth was recorded by overall coverage for all species and as individual species present. The abundance scale was based on the following:

0 = No plants on rake head.
1 = A few plants on rake head (>0-10%).
2 = Obviously less than one-half of rake head,



Myriophyllum tenellum
(Dwarf water milfoil)

but uniform cover toward the base
(>10-40%).

3 = Rake head is about one-half full, can easily see the top of the rake head (>40-60%).

4 = Obviously more than one-half full, but not overflowing. Can barely see the top of the rake head (>60-90%).

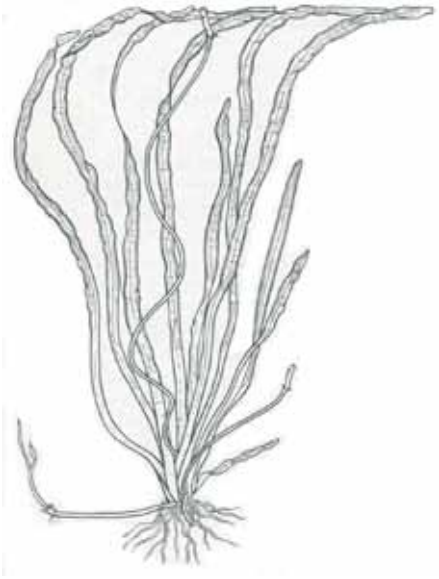
5 = Overflowing, cannot see the top of the rake head (>90%).

For those sampling points where the rake handle was not long enough to reach the bottom to obtain an effective sample, the rake with a rope attached to the handle was cast out into the water and dragged for approximately 6 feet over the sampling point. Only presence/absence data (P=present) was recorded for these sampling points.

The aquatic macrophyte survey was conducted during the summer of 2005 on July 9 (7 hours) and July 10 (6 hours). A follow-up survey of specific sampling points was also conducted on September 3, 2005, in conjunction with the scuba dive survey described below. Aquatic macrophyte sampling was conducted by volunteers utilizing a pontoon boat provided as an in-kind contribution by Mike Hinz. Anvil Lake Association volunteers included Don Gillum, Mike Hinz, Tim Nordin, Bryan Pierce and Fred Young. Scott Nordin also contributed in-kind professional services during the aquatic macrophyte field survey utilizing the RTK GPS unit.

Low water levels were manifest during 2005. Several sample points which normally would be below the Ordinary High Water Mark of Anvil Lake, were dry at the time of the macrophyte surveys, and resulted in no or only limited samples taken.

Samples of each aquatic macrophyte species were collected, pressed in a plant press for preservation, mounted, laminated and identified. Don Gillum did the plant pressing and preservation. Plant species identification was confirmed by Susan Knight, PhD, University of Wisconsin-Trout Lake Station. Two full sets of aquatic plant specimens were prepared by Gillum. One set was provided to the Wisconsin Department of Natural Resources with this report. (NOTE: Plant species identifications were corrected by UW-Stevens Point and WDNR on 3/6/2007.)



Vallisneria americana
(Wild celery)

Processing of RTK GPS coordinates and survey data was conducted by Nordin-Pedersen Associates LTD. The scuba dive survey report was also prepared by the consulting engineers.

Aquatic Macrophyte Survey Results:
No aquatic invasive species were found during either the point intercept macrophyte rake survey or either of the scuba dive surveys on Anvil Lake – a very positive survey result. With the popularity of Anvil Lake as a recreational resource for both local lake residents and visitors, eternal vigilance will be required to continue to keep the lake free from aquatic invasive species.

Primary aquatic macrophytes identified through the point-intercept survey included *Potamogeton pusillus* (Small pondweed), *Elodea canadensis* (Common waterweed), *Myriophyllum tenellum* (Dwarf water milfoil), *Potamogeton amplifolius* (Large-leaf pondweed), *Potamogeton nodosus* (Long-leaf pondweed), and *Valliseria americana* (Wild celery). Also identified as present among the samples of *Myriophyllum tenellum* was *Juncus pelocarpus* (Brown-fruited rush).

Potamogeton amplifolius
(Large-leaf pondweed)

Of the 151 point-intercept grid sampling locations, three were not sampled (due to low water conditions).

Just 14 of the 148 sampled point-intercept survey locations had no aquatic plants recorded. These sites ranged in depth from 1 foot to 22 feet (the deepest site sampled). Mean depth of sites with aquatic plants absent was 11.6 feet.

Potamogeton pusillus (Small pondweed) was present at 82 of the sites sampled (55.4%), making it the most abundant aquatic macrophyte species in terms of presence or absence at the sampling points. This macrophyte also occurred at the most diverse depths ranging from 1 foot to 22 feet. Small pondweed also scored some of the highest abundance rake samples recorded – 5 on the scale at 3 sampling locations. This species is distributed throughout the littoral zone of the lake basin.

Elodea canadensis (Common waterweed) was found at 53 of the sampled sites (35.8%). Again, it was found at diverse depths ranging from just 3 feet to 20 feet. This species was broadly distributed throughout the littoral zone.

Vallisneria americana (Wild celery) was found at 41 sampled sites in the littoral zone (27.7%). Found from just one foot in depth up to 13 feet, this species is also known as "eel-grass." At these slightly shallower depths, this species was also distributed throughout most of the lake's littoral zone.

Myriophyllum tenellum (Dwarf water milfoil) was found at 18 of the sampled sites (12.2%). This species is a small native relative of the non-native, highly-invasive

Eurasian water milfoil. Although not as abundant as the above species, Dwarf water milfoil was found in shallower depths (7 feet or less) in all regions of the lake's littoral zone. *Juncus pelocarpus* (Brown-fruited rush) was also identified by UWSP as present within one of these sites from the collected and preserved samples submitted.

Potamogeton nodosus
(Long-leaf pondweed)

The least common aquatic macrophytes identified during the survey were *Potamogeton amplifolius* (Large-leaf pondweed) and *Potamogeton nodosus* (Long-leaf pondweed). Large-leaf pondweed was found at just one sampling point in the southwest bay of Anvil Lake in 5.5 feet of water depth. Long-leaf pondweed was identified at just two sampling points – at 6 and 7 foot depths respectively. This aquatic macrophyte was located in the southeast bay of Anvil Lake.

Additional aquatic or semi-aquatic plant species identified during the survey included *Nitella* species (a common algae known as Stonewort), *Eleocharis palustris* (Creeping spikerush), as well as emergent vegetation *Sparganium chlorocarpum* (Short-stemmed bur-reed) and *Typha angustifolia* (Narrow-leaved cattail).

Nitella was present at more than half (83) of the sites. *Nitella* was also present at depths up to 22 feet, the deepest intercept point sampled.

Scuba Dive Survey Purpose:
The purpose of the aquatic plant dive survey was to search for non-native plant species and to document the types and densities of aquatic plants at specific locations in Anvil Lake.

Dive Survey Approach:
This aquatic plant survey was conducted on September 3, 2005. The actual survey was performed by scuba diver Nils Holmgren, assisted by his wife Cindy. Nils and Cindy have experience identifying non-native plant species such as eurasion water-milfoil and curly leaf pondweed and have worked with other area lake associations on similar surveys. Nils and Cindy performed a similar preliminary dive for the Anvil Lake Association in 2004. Assisting with plant collection and GPS location recording were Scott Nordin and volunteers Don Gillum and Mike Hinz.

Dive surveys were performed at four separate locations, D-1 through D-4, shown on the attached dive location map. At each of the four locations the pontoon boat used as a dive platform was anchored, beginning coordinates were noted and the diver entered the water. The diver surveyed the approximate area shown on the dive location map while the pontoon boat kept a safe distance away. The diver collected aquatic plant samples, took photographs, and made visual inspections for non-native plant species.

Occasionally the diver surfaced and brought plant samples to the dive platform. All plant samples were temporarily stored in ziplock bags, and were later identified as part of the Aquatic Macrophyte Baseline Survey. Coordinates were recorded at the end of each dive where the diver exited the water onto the dive platform.

All dive coordinates were recorded using a Trimble GeoXT differential GPS unit, accurate to within 1 meter, and referenced to the US State Plane Coordinate System, Wisconsin North 4801 Zone, NAD 1983.

Dive Survey Results:
No non-native plant species were encountered during the dive survey. Copies of photographs taken by Nils Holmgren are attached. The CD with digital files of all photos along with a copy of this report were turned over to officials of the Anvil Lake Association for permanent storage.

Aquatic Macrophyte Monitoring and Management Recommendations:
Aquatic Macrophyte Monitoring – Aquatic macrophytes are indicators of water quality. In particular, their abundance in the littoral zone is an indication of nutrient levels in the lake. Increases in overall aquatic macrophyte abundance (density as identified by rake samples) would be an indicator of increased nutrients and eutrophication of the lake. Based on the results of this aquatic macrophyte survey, it is recommended that the survey be repeated a five-year intervals to compare the density (abundance), distribution and species composition of aquatic macrophytes (and other aquatic plants such as *Nitella*) in Anvil Lake.

Similarly, the scuba dive survey and photographic record serve as valuable baseline information documenting the current status of Anvil Lake's aquatic macrophytes. It is recommended that this survey also be repeated at five-year intervals, or more frequently if infestations of aquatic invasive species are suspected. Having the aquatic macrophyte baseline survey is an advantage for the Anvil Lake Association because it enhances the lake's eligibility for state funding for rapid response and best management practices for any infestations of aquatic invasive species.

Because of the great threat of infestation of aquatic invasive species such as Eurasian water milfoil and Curly-leaf pondweed, as well as other aquatic invasives such as Zebra mussels (which are currently being monitored due to shells being transported to the lake shoreline in 2005) and Spiny water fleas, continued vigilance and more frequent monitoring for aquatic invasives is warranted. It is recommended that the Anvil Lake Association continue to recruit and train volunteers who are willing to take rake samples periodically at diverse locations of the lake, especially concentrated at potential access points for the aquatic invasives (boat landings). Continued information and education of lake users will be necessary. Suggested strategies include maintaining up-to-date signage at the boat landings, information to lake residents through the Anvil Chimes newsletter, and informational handouts and volunteer inspections for lake users (Clean Boats/Clean Waters program at the boat landing).

Aquatic macrophyte management – Relatively few sampling sites had aquatic macrophytes in high abundance. Just 9 of the 75 shallower rake-pole sampled sites (12%) had rake sample abundance ratings of 4 or 5. These samples occurred sporadically in the southwest and southeast bays, and more concentrated in the northeast bay of Anvil Lake. Depths of these more abundant aquatic plant sites ranged from 5 feet to 15 feet (mean depth of 9.8 feet).

This relatively limited scope of dense aquatic macrophyte beds is an indicator that Anvil Lake still enjoys relatively high water quality. Increases in density over time would indicate a reduction of overall water quality due to enrichment of the nutrients that fuel aquatic plant growth (primarily limited by phosphorus concentrations in Anvil Lake).

The only aquatic plant management practices recommended at this time for Anvil Lake would include land management strategies focused on preventing nutrients from entering the lake through stormwater runoff and flow of septic effluents. Retention and restoration of natural shoreline buffer zones, reduction of lawns (and lawn fertilization), prevention of stormwater runoff from impervious surfaces, and prevention of construction site erosion are all strategies that the Anvil Lake Association can promote to prevent eutrophication (nutrient enrichment) of the lake.

Current septic systems are designed for human health protection from biotic organisms (primarily bacterial contamination), and are not designed for nutrient removal. Elevated phosphorus concentrations have been documented as much as 150 feet down gradient from septic seepage beds (UW-Stevens Point College of Natural Resources). Many septic fields around Anvil Lake are within that radius. As a seepage lake, Anvil Lake has little buffering capacity from water flow. According to the Wisconsin Geological & Natural History Survey map for Vilas County, groundwater flow through Anvil Lake is generally in a northeast to southwest direction. Nutrient removal from septic effluent will require new technologies such as filtration systems and other strategies in the future, which are not very readily available currently. The Anvil Lake Association should share information and education on new technologies for treating septic effluents as they become more available.

Sharing of Results:
The Executive Summary of this Project Report was distributed, and a verbal report presented, to lake residents at the Anvil Lake Association's Annual Meeting on Saturday, July 1, 2006. This presentation was conducted by Scott Nordin and Don Gillum.

The Executive Summary was printed and distributed through the Anvil Chimes newsletter for the fall issue, 2006. The Anvil Chimes is mailed to property owners residing within the watershed of Anvil Lake. Copies of the full Project Report including maps were distributed to the Vilas County Land & Water Conservation Department and Wisconsin Department of Natural Resources.

Note: illustrations from "Through the Looking Glass… A Field Guide to Aquatic Plants", ISBN 0-932310-32-X, DNR Publication # FH-207-97, 1997, were used with permission from the Wisconsin Lakes Partnership.