An Aquatic Plant Management Plan for Townsend Flowage, Oconto County, Wisconsin

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Table of Contents — Page

Figures		Page

Tables Page

Appendices

Executive Summary

A thorough study of Townsend Flowage, Oconto County, Wisconsin was conducted between May and August, 2006. The primary goal of this project has been to develop an Aquatic Plant Management Plan for the Townsend Flowage Lake Association, as a means to 1) reduce excessive aquatic plant growth, 2) protect the native plant communities, 3) provide adequate navigation, 4) develop contingency plans for the possible invasion of exotic species, and 5) develop and prioritize management recommendations based on the concerns raised by members of the Association.

Project elements focused primarily on the aquatic plant community of Townsend Flowage and McCaslin Creek, water quality parameters, and an assessment of the Flowage's watershed. This project was funded in part by the Wisconsin Department of Natural Resources's Aquatic Invasive Species grant program.

Results of this study include:

- The most abundant plant species encountered in Townsend Flowage were bushy pondweed (*Najas flexilis*), common waterweed (*Elodea canadensis*), coontail (*Ceratophyllum demersum*) and small pondweed (*Potamogeton pusillus*).

- No Eurasian watermilfoil (*Myriophyllum spicatum)* or curly-leaf pondweed *(Potamogeton crispus*) were found in the Flowage at the time of the survey.

- Purple loosestrife (*Lythrum salicaria*) was identified at one location growing along the northern shore of McCaslin Creek.

- Analysis of plant data using the Floristic Quality Index (FQI) ranks Townsend Flowage as a higher than average quality lake.

- Townsend Flowage has very good water quality and falls well within the range of a mesotrophic lake.

- Dissolved oxygen measurements indicate high levels of oxygen throughout much of the lake during the entire study.

- Results of coliform bacteria testing show low levels of *E. coli* bacteria existing in the Flowage.

- A delineation found that the watershed of Townsend Flowage is over 20 square miles, with more than three-quarters covered with forests.

- Modeling of land cover and water quality data indicated the largest contributors of phosphorus include watershed runoff, precipitation and septic systems.

Introduction

The 476-acre Townsend Flowage is located within the Chequamegon-Nicolet National Forest in the northwest corner of Oconto County (**Figures 1 and 2**). The Flowage is composed of three sections: the northern basin (173 acres; max. depth 10 feet), the southern basis (303 acres; max depth 30 feet) and a portion of the McCaslin Creek which enters from the south. Mosquito Creek empties into the north basin of the Flowage. Directly upstream of the Flowage are the lakes of the Inland Lakes Protection and Rehabilitation District No. 1. The dam which was built to create the Flowage is located on the south end of the south basin.

The Townsend Flowage Lake Association represents the interests of lakeshore property owners and other lake users. Association member are very concerned about the ecological health of the Flowage. As a result, they play an active role in lake management largely through volunteer efforts. A number of studies have been conducted on the Flowage in the last ten years. These include a limnological survey of the Flowage conducted in 1995 by M.M.A. and a "Townsend Flowage Water Quality Analysis" conducted in 1998 by Foth and Van Dyke.

Excessive aquatic plant growth has been a major issue for lake users for a number of years. Historically, the Association has managed aquatic plant growth through the harvesting of aquatic plants on a volunteer basis. Annually approximately 30 acres have been harvested throughout the Flowage. Neither Eurasian watermilfoil (*Myriophyllum spicatum*) nor curly-leaf pondweed (*Potamogeton crispus*), both exotic nuisance aquatic plants, have been identified within the Flowage. However, a survey conducted in 2005 by Wisconsin Lake & Pond Resource found over 12 acres of Eurasian watermilfoil growing in Horn Lake and Explosion Lake located within the Inland Lakes Protection and Rehabilitation District No. 1. As a result, the Association was particularly eager to develop a management plan that would include, among other elements, contingency plans for the possible invasion by exotic plant species.

The Wisconsin Department of Natural Resources has requested that the Townsend Flowage Lake Association develop an aquatic plant management plan in order to address current concerns over excessive aquatic plant growth within the Flowage. This report, then, presents the information gathered during the study, and makes recommendations for long-range management of aquatic plants in the Flowage. With the knowledge gained by this project, the Association hopes to take the appropriate actions needed to best manage the aquatic plants for lake users and the biotic community alike.

Figure 1. Area surrounding Townsend Flowage, Oconto County, Wisconsin

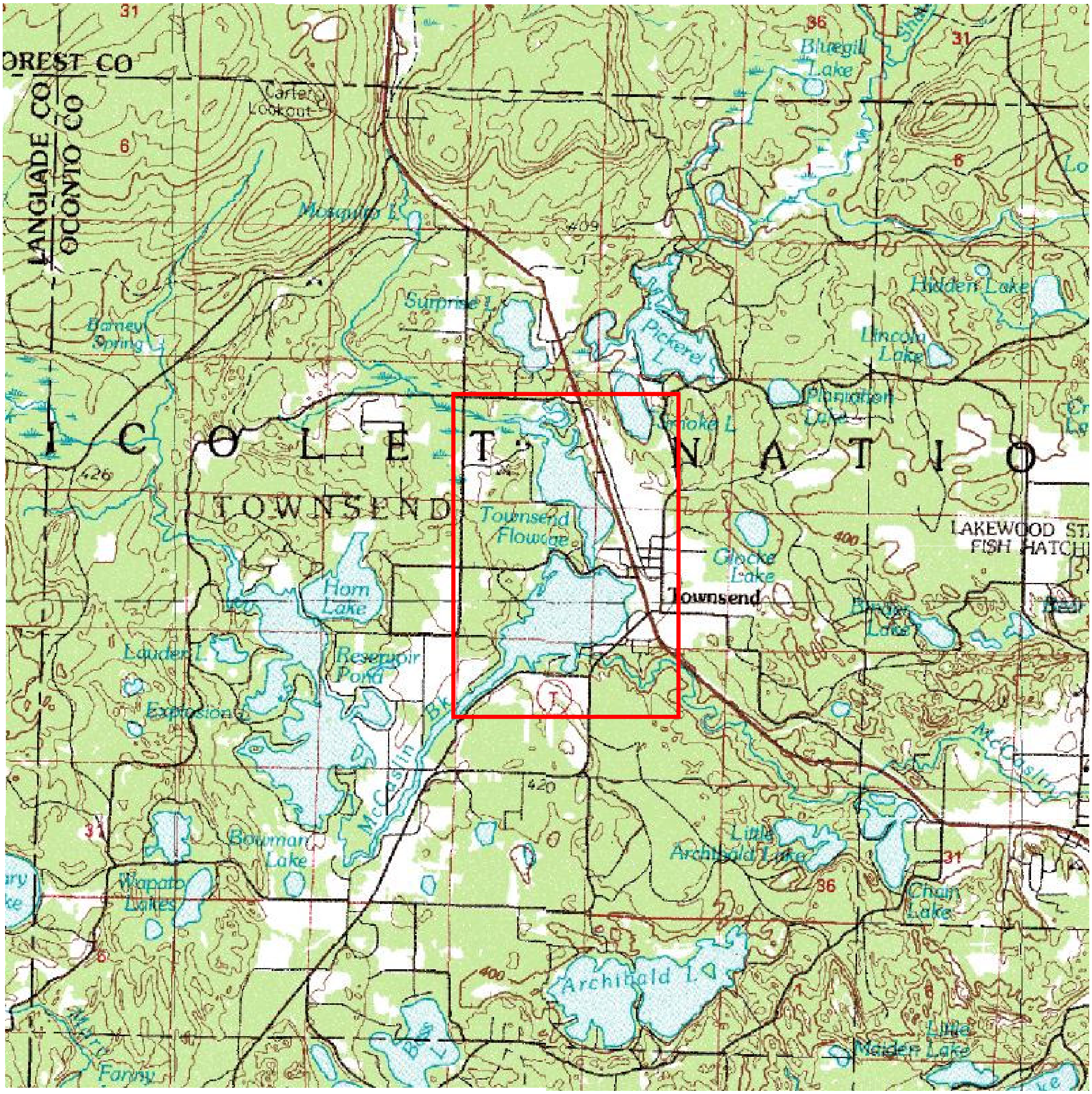
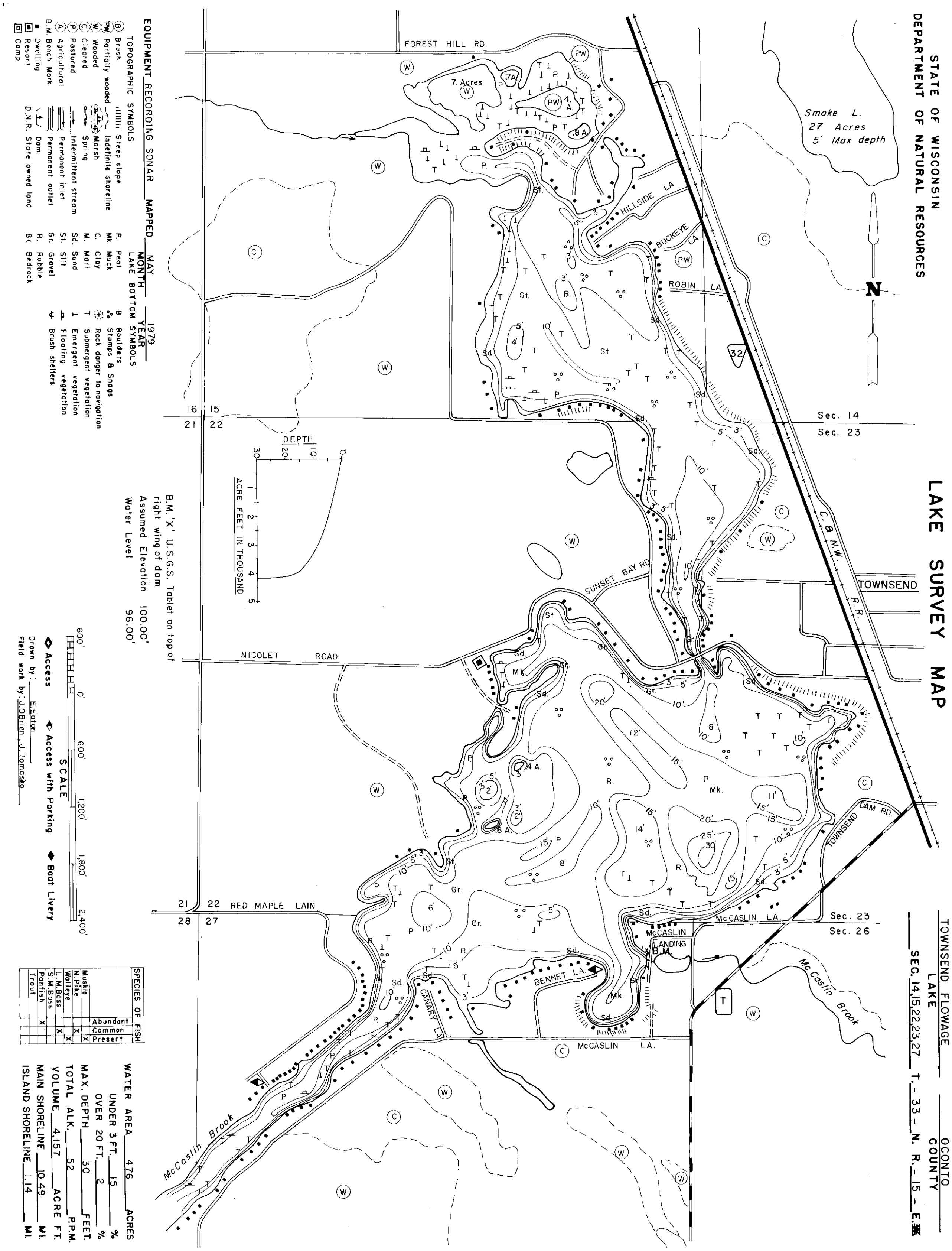


Figure 2. Townsend Flowage, Oconto County, Wisconsin.



Methods

Aquatic Plant Assessment

In July 2006, a submergent aquatic plant survey was conducted utilizing reproducible methods so that future surveys can accurately assess changes to the plant community. Under the guidance of Jennifer Hauxwell from the Wisconsin DNR, an approved plant survey map for Townsend Flowage was provided (**Figure 3**). A series of grid points spaced 65 meters apart were mapped across the lake. At each point, aquatic plant samples were collected from a boat with a single rake tow. In total 426 points were sampled in the Flowage. Following DNR guidelines, the rake used consisted of two short-toothed garden rake heads welded together and attached to a rope. At each sample point, the rake was thrown from the boat and dragged along the bottom for approximately 2.5 feet to collect plants. All plant samples collected were identified to *genus* and *species* whenever possible, and recorded. An abundance rating was given for exotic species collected using the criteria described in **Figure 4**. In addition to the plant data, depth, and bottom substrate composition were recorded for each point intercept. Data collected will be used to determine species composition, percent frequency and relative abundance.

A similar survey was carried out on the portion of McCaslin Creek between the mouth of the south basin and the boundary between the Townsend Flowage Association and the Inland Lakes P & R District #1. A total of 46 rake tows were made along this section of the creek. Again all plant samples collected were identified to *genus* and *species* whenever possible, and recorded.

Figure 3. Townsend Flowage aquatic plant survey map.

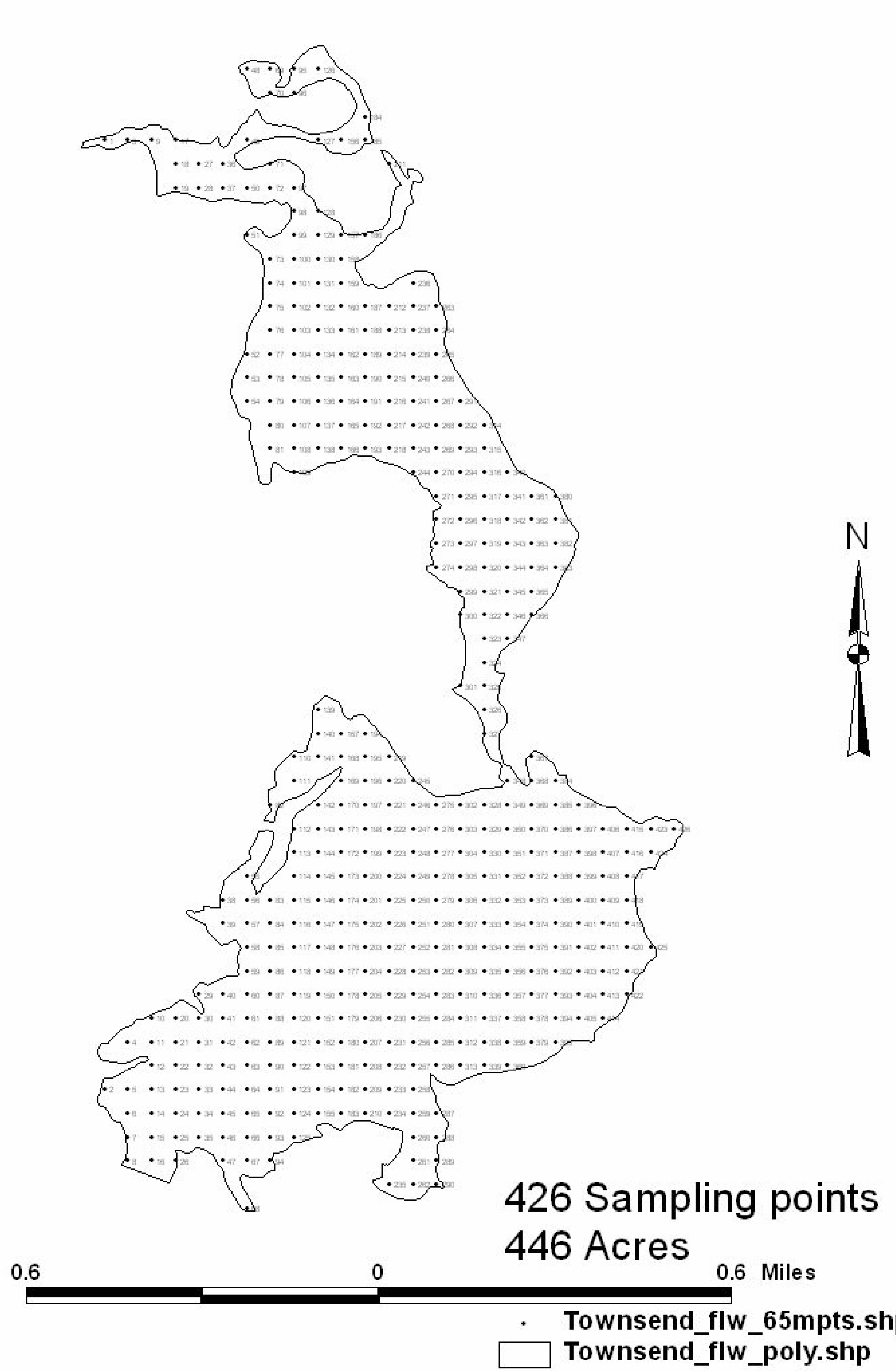
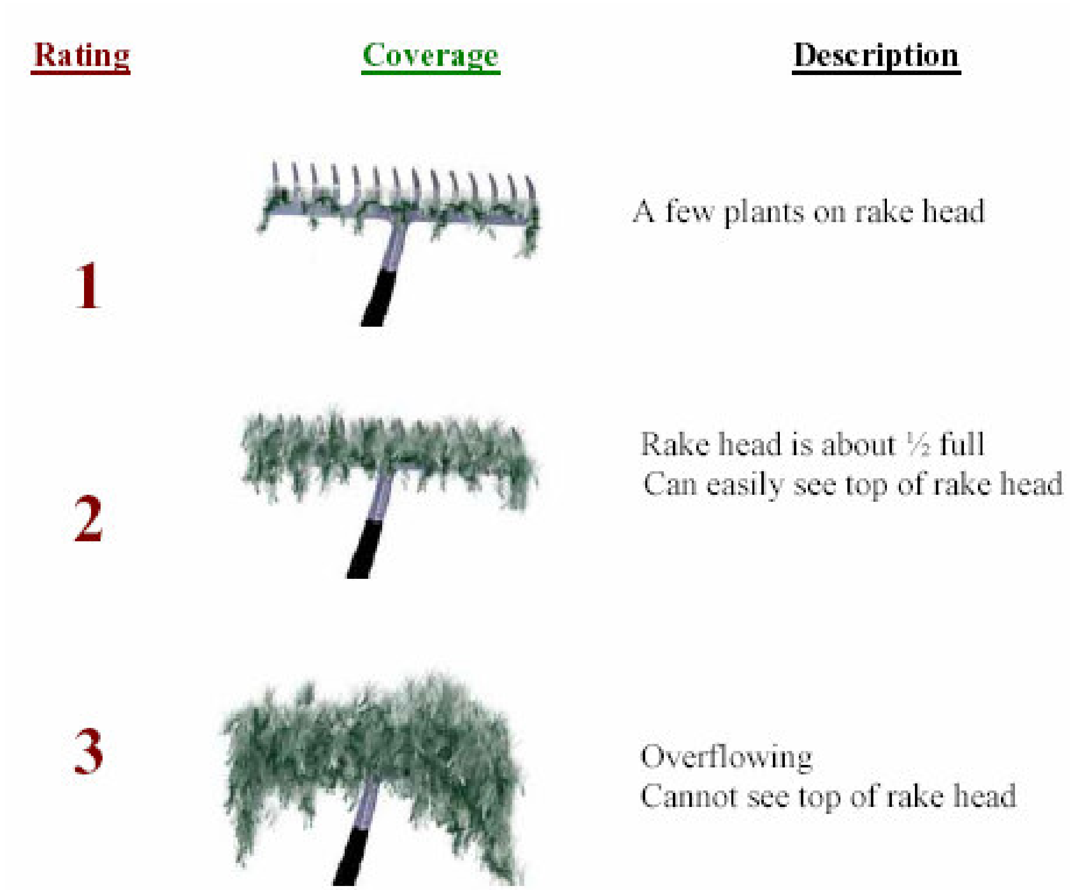


Figure 4. Plant abundance rating criteria used in submergent aquatic plant surveys.



Water Quality Assessment

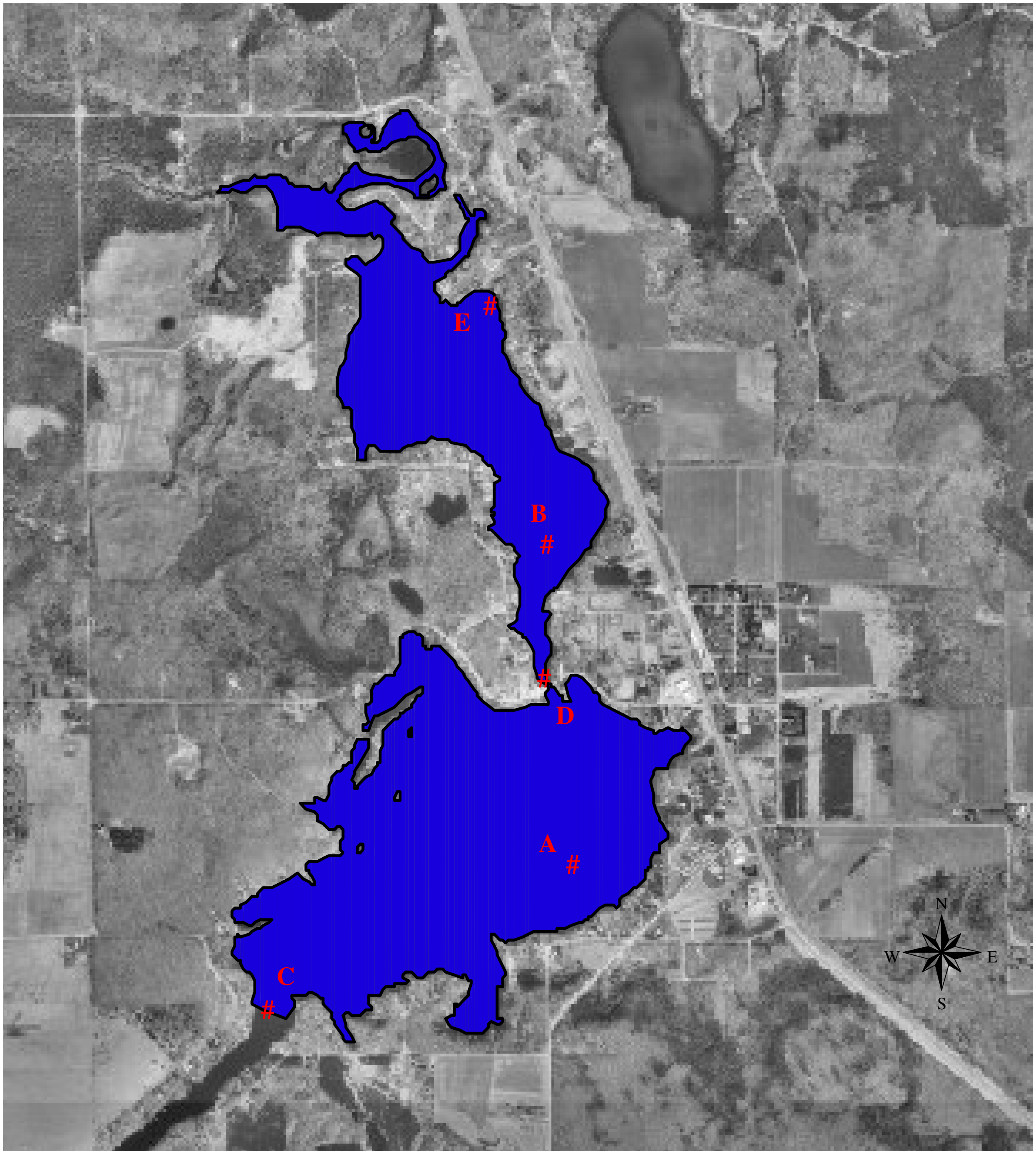
Water quality samples were collected, and measurements made, at the deepest points in both the north and south basins. These are indicated in **Figure 5** as sites A and B. Monitoring occurred during spring mixing (May), and three times during the growing season (June, July and August). Water samples were collected one foot below the surface for analysis by the State Lab of Hygiene for total phosphorus and chlorophyll. At the same time and location where water samples were collected, Secchi depth and pH measurements were made and profile data were collected for temperature and dissolved oxygen.

On July 25, 2006, five samples were collected for analysis of total coliform and E. coli. Analysis of these samples was conducted by a State Certified Laboratory. These are indicated in **Figure 5** as sites A through E. Locations for sampling were determined on site with the assistance of Association volunteers. **Table 1** gives the location and coordinates of these five sampling points.

Table 1. Location of water quality and coliform sampling sites.

Site	Location description	GPS Coordinates	
A	Deep point in south basin	N 45º 19.314'	W 88º 35.646'
B	Deep point in north basin	N 45º 19.886'	W 88º 35.730'
C	McCaslin Creek at south basin	N 45º 19.089'	W 88º 36.484'
D	Under bridge between basins	N 45º 19.641'	W 88º 35.739'
E	Near old Birchwood Resort, north basin	N 45º 20.366'	W 88º 35.875'

Figure 5. Water quality assessment map for Townsend Flowage, Oconto County.



A Water quality sampling locations.

Watershed Assessment

In July 2006 the Townsend Flowage's watershed boundary was delineated and its physical characteristics described by using topographic maps, county soil surveys, and land-use data available through the Wisconsin DNR. Land use patterns, vegetative cover, potential nutrient loading sources, and environmentally sensitive areas were further assessed by an on-site ground survey. Pollutant loads for land-use types within the watershed were estimated using standard runoff coefficients.

The potential impacts of these features on the aquatic plant community of Townsend Flowage are presented and discussed. Management strategies for watershed features which are potential pollution sources have been incorporated.

Special attention was made to the condition of the Flowage's shoreline. A significant amount of nutrients and sediments can enter a lake from areas closest to the lake, it was important to focus on the entire lake shore and identify potential areas of concern. These included possible areas of disturbance, high erosion, or generally poor riparian health. Areas identified were documented and presented with management recommendations for remediation or improvement.

Results and Discussion

Aquatic Plant Communities

Of the 426 sampling points mapped across the flowage 399 were sampled. The remaining 27 sites were located primarily in the far north section of the flowage where Mosquito Creek enters. Because of very shallow water and dense vegetation, these sites could not be reached. Coordinates for the sampling points within the Flowage and McCaslin Creek can be found in **Appendix A**.

A total of 24 aquatic plant species were found during the 2006 submergent plant survey (**Table 2**). The most abundant plant species encountered in Townsend Flowage were bushy pondweed (*Najas flexilis*), common waterweed (*Elodea canadensis*), coontail (*Ceratophyllum demersum*) and small pondweed (*Potamogeton pusillus*). Each of these species were found at over 200 of the sampling points, and made up more than 10% of the plant community composition.

On March 29, 1995 a similar aquatic plant survey was conducted (MMA, Inc. 1995). However, the point-intercept method was not used for that survey as it was in 2006. Instead the Flowage was broken into 98 irregularly shaped areas primarily concentrated near shore. The data for this survey were compiled and results of this analysis can also be found in **Table 2**. Although the survey methods differed from 1995 to 2006, some comparisons can be made between the two sets of data. In 1995 bushy pondweed was also the most abundant species in the Flowage. A number of species including native pondweeds and northern milfoil appear to have higher relative frequencies when compared to the 2006 data. This can in part be a result of the sampling methodology. In addition, the 1995 survey identified fewer species (15) growing in the Flowage than when compared to the 2006 data. This is also likely a result of the sampling protocol. In 1995 data were collected from one-third the number of sites sampled in 2006.

The raw data for the 2006 submergent aquatic plant survey can be found in **Appendix B**. **Figure 6** presents the relative abundance of submergent aquatic plant species found in Townsend Flowage at the time of this survey.

A zone of aquatic plant growth exists in all lakes and is referred to as the littoral zone. Plant growth in the littoral zone is controlled primarily by light penetration. The clearer the water the deeper plants can grow. Because of the high water clarity in Townsend Flowage, plants are able to grow deep within the lake. A number of plant species were found growing at a depth of up to 20 feet.

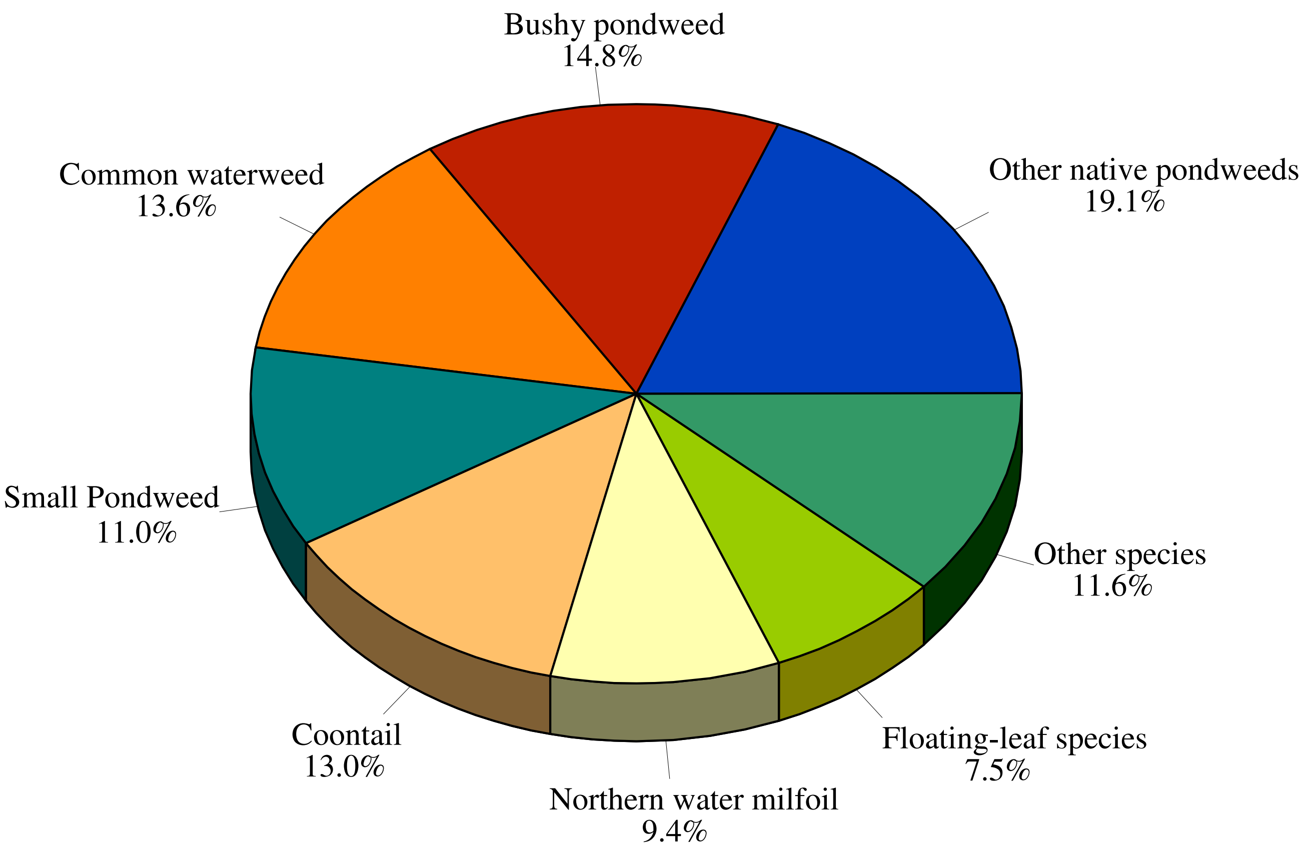
At the time of the aquatic plant survey, purple loosestrife (*Lythrum salicaria*), another exotic plant species, was identified at one location growing along the northern shore of McCaslin Creek. After the land owner was notified of the nuisance potential of this species, it was removed.

Table 2. Results of the submergent aquatic plant survey conducted on Townsend Flowage on July 16, 2006 and March 29, 1995.

		2006*		1995*	
Species common name	**scientific name**	**Percent Frequency**	**Relative Frequency**	**Percent Frequency**	**Relative Frequency**
Bushy pondweed	*Najas flexilis*	61.5	14.8	75.5	14.5
Common waterweed	*Elodea canadensis*	56.7	13.6	25.5	4.9
Coontail	*Ceratophyllum demersum*	53.8	13.0	2.0	0.4
Small pondweed	*Potamogeton pusillus*	46.7	11.2	44.9	8.6
Northern water milfoil	*Myriophyllum sibericum*	39.0	9.4	68.4	13.2
Clasping-leaf pondweed	*Potamogeton richardsonii*	28.5	6.9	65.3	12.6
Flat-stem pondweed	*Potamogeton zosteriformis*	20.3	4.9	35.7	6.9
Wild celery	*Vallisneria americana*	16.7	4.0	49.0	9.4
Nitella	*Nitella* spp.	12.6	3.0	--	--
Muskgrasses	*Chara* spp.	11.3	2.7	30.6	5.9
Spatterdock	*Nuphar variegata*	11.3	2.7	28.6	5.5
Forked duckweed	*Lemna trisulca*	10.5	2.5	--	--
Large-leaf pondweed	*Potamogeton amplifolius*	9.0	2.2	--	--
White-stem pondweed	*Potamogeton praelongis*	8.2	2.0	--	--
Illinois pondweed	*Potamogeton illinoensis*	5.1	1.2	--	--
Watershield	*Brasenia schreberi*	4.9	1.2	4.1	0.8
Floating-leaf pondweed	*Potamogeton natans*	4.9	1.2	12.2	2.4
White water lily	*Nymphaea odorata*	4.1	1.0	27.6	5.3
Variable pondweed	*Potamogeton gramineus*	3.6	0.9	--	--
Common bladderwort	*Utricularia vulgaris*	2.8	0.7	--	--
Filamentous Algae	*Pithophora,Cladophora, etc.*	1.5	0.4	--	--
Sago pondweed	*Stuckenia pectinata*	1.3	0.3	--	--
Stiff water crowfoot	*Ranunculus aquatilis*	0.8	0.2	--	--
Watermeal	*Wolffia colulmbiana*	0.5	0.1	--	--
Water star-grass	*Heteranthera dubia*	--	--	49.0	9.4
Large quillwort	*Isoetes lacustris*	--	--	1.0	0.2

* 2006 results include data collected within McCaslin Creek. 1995 results do not.

Figure 6. Submergent aquatic plant community composition for Townsend Flowage, Oconto County, July 2006.



Assessment of Floristic Quality

The plant data collect for Townsend Flowage were used to assess the "floristic quality" of the lake. The method used assigns a value to each native plant species called a Coefficient of Conservatism. Coefficient values range from 0 -10 and reflection a particular species' likelihood of occurring in a relatively undisturbed landscape. Species with low coefficient values, such as cattails, are likely to be found in a variety of habitat types and can tolerate high levels of human disturbance. On the other hand, species with higher coefficient values, such as stiff water crowfoot, are much more likely to be restricted to high quality natural areas. By averaging the coefficient values available for the submergent and emergent species found in Townsend Flowage a lake-wide value of 5.96 was calculated (see **Appendix C**).

By utilizing the Coefficients of Conservatism for the plant species of Townsend Flowage, further assessment of floristic quality can be made. By multiplying the average coefficient values for Townsend Flowage by the square root of the number of plant species found, a Floristic Quality Index (FQI) was calculated at 28.57 (see **Appendix C**). In general, higher FQI values reflect higher lake quality. The average for Wisconsin lakes is 22.2 (UW-Extension, 2005).

Both Coefficient of Conservatism and the Floristic Quality Index values suggest the quality of Townsend Flowage, specifically in terms of the plant community, is slightly above average.

Aquatic plants serve an important purpose in the aquatic environment. They play an instrumental role in maintaining ecological balance in ponds, lakes, wetlands, rivers, and streams. Native aquatic plants have many values. They serve as important buffers against nutrient loading and toxic chemicals, act as filters that capture runoff-borne sediments, stabilize lakebed sediments, protect shorelines from erosion, and provide critical fish and wildlife habitat. Therefore, it is essential that the native aquatic plant community in Townsend Flowage be protected. **Appendix D** provides a list of the more abundant native aquatic plant species that were found in Townsend Flowage. Ecological values and a description are given for each species.

Water Quality Analysis

Dissolved Oxygen and Temperature
Dissolved oxygen and temperature data collected for Townsend Flowage is included in **Appendix E**. These data were used to develop profile graphs for oxygen, temperature, and percent saturation for all sampling dates (**Figures 7 & 8**).

The profiles shown for Townsend Flowage are typical for lakes in Wisconsin. The dissolved oxygen data and profiles show that surface levels of dissolved oxygen remained high throughout the season. The threshold level of oxygen needed for fish such as bass, perch, and sunfish to survive and grow is 5 mg/L (Shaw, et al., 2004). **Figures 7 & 8** shows that even at the warmest times of the year, sufficient levels of oxygen were present at the surface of the lake. However, during the summer months, oxygen levels dropped off in the deeper portions of the south basin. The depths at which oxygen levels dropped off, referred to as the oxycline, was a depths between 15 and 20 feet during the summer months. In many lakes of Wisconsin, this decrease in oxygen is seen. These oxygen conditions produce an effect referred to as lake stratification. Below the oxycline there was insufficient oxygen to support many fish species.

Table 3. Oxygen solubility in water at different temperatures.

Temperature °C	°F	Oxygen solubility (mg/L)
0	32	15
5	41	13
10	50	11
15	59	10
20	68	9
25	77	8

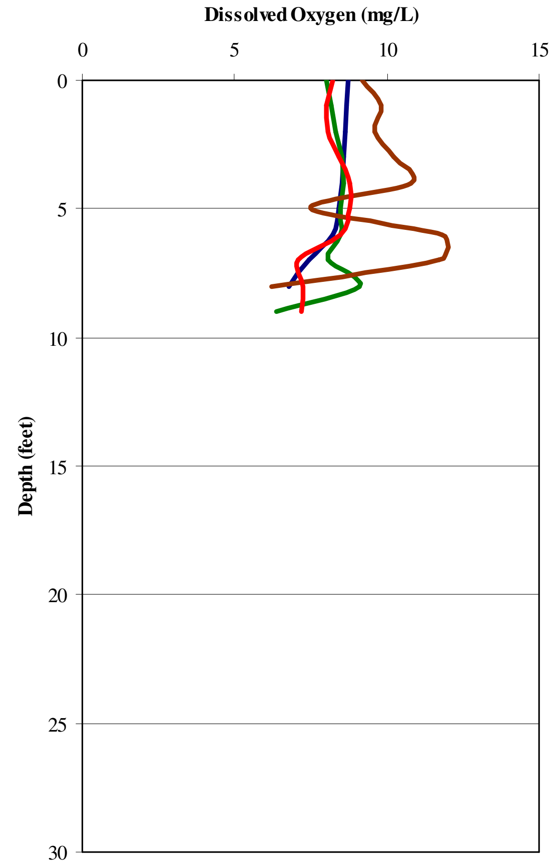
To better understand the data, it is important to first understand the relationship between dissolved oxygen and temperature. As a rule, colder water can hold more oxygen than warmer water. **Table 3** illustrates this point. By utilizing this relationship, the level (or percent) of saturation of oxygen can be determined at a given temperature. Saturation levels from sampling at Townsend Flowage can also be found in **Appendix E**. A number of the readings taken throughout the year appear to exceed the oxygen solubility given in **Table 3**. For these data the dissolved oxygen levels were higher than solubility levels at the corresponding temperatures. As a result, the percent saturation levels recorded in the field were quite high. Under warm sunny conditions in particular, oxygen levels in the lake can rise above 100%. This is a condition referred to as supersaturation and is due to conditions in the lakes such as wind and wave action as well as biological processes. In lakes with high levels of plants and algae, large amounts of oxygen can be produced through photosynthesis. During the night when photosynthesis ceases and respiration takes over, oxygen levels can drop off significantly. Through respiration, oxygen is consumed leaving depleted levels in the lake (Shaw, et al., 2004). These wide fluctuations can be particularly stressful to many fish and invertebrate species. The daily fluctuations in oxygen levels in Townsend

Flowage are likely minimal because algal abundance is low. Low levels of algae are indicated by the chlorophyll concentrations that were found.

Percent saturation values of 80-120% are considered to be excellent and values less than 60% or over 125% are considered to be poor (Stevens IT, 2004). With a few exceptions the saturation levels in the upper portions of Townsend Flowage were indicative of excellent water quality.

Summer temperature profiles in Townsend Flowage show changes with depth similar to the changes seen in the dissolved oxygen profiles. During the summer months the surface water temperatures were between 70º and 80º F. Although stable in the upper 10 feet of the lake, the deeper portions were generally 15ºF cooler.

Figure 7. Dissolved oxygen, temperature, and percent saturation profile graphs for the north basin of Townsend Flowage, Oconto County, Wisconsin.



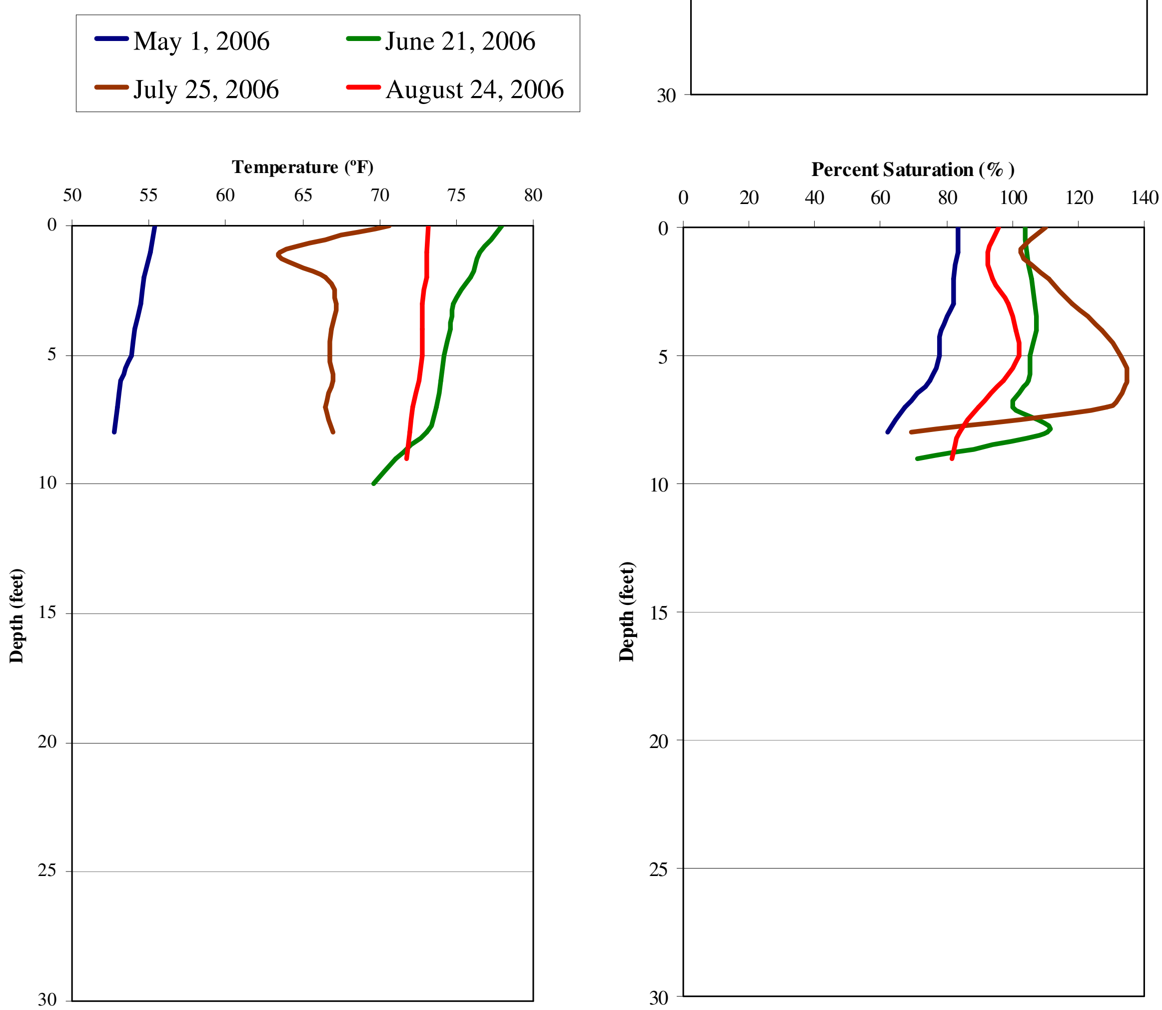
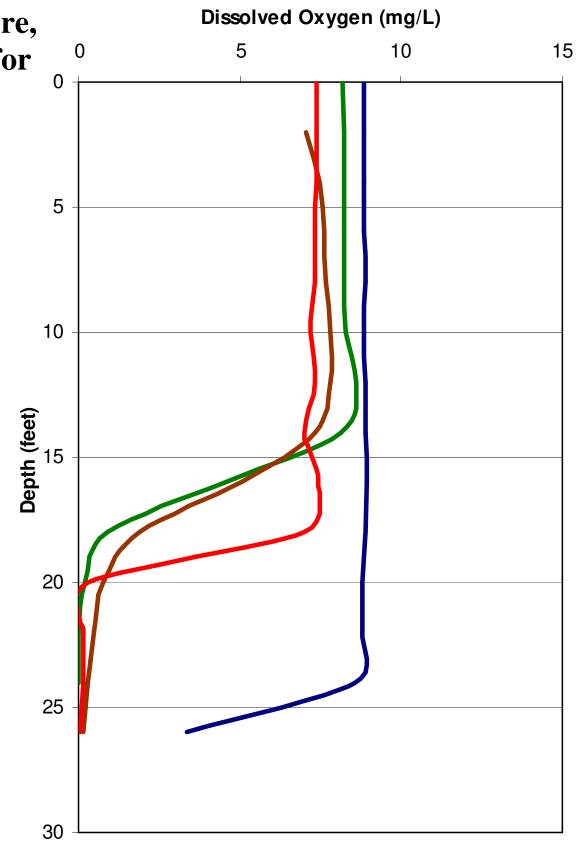
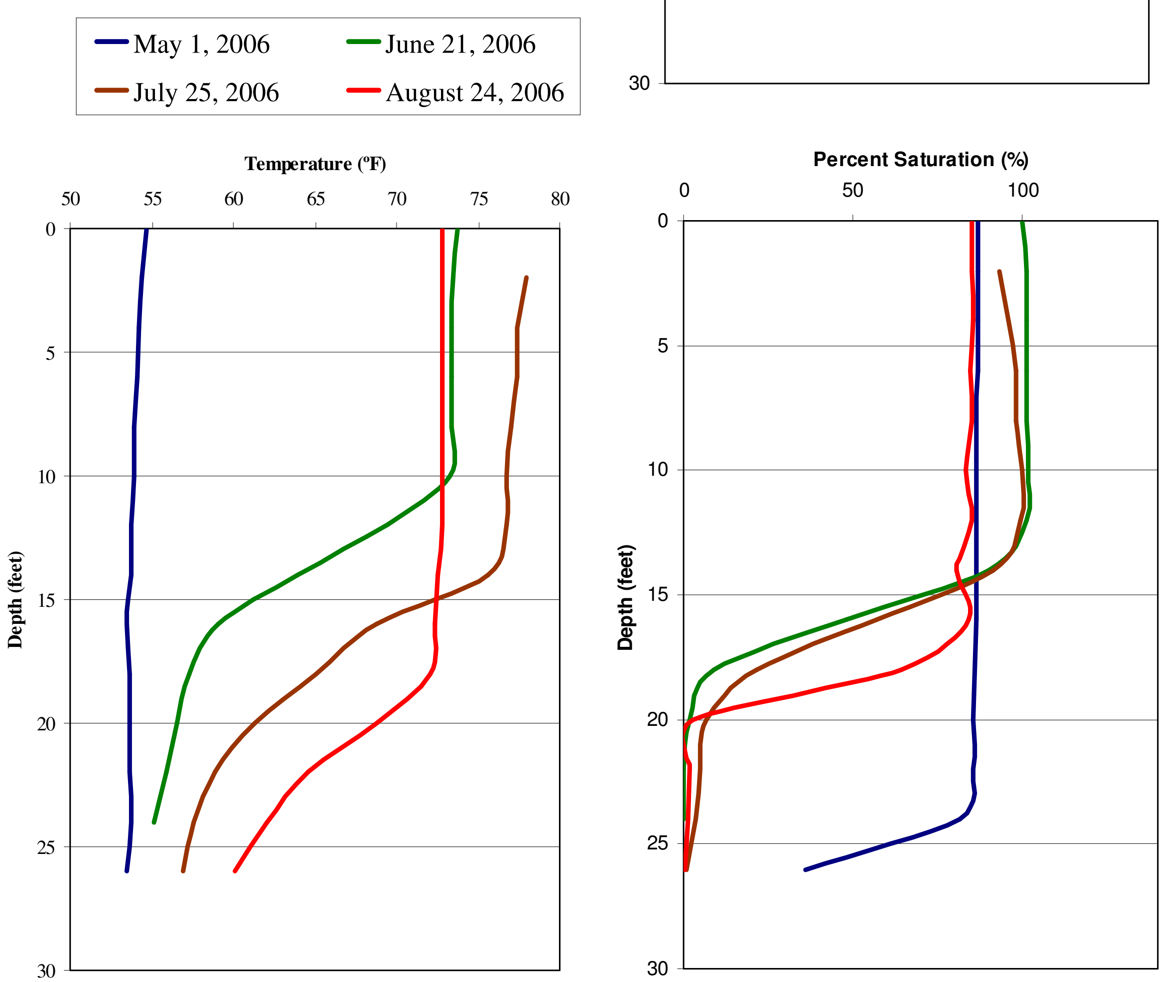


Figure 8. Dissolved oxygen, temperature, and percent saturation profile graphs for the south basin of Townsend Flowage, Oconto County, Wisconsin.





Seasonal trends in a number of water quality parameters for the period of May to August 2006 are shown in **Table 4**. Water testing results are not available for samples collected from the north basin in May.

pH
pH is a measure of a lake's acid level. It is the negative log of the hydrogen ion concentration in the water. Many factors influence pH including geology, productivity, pollution, etc. pH levels between 7 and 9.5 are not uncommon for hard water lakes in Wisconsin. (Shaw et al., 2004). pH data for Townsend Flowage fall within this range and do not raise concern over water quality in the flowage.

Phosphorus
Total phosphorus is one of the most important water quality indicators. Phosphorus levels determine the amount of plant and algae growth in a lake. Phosphorus can come from external sources within the watershed (fertilizers, livestock, septic systems) or to a lesser extent, from groundwater. Phosphorus can also come from within the lake. Internal loading occurs when plants and chemical reactions release phosphorus from the lake sediments into the water column.

The average phosphorus concentration for natural lakes in Wisconsin is 0.025 mg/L. Values above 0.05 mg/l are indicative of poor water quality (Shaw et al., 2004). Phosphorus concentrations throughout Townsend Flowage were consistently at or below 0.025 mg/L which is indicative of good water quality.

Total phosphorus measurements made from February to August 1994 (Foth & Van Dyke, 1998) were also consistently below the 0.025 mg/L level. In general data collected in May 2004 were the highest measured for the season. This is the same trend seen in the 2006 data as well.

Secchi Transparency
Water clarity is often used as a quick and easy test for a lake's overall water quality, especially in relation to the amount of algae present. There is an inverse relationship between Secchi depth and the amount of suspended matter, including algae, in the water column. The less suspended matter, the deeper the Secchi disc is visible. Water clarity readings collected for Townsend Flowage ranged between 2.4 and 3.8 meters in depth. These readings again indicate good to very good water quality (Shaw et al., 2004).

Data available from the 1994 study (Foth & Van Dyke, 1998) indicate water transparency at the time was between 3.5 to 3.7 meters. The data were relative consistent throughout the season. A limited amount of additional Secchi depth data is also available from 1996. These data were collected in July and August. At that time the Secchi depths were between 3.4 to 3.5 meters. Both the 1994 and 1996 data are consistent with the July and August 2006 Secchi depth data collected in the south basin of Townsend Flowage.

Chlorophyll
Chlorophyll is the pigment found in all green plants including algae that give them their green color. It is the site in plants where photosynthesis occurs. Chlorophyll absorbs sunlight to convert carbon dioxide and water to oxygen and sugars. Chlorophyll data is collected because this green pigment is found in algae and can be used to estimate how much phytoplankton (algae) there is in the lake. Generally speaking, the more nutrients there are in the water and the warmer the water, the higher the production of algae and consequently chlorophyll.

Chlorophyll concentrations below 10 µg/l are most desirable for lakes (Shaw et al., 2004). The highest chlorophyll concentrations (5.12 µg /L) were measured from the south basin sample collected in May. This is somewhat unexpected since one would expect early season chlorophyll readings to be at their lowest. As the season progresses, day lengths and temperatures increase, encouraging algal growth. Since concentrations were consistently low throughout the remainder of the season, the May concentrations should not be of concern.

This peak in chlorophyll concentrations was also seen in 1994 (Foth & Van Dyke, 1998). Again the highest concentrations were seen in May and June followed by a slow, steady decline. In general, concentrations of chlorophyll measured in 1994 were very similar to those measured in 2006.

Table 4. Water quality data collected for Townsend Flowage, May – August 2006.

	Parameter				
May 1, 2006	pH	Total Phosphorus (mg/l)	Chlorophyll (µg/l)	Secchi (m)	Secchi on bottom?
North Basin	7.48	n/a	n/a	2.6	Y
South Basin	7.24	0.025	5.12	3.0	N
June 21, 2006					
North Basin	9.40	0.024	4.52	2.7	N
South Basin	9.44	0.018	3.86	2.6	N
July 25, 2006					
North Basin	9.23	0.013	2.60	2.4	N
South Basin	9.15	0.015	2.74	3.4	N
August 21, 2006					
North Basin	8.54	0.014	2.6	2.7	Y
South Basin	8.93	0.012	2.73	3.8	N

When the 2006 results for total phosphorus, Secchi depth, and chlorophyll are compared to previous data dating back to 1994, little change is seen**.** This suggests that the water quality of Townsend Flowage has not changed significantly over the past 12 years.

Trophic State

There is a strong relationship between levels of phosphorus and chlorophyll and water clarity in lakes. As a response to rising levels of phosphorus, chlorophyll levels increase and transparency values often decrease. The effect of this is viewed as an increase in the productivity of a lake.

Lakes can be categorized by their productivity or trophic state. When productivity is discussed, it is normally a reflection of the amount of plant and animal biomass a lake produces or has the potential to produce. The most significant and often detrimental result is elevated levels of algae and nuisance aquatic plants. Lakes can be categorized into three trophic levels:

- oligotrophic - low productivity, high water quality
- mesotrophic - medium productivity and water quality
- eutrophic - high productivity, low water quality

These trophic levels form a spectrum of water quality conditions. Oligotrophic lakes are typically deep and clear with exposed rock bottoms and limited plant growth. Eutrophic lakes are often shallow and marsh-like, typically having heavy layers of organic silt and abundant plant growth. Mesotrophic lakes are typically deeper than eutrophic lakes with significant plant growth, and areas of exposed sand, gravel or cobble bottom substrates.

Lakes can naturally become more eutrophic with time, however the trophic state of a lake is more influenced by nutrient inputs than by time. When humans negatively influence the trophic state of a lake the process is called *cultural eutrophication*. A sudden influx of available nutrients may cause a rapid change in a lake's ecology. Opportunistic plants such as algae and nuisance plant species are able to out-compete other more desirable species of macrophytes. The resultant appearance is typical of poor water quality.

Total phosphorus, chlorophyll and Secchi depth are often used as indicators of the water quality and productivity (trophic state) in lakes. Values measured for these parameters can be used to calculate Trophic State Index (TSI) values (Carlson 1977). The formulas for calculating the TSI values for Secchi disk, chlorophyll, and total phosphorus are as follows:

$$TSI = 60 - 14.41 \ln \text{Secchi disk (meters)}$$

$$TSI = 9.81 \ln \text{Chlorophyll } (\mu g/L) + 30.6$$

$$TSI = 14.42 \ln \text{Total phosphorus } (\mu g/L) + 4.15$$

The higher the TSI calculated for a lake, the more eutrophic it is (**Figure 9**). Classic eutrophic lakes have TSI values starting around 50. Values calculated from the Townsend Flowage water quality data for 2006 were consistently below this level during the summer months (**Table 5**). Water quality measurements taken throughout this study place Townsend Flowage within the boundaries of a mesotrophic lake. Interestingly, TSI values for both the north and south basins dropped continuously throughout this study. This is likely due to a late summer drought and the resultant reduction in nutrient and sediment loading.

Figure 9. Relationship between trophic state in lakes and parameters including Secchi transparency, chlorophyll, and total phosphorus.

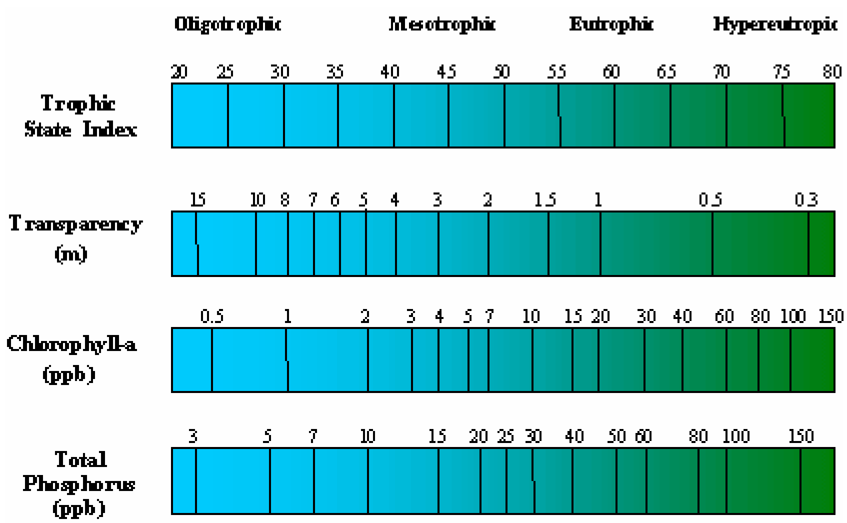


Table 5. Trophic State Index values calculated for Townsend Flowage, Oconto County, Wisconsin

	Parameter			
North Basin	*Phosphorus TSI*	*Chlorophyll TSI*	*Secchi TSI*	*Average TSI*
May 1, 2006	*n/a*	*n/a*	*n/a*	*n/a*
June 21, 2006	*49.98*	*45.40*	*45.46*	*46.94*
July 25, 2006	*41.14*	*39.97*	*47.16*	*42.76*
August 21, 2006	*42.21*	*39.82*	*n/a*	*41.01*

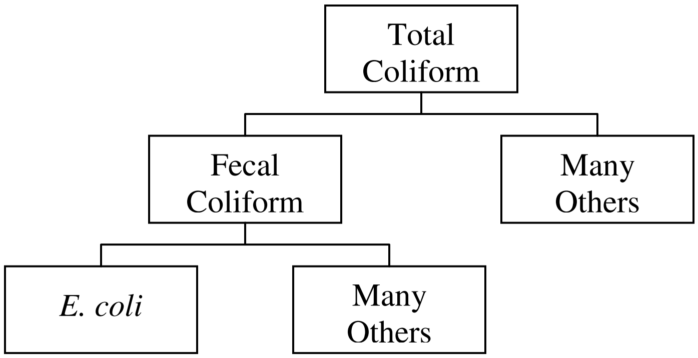
	Parameter			
South Basin	*Phosphorus TSI*	*Chlorophyll TSI*	*Secchi TSI*	*Average TSI*
May 1, 2006	*50.57*	*46.62*	*44.23*	*47.14*
June 21, 2006	*45.83*	*43.85*	*46.28*	*45.32*
July 25, 2006	*43.20*	*40.49*	*42.57*	*42.08*
August 21, 2006	*39.98*	*40.45*	*40.72*	*40.39*

Software available from the Wisconsin DNR entitled Wisconsin Lake Modeling Suite (WiLMS) can be used to predict the trophic state of a lake given its size, watershed area, mean depth and eco-region. Comparisons were made between the predicted TSI values and those calculated from the phosphorus, chlorophyll and Secchi data for the August sampling. The observed or measured values for these parameters were found to be slightly lower than those predicted by the WiLMS software. In other words, Townsend Flowage has better water quality than expected.

Coliform Sampling

The coliform test conducted on the samples collected from Townsend Flowage measured the concentration of both total coliform bacteria as well as *E. coli* or *Escherichia coli*. *E. coli* is a species of bacteria known to have the potential to cause related illnesses in humans and other animal species. **Figure 10** shows a simplified classification of coliform bacteria. The presence of coliform bacteria in a lake indicates the possible presence of fecal contamination. However, many species of coliform bacteria are not fecal in origin. In addition, fecal coliform bacteria can come from a number of animals including vertebrates and invertebrates. Those fecal coliform bacteria which are not mammalian in origin are not considered pathogenic to humans. As a result, attention is primarily directed at the *E. coli*. It should be further noted that there are a number of strains of *E. coli* and a vast majority do not cause illnesses in humans (Anderson and Davidson, 1997). Recent *E. coli* related illnesses in the U.S. have been caused by one of the few pathogenic strains of *E.coli.*

Figure 10. Simplified classification of coliform bacteria



Results of total coliform and E. coli sampling in Townsend Flowage can be found in **Table 6**. The Environmental Protection Agency has established primary and secondary contact water recreation criteria for the presence of *E. coli* in freshwater. Primary contact criteria are used when persons are likely to be fully immersed in the water, while secondary criteria are used for less than full immersion. For freshwater systems such as Townsend Flowage, the primary contact criterion establishes a maximum allowable level of 235 bacteria/100 ml. while the secondary criterion is a maximum allowable level of 298 bacteria/100 ml. Results for Townsend Flowage show that the highest level measured for *E. coli* (20 bacteria/100ml) was less than a tenth of the level needed to reach the primary contact criterion.

Table 6. Results of total coliform and E. coli sampling in Townsend Flowage

Site	**Total coliform (MPN/100 ml)**	**E. coli. (MPN/100 ml)**
Deep point in south basin	2420	20
Deep point in north basin	99	<1
McCaslin Creek at south basin	921	16
Under bridge between basins	>2420	5
Near old Birchwood Resort, north basin	1553	1

* MPN = Most Probable Number (bacteria count)

Watershed Analysis

In July 2006, the watershed analysis was conducted. **Figures 11 and 12** show the delineation of the Townsend Flowage watershed and the land use types present. The data for the land use map (**Figure 12**) was provided by the Wisconsin DNR's Bureau of Technology Services.

The survey and resulting analysis found that the watershed of Townsend Flowage is approximately 22.5 square miles. This area includes the waters of the Inland Lakes P & R District, stretches of McCaslin and Mosquito Creeks, much of the Town of Townsend as well as surrounding forests and wetlands within the Nicolet National Forest.

Table 7 contains a breakdown of land use and cover types within the watershed of Townsend Flowage. Not surprisingly, the watershed as a whole is dominated (nearly three quarters) by coniferous and deciduous forests. The agricultural areas of the watershed are concentrated between Reservoir Pond and Townsend Flowage near Valley View Road and are primarily hay, alfalfa, and fallow fields.

Table 7. Land use and cover types found within the watershed of Townsend Flowage, Oconto County, WI.

Land Type	% cover
Forest (coniferous/deciduous)	73.8
Wetland (forested/wet meadow)	13.8
Agriculture (general/row crops)	8.0
Surface Water (not including Flowage)	3.2
Urban (Town of Townsend)	1.1

During the watershed assessment, no obvious signs of runoff or erosion were found in the outlying areas. Much of the shore of Townsend Flowage has a high concentration of homes with rip rap, sea walls, or undeveloped waterfronts. However, a number of homes along McCaslin Creek have waterfronts with native shoreline vegetation.

Along the northwest shore of the Flowage, there are 17 new lots that have been developed in the past 24 months. An increase in development translates to increases in the number of lawns, driveways and other hard surfaces which are known to contribute nutrients and sediments to a lake. In addition, there are a number of areas along the shoreline of the Flowage which have steep slopes. For these reasons, it is those areas closest to the lakes which have the greatest influence on water quality.

Figure 11. Watershed of Townsend Flowage, Oconto County, Wisconsin.

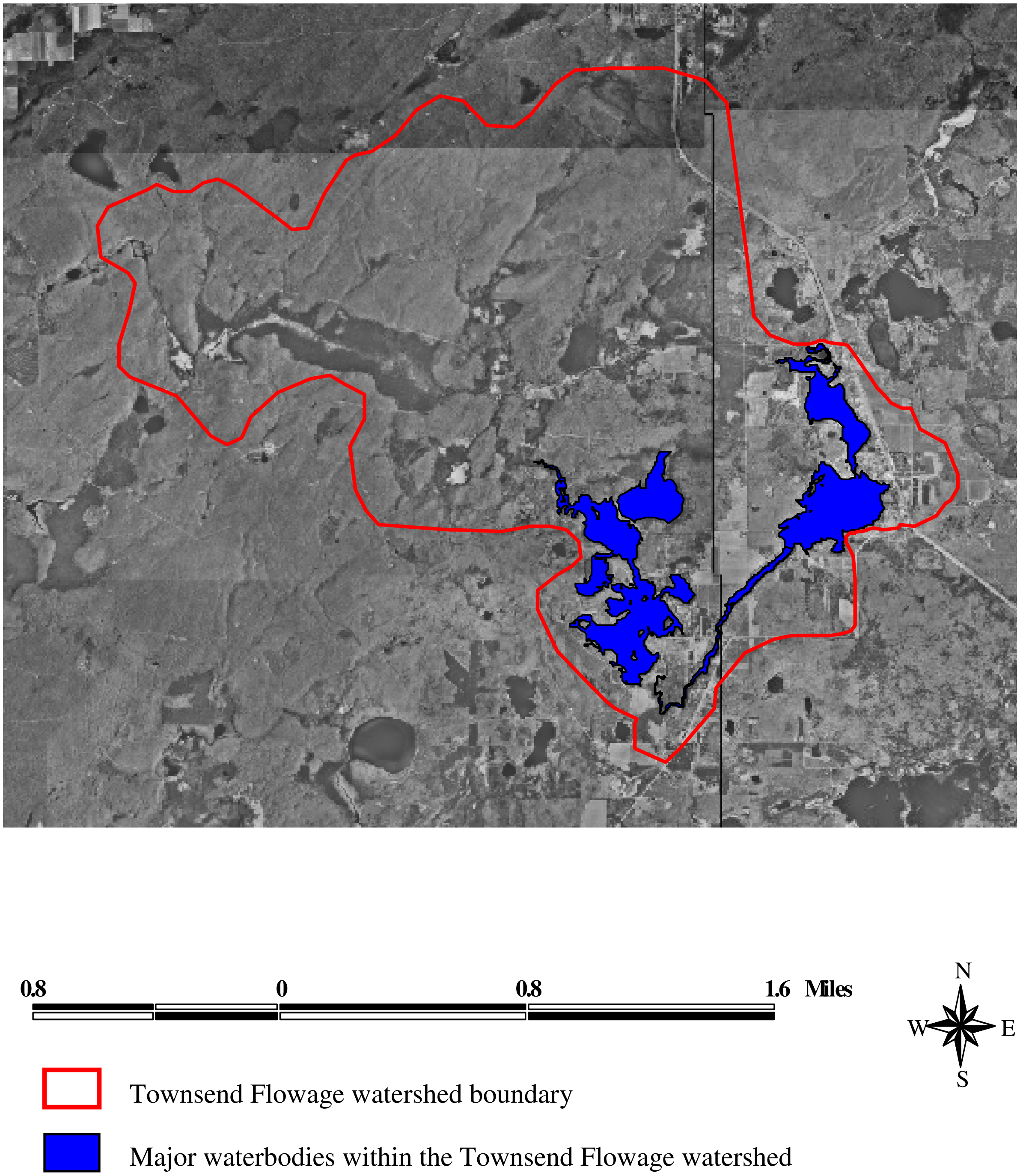
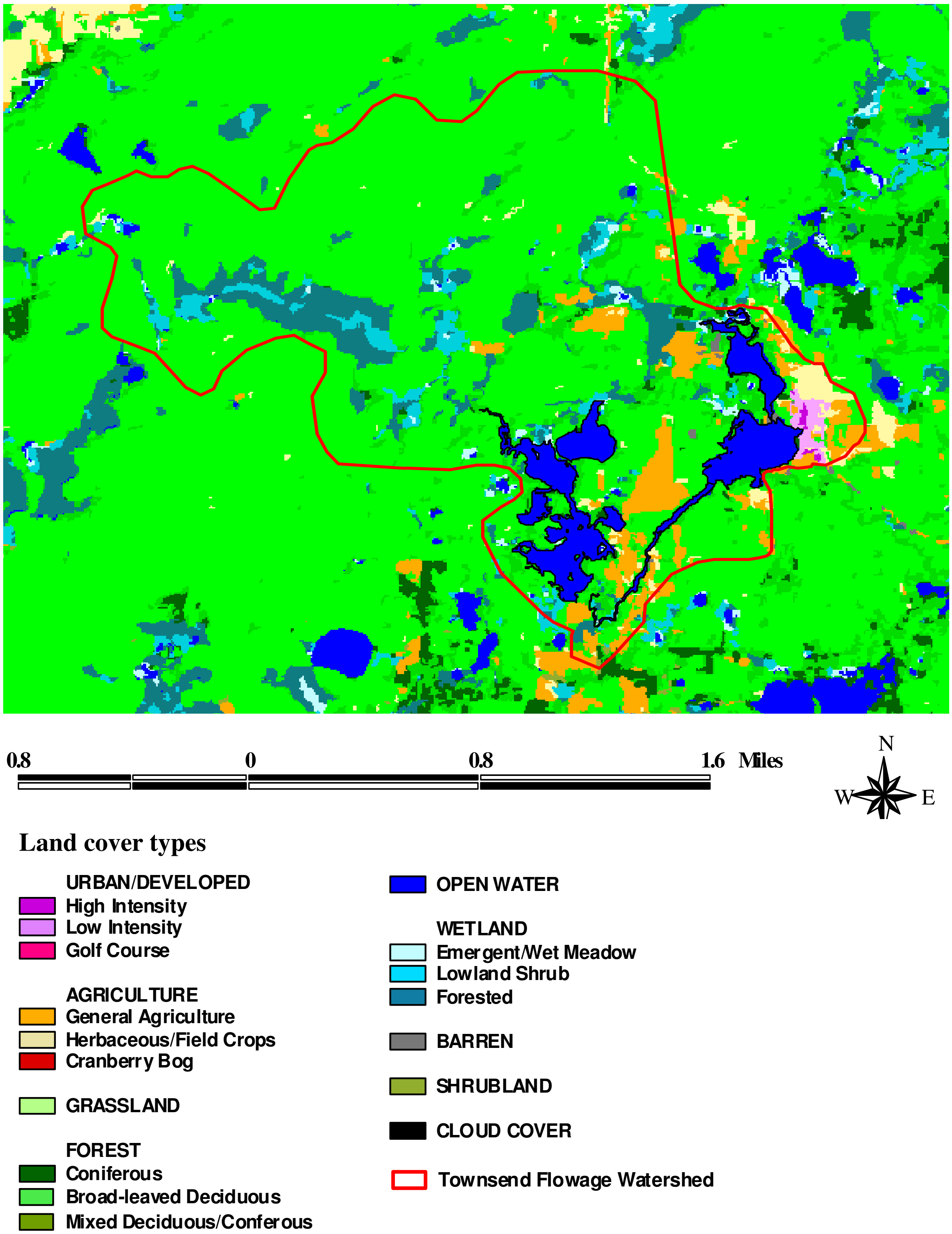


Figure 12. Land cover types and watershed delineation for Townsend Flowage, Oconto County, Wisconsin.



The soils found in the Townsend Flowage watershed are dominated (80.3 %) by loam soils (loam, silty loam, and sandy loam) (NRCS, 2006) (**Appendix F**). Loamy soils are comprised of relatively even amounts of the three main mineral soil components: sand, silt, and clay. Loams are gritty soils, which are pliable when wet and which retain water easily. Where slopes allow, these soils also drain well. In general these soils contain more nutrients0020than sandy or clay soils. Silty loam soils are less gritty than loam soils and have a higher concentration of organic matter and subsequently are higher in nutrient content. Oppositely, sandy loam soils are grittier than loam soils and have a lower concentration of organic matter and are lower in nutrient content. The remaining watershed contains sandy muck soils (11.7%), water (4.5%), and sandy soils (3.5%). Muck soils are highly organic, poorly drained (wet or *hydric*) soils and are indicative of wetland areas. Sandy soils are well-drained soils with little water holding capacity. **Appendix F** also gives more detailed explanation of the soils found within the watershed.

External nutrient loading
The external loading of runoff pollutants, namely phosphorus, into Townsend Flowage can be approximated by utilizing general export coefficients and the WiLMS predictive modeling software. Export coefficients are available for a number of land use types as kilograms of pollutant per hectare per year. Coefficients for total phosphorus used in the WiLMS model are given in **Table 8**.

Table 8. General Export Coefficients for total phosphorus for the Eastern U.S.

	Export Coefficients* (kg/ha/yr)
Land Use	TP
Urban	0.5
Rural/Agriculture	0.8
Forest	0.09

*From Rast and Lee (1978).

By utilizing the data available for land use types in the Townsend Flowage watershed and the above coefficients, it was estimated that the total input of phosphorus from direct runoff annually is approximately 1975 lbs (896 kg). Other sources of phosphorus would include atmospheric contributions, namely precipitation (4.36 lbs/year), groundwater and internal cycling (Holdren, 2001).

In addition, contributions of nutrients, namely phosphorus by septic tanks can be estimated with the WiLMS software. On average a septic system is expected to contribute 0.5 Kg P/capita-year. A capita year is equivalent to one person occupying a dwelling for a period of one year. This contribution assumes that 90% of this output of phosphorus within the drainage field is retained by the soil. It has been estimated that there are over 225 homes on the shore of Townsend Flowage. However, many of these are part-time residents. The total usage of septic systems around the Flowage was estimated at 113 capita-year. As a result, the contribution of phosphorus by septic systems around Townsend Flowage was estimated to be 12.5 lbs (5.7 kg) phosphorus per year.

By inputting additional data related to the oxygen stratification, measured phosphorus concentrations during turnover and the growing season, and estimated area of anoxia, the WiLMS software was able to predict the total annual phosphorus load into Townsend Flowage. The internal load, contributed primarily through nutrient release in the sediments was predicted to be 13.6 lbs (6.2 kg) of phosphorus per year. The total external load was predicted to be 2001 lbs (908 kg) of phosphorus per year

Sediment Management

During this study, concerns were raised regarding sediment accumulations and impairments to navigation in the northern most part of Townsend Flowage. Specifically the concern was raised regarding the area between West Summer Lane and Forest Hill Drive. This area of shallow water can be considered the back waters of Mosquito Creek as it enters the Flowage. Residents in this area are very limited in their access to the rest of the Flowage. During a majority of the year, dense aquatic vegetation, shallow water and heavy sediment deposits prohibit the westerly movement of boats toward Mosquito Creek. These sediments also prohibit the use of the harvesters in most northern parts of the Flowage. These residents have had to rely on other limited options to gain access to the Flowage. A culvert running under Summer Lane allows some watercrafts to access the Flowage from the other direction. However, this culvert is often blocked by beaver activity and only small watercrafts can fit through it. Most residents are resigned to either not having a boat on their property or docking their boats elsewhere.

Some residents would like to consider the option of dredging sediments out of this back water area to allow navigation and if needed harvesting. For the Association's consideration **Appendix G** contains general information regarding sediment reduction options and what to expect when undertaking a dredging project. Members should be aware that a dredging project can be a long, costly, and inconvenient process. In general the permit process alone can take six months or more to complete. It is important that the Townsend Flowage Association be aware of the process and the amount of work required to obtain a permit and to complete a dredging project of this magnitude.

Conclusions and Recommendations

Aquatic Plant Management

Results of the aquatic plant survey conducted in 2006 confirm that neither Eurasian watermilfoil *(Myriophyllum spicatum)* nor curly-leaf pondweed *(Potamogeton cripsus)* currently infest the waters of Townsend Flowage. However, the waters upstream of Townsend Flowage including Reservoir Pond and Horn Lake do contain Eurasian watermilfoil. Although members of the Inland Lakes Protection and Rehabilitation District No. 1 have undertaken a milfoil management program, milfoil has not been eradicated from their waters. Due to the close proximity of these waters it is reasonable to assume that for the foreseeable future, Eurasian watermilfoil will pose a risk of infesting the waters of Townsend Flowage.

Exotic Species Contingency Plan

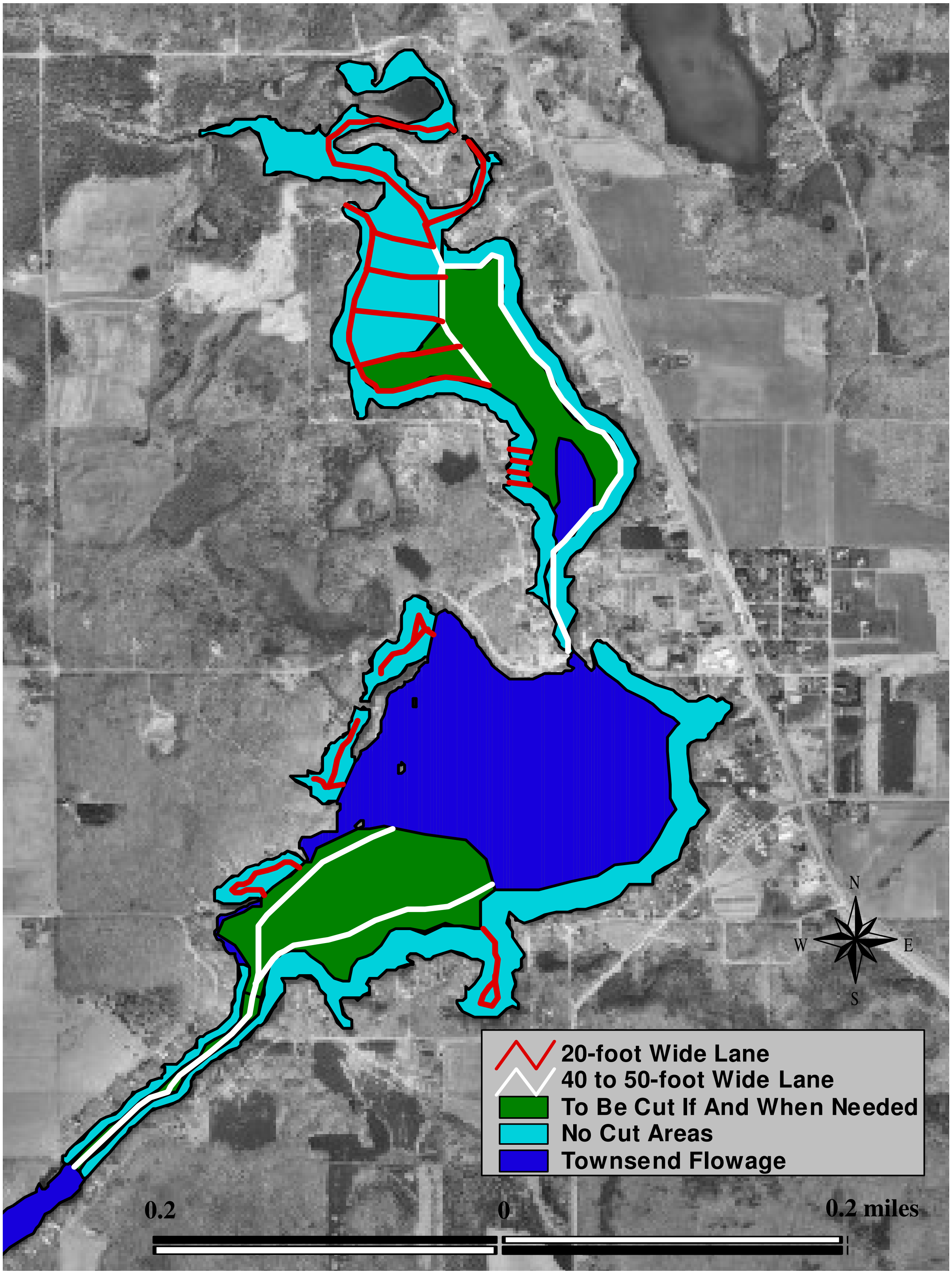
Because of the risk of infestation by exotic species, it is important that contingency plans be put in place to respond to the introduction of exotic species as quickly as possible. To this end, Townsend Flowage should be monitored annually for the possible presence of Eurasian watermilfoil as well as other exotic species. Lake residents should undertake an active monitoring program for the purpose of identifying and documenting possible exotics. Education should play a big part in this program. All individuals willing to participate should be taught to identify exotic species. The Association should make it a priority to include such measures during all normally scheduled meetings whenever possible. In addition, special meetings should be considered to focus primarily on the identification of these species for riparian property owners and frequent lake users. The native plant, northern watermilfoil *(M. sibericum)*, grows in abundance in parts of the Flowage. Because it superficially looks much like Eurasian watermilfoil, care should be taken to specifically learn to differentiate between the two species. In addition to Eurasian watermilfoil and curly-leaf pondweed, it would behoove members of the association to become familiar with the identification of species such as purple loosestrife and zebra mussels *(Dreissena polymorhpa)*. Each of these four species has been identified throughout Wisconsin. **Appendix H** gives information regarding the identification and life history for these four species. Further information and education materials are available through the Wisconsin DNR.

Once education efforts are underway, the Association should organize lake volunteers to regularly monitor the Flowage for these four species. If a volunteer locates what he or she believes to be an exotic species, its location should be documented by recording GPS coordinates. In addition, a sample should be collected and taken to a member of the Association's Board or a coordinator of the monitoring program if one is appointed. Any suspicious material should be sent to the nearest Wisconsin DNR office for verification. In addition to volunteer monitoring, it would be wise to call upon the assistance of lake management consultants to annually survey the Flowage for exotic species. If the identification is confirmed it will be important to initiate management measures as quickly as possible. The extent of an exotic species infestation often dictates which management option is most likely to result in successful control. As a result, **Appendix H** also contains information regarding management options for the four exotic species previously mentioned. As always education should be a key component of any exotic species management effort.

Aquatic Plant Harvesting

In order for the Townsend Flowage Association to continue the current aquatic plant cutting operation, it will be necessary to renew the harvesting permit. Currently, the two main areas of cutting are located in the upper portion of the north basin and the along the shores of the south basin leading to and including McCaslin Creek. This approach was modified in 2002 with the assistance of Wisconsin DNR staff. Since that time, lake users and Association members have expressed a desire to further modify the cutting approach. As a result of conversations with the Association and the harvester crew, certain modifications have been made. **Figure 13** shows the newly modified approach the Association wishes to take in regards to future aquatic plant harvesting. Much of the plan has remained the same including primarily the 20 foot and 40-50 foot navigation lanes. However, areas in both basins have been included which would be cut if and when needed. Over the past ten years it has been noted by many lake users that aquatic plant growth in these areas often become quite dense causing impairments to navigation. However, with the current harvesting plan, these areas cannot be cut. In particular, northern milfoil has grown noticeably denser over the past two years in areas of the southern basin. In addition, these areas are also the locations where the cutting crew has often noticed mats of uprooted vegetation which have caused further navigation and aesthetic problems along shores. The decision whether or not to cut in these areas would be at the discretion of the cutting crew. Cutting will only occur when aquatic vegetation has reached, or nearly reached the surface of the water and when this vegetation clearly hinders navigation. Subsequently, navigation lanes only would be cut through these areas. In addition, the cutting crew would operate in these areas to remove the uprooted mats of vegetation when they form.

Figure 13. Aquatic plant harvesting approaches proposed by the Townsend Flowage Association.



Herbicide Treatment of Navigation Lanes

As was evident from the results of the aquatic plant survey, native aquatic plants play a large part in interfering with navigation in Townsend Flowage. In the past, the Association has relied on harvesting as a means to maintain navigation in areas of dense aquatic plant growth. If in the future, the cutters are unable to keep up with the level of aquatic plant growth, herbicide treatments may be considered as an alternative. A broad spectrum herbicide or mixture of herbicides will target all plant species in a treatment area. If individual species are targeted, a more specific herbicide may be applied in a manner that would target that particular species. Herbicide treatment of native plants may be a less desirable option than harvesting when exotic species invasion is a threat. Because the herbicides kill plants instead of merely cutting them, more opportunistic exotic plants may be better able to colonize the treated areas.

The method used for this type of treatment involves spraying herbicides to the surface of the water within the treatment area. Only those chemicals registered with the U.S. EPA and the Wisconsin Department of Agriculture, Trade, and Consumer Protection may be used. Often a mixture of three chemicals (Cutrine®, Aquathol K®, and Reward®), will be used to target all plants and algae. This approach should be used for early season applications on low-growing plants to minimize the amount of plant matter dying off at once. However, sometimes a later season follow-up treatment is needed to maintain open water. If this approach is used, it is likely that annual treatments would be needed to maintain effective control.

Management of Shoreline Vegetation

Aquatic vegetation can grow to nuisance levels in the near-shore areas of a lake. Since conventional weed harvesting equipment is unable to operate in the shallow waters along shore, other management options are available to riparian property owners. Typically, there are four management options for control of aquatic vegetation. They are biological, physical, manual/mechanical or chemical. Biological and physical options are used in very specific circumstances. For the homeowners living on Townsend Flowage, manual removal and chemical control are the best options for successful control. It is important to note that the removal of native vegetation from a lake regardless of the method being employed can create conditions favorable for colonization by opportunistic plants. This is particularly the case for more aggressive exotics species such a Eurasian watermilfoil.

Manual removal of shoreline vegetation
Individuals can remove aquatic vegetation in front of their homes, however, there are limitations as to where it can occur and how much can be removed. In most instances, control of native aquatic plants is discouraged or should be limited to areas next to piers and docks.

While larger-scale mechanical removal of vegetation requires a permit from the Wisconsin DNR, manually removing plants along shore (i.e. hand-pulling or using rakes) does not. However, when aquatic vegetation is manually removed it is restricted to an area that is 30 feet or less in width along the shore. The non-native invasive plants (Eurasian watermilfoil, curly-leaf pondweed, and purple loosestrife) may be manually removed beyond 30 feet without a permit, as long as native plants are not harmed.

Herbicide treatment of *s*horelines
Since exotic plant species have not been found within Townsend Flowage, members of the Association must contend with the problems associated with excessive growth of native aquatic plants. One option commonly utilized by individual property owners involves near shore chemical treatment of aquatic plants. Individuals can obtain a permit from the Wisconsin DNR to chemically treat aquatic plants in a 30-foot strip along their property extending out 150 feet if necessary. The same three chemicals used in treating navigation lanes would be use in this approach as well.

Before any treatment plan is adopted for a lake, a number of concerns should be addressed.

Are these herbicides safe for humans? Aquathol K® (chemical name: endothall) and Reward® (Chemical name: diquat) are both organic herbicides, while Cutrine® is a copper-based herbicide. The Environmental Protection Agency (EPA) lists endothall as a Class D herbicide. This classification means that there are insufficient data to suggest that this compound causes cancer or is harmful to humans. Diquat is classified as Class E herbicide. This means diquat is a chemical for which there is no evidence of carcinogenicity for humans based on a lack of evidence in studies with two species, rat and mouse. In a study using mice, diquat was not carcinogenic. At the rates applied with this approach the concentration of copper in the water column is at such a low concentration that there are no health risks to humans.

The EPA product label for endothall lists a three-day fish consumption waiting period, while the diquat label lists a three-day waiting period for drinking and a five-day waiting period for irrigation of food crops. Copper-containing herbicides do not have such use restrictions. While it is not possible to guarantee that any herbicide is 100% safe, the overwhelming body of evidence suggests that these herbicides when properly used pose minimal risks to humans.

Are these herbicides safe for the environment? All three of these herbicides are organic in nature and biodegrade quickly in aquatic environments and do not bioaccumulate. . Generally, fish species are tolerant of the Aquathol® formulation of endothall at concentrations of approximately 100 ppm or over. Meanwhile, concentrations of only 0.5 to 5.0 ppm are generally required for aquatic weed control. Endothall also has a low toxicity to crustaceans and a medium toxicity to aquatic insects. Diquat is a broad-spectrum contact herbicide. It is used to control a wide variety of submersed, floating and marginal aquatic weeds as well as algae. For this reason, it is important to minimize the use of such chemicals. Impacts to desirable native plants can be minimized by treating early in the season only in areas of highest priority. Diquat dissipates so quickly it is often undetectable 1-3 days following treatment. Although copper is considered to be toxic to mollusk and fish, it is applied at a low enough rate to target only aquatic plants, algae in particular.

Are they effective? These herbicides have been used on thousands of lakes throughout North America. When applied at the labeled rates in conjunction, this combination will eliminate all plant species in the treatment area.

Are they economical? While no control method could be considered cheap, herbicide treatments are among the least costly of methods. This is in part due to the relatively low labor costs in comparison to measures such as hand-pulling, mechanical harvesting, etc. Perhaps the greatest consideration is that these herbicides typically produce long-term control of exotics. This means that lake management units seldom need to spend as much in the long-term as they do for the initial treatments. Once the target species are brought under control, the costs of annual maintenance treatments, if needed, are minimal.

What are the disadvantages? The greatest disadvantage of herbicide treatments is that they rarely produce 100% control. In most cases, herbicides tend to work only where applied. This is more so the case with granular formulations. Unnoticed and untreated plants may eventually grow to dense beds if left unchecked. Factors such as pH and plant maturity may also reduce treatment efficacy. Several follow-up treatments, whether in-season or in subsequent years, may be needed to reduce exotic species to target levels.

Designation of Critical Habitat

Lakes with high quality plant communities often contain areas where critical habitat can be found associated with threatened or endangered plant species. If certain criteria are met, areas can be identified and protected through a Sensitive Area designation by the Wisconsin DNR. Areas of Townsend Flowage may meet the criteria necessary for such a designation. However, currently, none of the 24 plant species identified in the Flowage is considered threatened or endangered. In addition, Mosquito Creek has been designated as an Exceptional Resource water. An Exceptional Resource water is defined as a stream which has excellent water quality, high recreational and aesthetic value, and high quality fishing and is free from point source or nonpoint source pollution. However, it may also be impacted by point source pollution or have the potential for future discharge from a small sewer community. The shallow wet areas in the far north of the Flowage where Mosquito Creek enters may be considered for special designation if threatened or endangered species are found. Special attention should be paid during future aquatic plant surveys in order to further assess the potential for special designations within the Flowage.

Water Quality Management

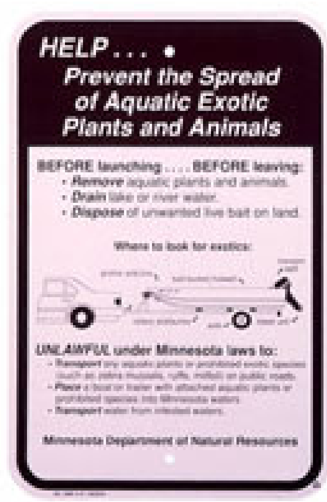
Water quality does not appear to be a serious problem for Townsend Flowage. Water clarity was consistently high and nutrient levels were consistently low throughout this study. To best ensure water quality remains high, it is recommended that the Association encourage riparian landowners to focus on improvements to individual lakeshore properties. Improved land use practices within watershed will help maintain water quality in Townsend Flowage. A number of water quality and shoreline improvement options are described in **Appendix I**.

Additional Association Involvement

Improved public awareness is one of the most important aspects of any lake management effort. By becoming knowledgeable about the condition of Townsend Flowage, the Association can learn what practices are necessary to reduce nutrient inputs and keep the lake healthy. There are a number of activities that Association members can carry out to improve lake users' awareness of the problems facing Townsend Flowage.

It is important that the boat landings on Townsend Flowage be posted with exotic species prevention signs. There are signs available through the Wisconsin DNR (see **Figure 14**). These signs should be posted and maintained at all access points to Townsend Flowage including boat launches and walk-ins. Many lake organizations choose to design and erect larger signs designed to call attention to specific concerns related to their lake.

Figure 14. Exotic species prevention signs available through the Wisconsin DNR.



Since exotic species have not yet been found in Townsend Flowage, the focus of these signs should be education and prevention.
It is recommended that all signs posted around the Flowage encourage boaters entering or leaving the lake to remove any plant or animal material from their watercrafts.

Several other prevention and educational awareness activities should be planned. This can include public notices regarding exotic species, distribution of Wisconsin DNR educational literature to public lake users, and conducting watercraft inspections. These volunteer efforts should focus on preventing the spread of Eurasian watermilfoil and other exotic species. Watercraft inspections can also be used as a tool to document potential watercraft infestations that can be communicated to the Wisconsin DNR.

Clean Boats, Clean Waters

The Wisconsin DNR in cooperation with the UW-Extension Lakes Program have developed a volunteer watercraft inspection program designed to educate motivated lake organizations in preventing the spread of exotic plant and animal species in Wisconsin lakes. This program would be particularly useful to Townsend Flowage since Eurasian watermilfoil has been found in nearby lakes. Through the Clean Boats, Clean Waters program volunteers are trained to organize and conduct boater education programs.

For more information contact:
Laura Felda-Marquardt
Clean Boats, Clean Waters Program Coordinator
Wisconsin Invasive Species Program
Ph: 715-365-2659 (Rhinelander)
Ph: 715-346-3366 (Stevens Point)

To download a printable brochure regarding the Clean Boats, Clean Waters program go to http://www.uwsp.edu/cnr/uwexlakes/CBCW/Pubs/CBCW_brochure.pdf.

Wisconsin Citizen Lake Monitoring Network

The Wisconsin DNR's Self-Help Lake Volunteer Monitoring Network provides an opportunity for volunteers from lake organizations to assist in state-wide water quality monitoring. Through this program volunteers collect a variety of water quality data in order to gain a better understanding of lake conditions. Through a database managed by the DNR, information gathered can be shared and archived. The types of data collected depend on what concerns and interests are for a particular lake as well as the amount of time available for monitoring.

The most common type of monitoring is for water transparency with the use of a Secchi disc. Volunteers collect water clarity data during spring and fall turnovers as well as throughout the summer. After collecting Secchi data for one or more years, some organizations begin collecting additional water quality data. Volunteers can collect phosphorus and chlorophyll samples in addition to collecting Secchi data. The data collected allows lake managers and the Wisconsin DNR to assess the nutrients present in a lake. In addition, temperature and dissolved oxygen data are also commonly collected on lakes. Other volunteer activities include monitoring for zebra mussel, Eurasian water-milfoil, Purple loosestrife, and curly-leaf pondweed.

The Townsend Flowage Lake Association is encouraged to participate in this program. For more information contact Laura Herman, Citizen Lake Monitoring Network Educator, at (715) 346-3989 (Stevens Point) or (715) 365-8984 (Rhinelander), or by email Laura.Herman@uwsp.edu.

For more information visit: http://dnr.wi.gov/org/water/fhp/lakes/selfhelp/.

To download a printable manual for the Self-Help Lake Volunteer Monitoring program go to: http://dnr.wi.gov/org/water/fhp/lakes/selfhelp/manual/lakesmanual_2006rev.pdf

State and Federal Grants
A number of grants are available to lake organizations wishing to implement effective lake management efforts or conduct lake related research. **Appendix J** describes a number of the most applicable grants, who qualifies and what type of projects can be funded.

Top Management Recommendations

The following is a condensed list of management recommendations based on the results of this study. It is intended to provide the Townsend Flowage Lake Association, a short list of the "top 5" management recommendations for the Flowage. These recommendations should be achievable with the cooperation of members of the Association.

1. Implement Exotic Species Contingency Plans
    - Continue to monitor for the presence of exotic species
    - Implement program to educate Association members how to identify exotic species
    - Focus primarily on Eurasian watermilfoil and curly-leaf pondweed.

2. Apply for harvesting permit based on updated cutting map
    - Complete the Aquatic Plant Harvesting Plan worksheet
    - Use modified map developed with input from the cutting crew
    - If permitted, begin new cutting approach

3. Water quality and shoreline improvement options
    - Promote shoreline practices to reduce erosion and sedimentation and increase water quality
    - Encourage riparian property owners to create vegetative buffer zones
    - Improve lawn care practices and properly maintain septic systems

4. Clean Boats, Clean Waters/ Wisconsin Citizen Lake Monitoring Network
    - Encourage Association members to participate in programs
    - Implement practices learned during training
    - Promote responsible lake stewardship

5. Aquatic Invasive Species grant program
    - Apply for grant funding to assist in exotic species prevention and education
    - Consider a joint approach with the inland Lakes Protection and rehabilitation District #1
    - If exotic species are introduced to the Flowage consider the Rapid Response grant option to quickly respond to the threat

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Appendix A

- GPS coordinates for the aquatic plant survey conducted on July 16, 2006 on Townsend Flowage, Oconto County, WI.

- GPS coordinates for the aquatic plant survey conducted on July 16, 2006 on McCaslin Creek, Oconto County, WI.

GPS coordinates for the aquatic plant survey conducted on July 16, 2006 on Townsend Flowage, Oconto County, WI.

Plotid	Plotrow	Plotcol	Xcoord	Ycoord	Easting	Northing	Latitude	Longitude
1	4	1	628968	541999	628967.77	541999.39	45.34304	-88.6091
2	44	1	628968	539399	628967.77	539399.39	45.31964	-88.6097
3	4	2	629033	541999	629032.77	541999.39	45.34303	-88.6083
4	42	2	629033	539529	629032.77	539529.39	45.32080	-88.6088
5	44	2	629033	539399	629032.77	539399.39	45.31963	-88.6088
6	45	2	629033	539334	629032.77	539334.39	45.31904	-88.6089
7	46	2	629033	539269	629032.77	539269.39	45.31846	-88.6089
8	47	2	629033	539204	629032.77	539204.39	45.31787	-88.6089
9	4	3	629098	541999	629097.77	541999.39	45.34302	-88.6074
10	41	3	629098	539594	629097.77	539594.39	45.32137	-88.6080
11	42	3	629098	539529	629097.77	539529.39	45.32079	-88.6080
12	43	3	629098	539464	629097.77	539464.39	45.32020	-88.6080
13	44	3	629098	539399	629097.77	539399.39	45.31962	-88.6080
14	45	3	629098	539334	629097.77	539334.39	45.31903	-88.6080
15	46	3	629098	539269	629097.77	539269.39	45.31845	-88.6080
16	47	3	629098	539204	629097.77	539204.39	45.31786	-88.6081
17	4	4	629163	541999	629162.77	541999.39	45.34301	-88.6066
18	5	4	629163	541934	629162.77	541934.39	45.34242	-88.6066
19	6	4	629163	541869	629162.77	541869.39	45.34184	-88.6066
20	41	4	629163	539594	629162.77	539594.39	45.32136	-88.6071
21	42	4	629163	539529	629162.77	539529.39	45.32078	-88.6072
22	43	4	629163	539464	629162.77	539464.39	45.32019	-88.6072
23	44	4	629163	539399	629162.77	539399.39	45.31961	-88.6072
24	45	4	629163	539334	629162.77	539334.39	45.31902	-88.6072
25	46	4	629163	539269	629162.77	539269.39	45.31844	-88.6072
26	47	4	629163	539204	629162.77	539204.39	45.31785	-88.6072
27	5	5	629228	541934	629227.77	541934.39	45.34241	-88.6058
28	6	5	629228	541869	629227.77	541869.39	45.34183	-88.6058
29	40	5	629228	539659	629227.77	539659.39	45.32194	-88.6063
30	41	5	629228	539594	629227.77	539594.39	45.32135	-88.6063
31	42	5	629228	539529	629227.77	539529.39	45.32077	-88.6063
32	43	5	629228	539464	629227.77	539464.39	45.32018	-88.6063
33	44	5	629228	539399	629227.77	539399.39	45.31960	-88.6064
34	45	5	629228	539334	629227.77	539334.39	45.31901	-88.6064
35	46	5	629228	539269	629227.77	539269.39	45.31843	-88.6064
36	5	6	629293	541934	629292.77	541934.39	45.34240	-88.6050
37	6	6	629293	541869	629292.77	541869.39	45.34182	-88.6050
38	36	6	629293	539919	629292.77	539919.39	45.32427	-88.6054
39	37	6	629293	539854	629292.77	539854.39	45.32368	-88.6054
40	40	6	629293	539659	629292.77	539659.39	45.32193	-88.6055
41	41	6	629293	539594	629292.77	539594.39	45.32134	-88.6055
42	42	6	629293	539529	629292.77	539529.39	45.32076	-88.6055
43	43	6	629293	539464	629292.77	539464.39	45.32017	-88.6055
44	44	6	629293	539399	629292.77	539399.39	45.31959	-88.6055
45	45	6	629293	539334	629292.77	539334.39	45.31900	-88.6055
46	46	6	629293	539269	629292.77	539269.39	45.31842	-88.6056
47	47	6	629293	539204	629292.77	539204.39	45.31783	-88.6056

GPS coordinates for the aquatic plant survey conducted on July 16, 2006 on Townsend Flowage, Oconto County, WI (cont.).

Plotid	Plotrow	Plotcol	Xcoord	Ycoord	Easting	Northing	Latitude	Longitude
48	1	7	629358	542194	629357.77	542194.39	45.34473	-88.6041
49	4	7	629358	541999	629357.77	541999.39	45.34297	-88.6041
50	6	7	629358	541869	629357.77	541869.39	45.34181	-88.6042
51	8	7	629358	541739	629357.77	541739.39	45.34064	-88.6042
52	13	7	629358	541414	629357.77	541414.39	45.33771	-88.6043
53	14	7	629358	541349	629357.77	541349.39	45.33713	-88.6043
54	15	7	629358	541284	629357.77	541284.39	45.33654	-88.6043
55	35	7	629358	539984	629357.77	539984.39	45.32484	-88.6046
56	36	7	629358	539919	629357.77	539919.39	45.32426	-88.6046
57	37	7	629358	539854	629357.77	539854.39	45.32367	-88.6046
58	38	7	629358	539789	629357.77	539789.39	45.32309	-88.6046
59	39	7	629358	539724	629357.77	539724.39	45.32250	-88.6046
60	40	7	629358	539659	629357.77	539659.39	45.32192	-88.6046
61	41	7	629358	539594	629357.77	539594.39	45.32133	-88.6047
62	42	7	629358	539529	629357.77	539529.39	45.32075	-88.6047
63	43	7	629358	539464	629357.77	539464.39	45.32016	-88.6047
64	44	7	629358	539399	629357.77	539399.39	45.31958	-88.6047
65	45	7	629358	539334	629357.77	539334.39	45.31899	-88.6047
66	46	7	629358	539269	629357.77	539269.39	45.31841	-88.6047
67	47	7	629358	539204	629357.77	539204.39	45.31782	-88.6047
68	49	7	629358	539074	629357.77	539074.39	45.31665	-88.6048
69	1	8	629423	542194	629422.77	542194.39	45.34472	-88.6033
70	2	8	629423	542129	629422.77	542129.39	45.34413	-88.6033
71	5	8	629423	541934	629422.77	541934.39	45.34238	-88.6033
72	6	8	629423	541869	629422.77	541869.39	45.34180	-88.6033
73	9	8	629423	541674	629422.77	541674.39	45.34004	-88.6034
74	10	8	629423	541609	629422.77	541609.39	45.33946	-88.6034
75	11	8	629423	541544	629422.77	541544.39	45.33887	-88.6034
76	12	8	629423	541479	629422.77	541479.39	45.33829	-88.6034
77	13	8	629423	541414	629422.77	541414.39	45.33770	-88.6034
78	14	8	629423	541349	629422.77	541349.39	45.33712	-88.6034
79	15	8	629423	541284	629422.77	541284.39	45.33653	-88.6035
80	16	8	629423	541219	629422.77	541219.39	45.33595	-88.6035
81	17	8	629423	541154	629422.77	541154.39	45.33536	-88.6035
82	32	8	629423	540179	629422.77	540179.39	45.32659	-88.6037
83	36	8	629423	539919	629422.77	539919.39	45.32425	-88.6038
84	37	8	629423	539854	629422.77	539854.39	45.32366	-88.6038
85	38	8	629423	539789	629422.77	539789.39	45.32308	-88.6038
86	39	8	629423	539724	629422.77	539724.39	45.32249	-88.6038
87	40	8	629423	539659	629422.77	539659.39	45.32191	-88.6038
88	41	8	629423	539594	629422.77	539594.39	45.32132	-88.6038
89	42	8	629423	539529	629422.77	539529.39	45.32074	-88.6038
90	43	8	629423	539464	629422.77	539464.39	45.32015	-88.6039
91	44	8	629423	539399	629422.77	539399.39	45.31957	-88.6039
92	45	8	629423	539334	629422.77	539334.39	45.31898	-88.6039
93	46	8	629423	539269	629422.77	539269.39	45.31840	-88.6039
94	47	8	629423	539204	629422.77	539204.39	45.31781	-88.6039

GPS coordinates for the aquatic plant survey conducted on July 16, 2006 on Townsend Flowage, Oconto County, WI (cont.).

Plotid	Plotrow	Plotcol	Xcoord	Ycoord	Easting	Northing	Latitude	Longitude
95	1	9	629488	542194	629487.77	542194.39	45.34471	-88.6024
96	2	9	629488	542129	629487.77	542129.39	45.34412	-88.6024
97	6	9	629488	541869	629487.77	541869.39	45.34178	-88.6025
98	7	9	629488	541804	629487.77	541804.39	45.34120	-88.6025
99	8	9	629488	541739	629487.77	541739.39	45.34062	-88.6025
100	9	9	629488	541674	629487.77	541674.39	45.34003	-88.6025
101	10	9	629488	541609	629487.77	541609.39	45.33945	-88.6026
102	11	9	629488	541544	629487.77	541544.39	45.33886	-88.6026
103	12	9	629488	541479	629487.77	541479.39	45.33828	-88.6026
104	13	9	629488	541414	629487.77	541414.39	45.33769	-88.6026
105	14	9	629488	541349	629487.77	541349.39	45.33711	-88.6026
106	15	9	629488	541284	629487.77	541284.39	45.33652	-88.6026
107	16	9	629488	541219	629487.77	541219.39	45.33594	-88.6026
108	17	9	629488	541154	629487.77	541154.39	45.33535	-88.6027
109	18	9	629488	541089	629487.77	541089.39	45.33477	-88.6027
110	30	9	629488	540309	629487.77	540309.39	45.32775	-88.6028
111	31	9	629488	540244	629487.77	540244.39	45.32716	-88.6029
112	33	9	629488	540114	629487.77	540114.39	45.32599	-88.6029
113	34	9	629488	540049	629487.77	540049.39	45.32541	-88.6029
114	35	9	629488	539984	629487.77	539984.39	45.32482	-88.6029
115	36	9	629488	539919	629487.77	539919.39	45.32424	-88.6029
116	37	9	629488	539854	629487.77	539854.39	45.32365	-88.6029
117	38	9	629488	539789	629487.77	539789.39	45.32307	-88.6030
118	39	9	629488	539724	629487.77	539724.39	45.32248	-88.6030
119	40	9	629488	539659	629487.77	539659.39	45.32190	-88.6030
120	41	9	629488	539594	629487.77	539594.39	45.32131	-88.6030
121	42	9	629488	539529	629487.77	539529.39	45.32073	-88.6030
122	43	9	629488	539464	629487.77	539464.39	45.32014	-88.6030
123	44	9	629488	539399	629487.77	539399.39	45.31956	-88.6030
124	45	9	629488	539334	629487.77	539334.39	45.31897	-88.6031
125	46	9	629488	539269	629487.77	539269.39	45.31839	-88.6031
126	1	10	629553	542194	629552.77	542194.39	45.34470	-88.6016
127	4	10	629553	541999	629552.77	541999.39	45.34294	-88.6016
128	7	10	629553	541804	629552.77	541804.39	45.34119	-88.6017
129	8	10	629553	541739	629552.77	541739.39	45.34060	-88.6017
130	9	10	629553	541674	629552.77	541674.39	45.34002	-88.6017
131	10	10	629553	541609	629552.77	541609.39	45.33944	-88.6017
132	11	10	629553	541544	629552.77	541544.39	45.33885	-88.6017
133	12	10	629553	541479	629552.77	541479.39	45.33827	-88.6018
134	13	10	629553	541414	629552.77	541414.39	45.33768	-88.6018
135	14	10	629553	541349	629552.77	541349.39	45.33710	-88.6018
136	15	10	629553	541284	629552.77	541284.39	45.33651	-88.6018
137	16	10	629553	541219	629552.77	541219.39	45.33593	-88.6018
138	17	10	629553	541154	629552.77	541154.39	45.33534	-88.6018
139	28	10	629553	540439	629552.77	540439.39	45.32891	-88.6020
140	29	10	629553	540374	629552.77	540374.39	45.32832	-88.6020
141	30	10	629553	540309	629552.77	540309.39	45.32774	-88.6020

GPS coordinates for the aquatic plant survey conducted on July 16, 2006 on Townsend Flowage, Oconto County, WI (cont.).

Plotid	Plotrow	Plotcol	Xcoord	Ycoord	Easting	Northing	Latitude	Longitude
142	32	10	629553	540179	629552.77	540179.39	45.32657	-88.6020
143	33	10	629553	540114	629552.77	540114.39	45.32598	-88.6021
144	34	10	629553	540049	629552.77	540049.39	45.32540	-88.6021
145	35	10	629553	539984	629552.77	539984.39	45.32481	-88.6021
146	36	10	629553	539919	629552.77	539919.39	45.32423	-88.6021
147	37	10	629553	539854	629552.77	539854.39	45.32364	-88.6021
148	38	10	629553	539789	629552.77	539789.39	45.32306	-88.6021
149	39	10	629553	539724	629552.77	539724.39	45.32247	-88.6021
150	40	10	629553	539659	629552.77	539659.39	45.32189	-88.6022
151	41	10	629553	539594	629552.77	539594.39	45.32130	-88.6022
152	42	10	629553	539529	629552.77	539529.39	45.32072	-88.6022
153	43	10	629553	539464	629552.77	539464.39	45.32013	-88.6022
154	44	10	629553	539399	629552.77	539399.39	45.31955	-88.6022
155	45	10	629553	539334	629552.77	539334.39	45.31896	-88.6022
156	4	11	629618	541999	629617.77	541999.39	45.34293	-88.6008
157	8	11	629618	541739	629617.77	541739.39	45.34059	-88.6009
158	9	11	629618	541674	629617.77	541674.39	45.34001	-88.6009
159	10	11	629618	541609	629617.77	541609.39	45.33942	-88.6009
160	11	11	629618	541544	629617.77	541544.39	45.33884	-88.6009
161	12	11	629618	541479	629617.77	541479.39	45.33826	-88.6009
162	13	11	629618	541414	629617.77	541414.39	45.33767	-88.6009
163	14	11	629618	541349	629617.77	541349.39	45.33709	-88.6010
164	15	11	629618	541284	629617.77	541284.39	45.33650	-88.6010
165	16	11	629618	541219	629617.77	541219.39	45.33592	-88.6010
166	17	11	629618	541154	629617.77	541154.39	45.33533	-88.6010
167	29	11	629618	540374	629617.77	540374.39	45.32831	-88.6012
168	30	11	629618	540309	629617.77	540309.39	45.32773	-88.6012
169	31	11	629618	540244	629617.77	540244.39	45.32714	-88.6012
170	32	11	629618	540179	629617.77	540179.39	45.32656	-88.6012
171	33	11	629618	540114	629617.77	540114.39	45.32597	-88.6012
172	34	11	629618	540049	629617.77	540049.39	45.32539	-88.6012
173	35	11	629618	539984	629617.77	539984.39	45.32480	-88.6013
174	36	11	629618	539919	629617.77	539919.39	45.32422	-88.6013
175	37	11	629618	539854	629617.77	539854.39	45.32363	-88.6013
176	38	11	629618	539789	629617.77	539789.39	45.32305	-88.6013
177	39	11	629618	539724	629617.77	539724.39	45.32246	-88.6013
178	40	11	629618	539659	629617.77	539659.39	45.32188	-88.6013
179	41	11	629618	539594	629617.77	539594.39	45.32129	-88.6013
180	42	11	629618	539529	629617.77	539529.39	45.32071	-88.6014
181	43	11	629618	539464	629617.77	539464.39	45.32012	-88.6014
182	44	11	629618	539399	629617.77	539399.39	45.31954	-88.6014
183	45	11	629618	539334	629617.77	539334.39	45.31895	-88.6014
184	3	12	629683	542064	629682.77	542064.39	45.34351	-88.6000
185	4	12	629683	541999	629682.77	541999.39	45.34292	-88.6000
186	8	12	629683	541739	629682.77	541739.39	45.34058	-88.6000
187	11	12	629683	541544	629682.77	541544.39	45.33883	-88.6001
188	12	12	629683	541479	629682.77	541479.39	45.33824	-88.6001

GPS coordinates for the aquatic plant survey conducted on July 16, 2006 on Townsend Flowage, Oconto County, WI (cont.).

Plotid	Plotrow	Plotcol	Xcoord	Ycoord	Easting	Northing	Latitude	Longitude
189	13	12	629683	541414	629682.77	541414.39	45.33766	-88.6001
190	14	12	629683	541349	629682.77	541349.39	45.33708	-88.6001
191	15	12	629683	541284	629682.77	541284.39	45.33649	-88.6001
192	16	12	629683	541219	629682.77	541219.39	45.33591	-88.6002
193	17	12	629683	541154	629682.77	541154.39	45.33532	-88.6002
194	29	12	629683	540374	629682.77	540374.39	45.32830	-88.6003
195	30	12	629683	540309	629682.77	540309.39	45.32772	-88.6004
196	31	12	629683	540244	629682.77	540244.39	45.32713	-88.6004
197	32	12	629683	540179	629682.77	540179.39	45.32655	-88.6004
198	33	12	629683	540114	629682.77	540114.39	45.32596	-88.6004
199	34	12	629683	540049	629682.77	540049.39	45.32538	-88.6004
200	35	12	629683	539984	629682.77	539984.39	45.32479	-88.6004
201	36	12	629683	539919	629682.77	539919.39	45.32421	-88.6004
202	37	12	629683	539854	629682.77	539854.39	45.32362	-88.6005
203	38	12	629683	539789	629682.77	539789.39	45.32304	-88.6005
204	39	12	629683	539724	629682.77	539724.39	45.32245	-88.6005
205	40	12	629683	539659	629682.77	539659.39	45.32187	-88.6005
206	41	12	629683	539594	629682.77	539594.39	45.32128	-88.6005
207	42	12	629683	539529	629682.77	539529.39	45.32070	-88.6005
208	43	12	629683	539464	629682.77	539464.39	45.32011	-88.6005
209	44	12	629683	539399	629682.77	539399.39	45.31953	-88.6006
210	45	12	629683	539334	629682.77	539334.39	45.31894	-88.6006
211	5	13	629748	541934	629747.77	541934.39	45.34233	-88.5992
212	11	13	629748	541544	629747.77	541544.39	45.33882	-88.5993
213	12	13	629748	541479	629747.77	541479.39	45.33823	-88.5993
214	13	13	629748	541414	629747.77	541414.39	45.33765	-88.5993
215	14	13	629748	541349	629747.77	541349.39	45.33706	-88.5993
216	15	13	629748	541284	629747.77	541284.39	45.33648	-88.5993
217	16	13	629748	541219	629747.77	541219.39	45.33590	-88.5993
218	17	13	629748	541154	629747.77	541154.39	45.33531	-88.5993
219	30	13	629748	540309	629747.77	540309.39	45.32771	-88.5995
220	31	13	629748	540244	629747.77	540244.39	45.32712	-88.5995
221	32	13	629748	540179	629747.77	540179.39	45.32654	-88.5996
222	33	13	629748	540114	629747.77	540114.39	45.32595	-88.5996
223	34	13	629748	540049	629747.77	540049.39	45.32537	-88.5996
224	35	13	629748	539984	629747.77	539984.39	45.32478	-88.5996
225	36	13	629748	539919	629747.77	539919.39	45.32420	-88.5996
226	37	13	629748	539854	629747.77	539854.39	45.32361	-88.5996
227	38	13	629748	539789	629747.77	539789.39	45.32303	-88.5996
228	39	13	629748	539724	629747.77	539724.39	45.32244	-88.5997
229	40	13	629748	539659	629747.77	539659.39	45.32186	-88.5997
230	41	13	629748	539594	629747.77	539594.39	45.32127	-88.5997
231	42	13	629748	539529	629747.77	539529.39	45.32069	-88.5997
232	43	13	629748	539464	629747.77	539464.39	45.32010	-88.5997
233	44	13	629748	539399	629747.77	539399.39	45.31952	-88.5997
234	45	13	629748	539334	629747.77	539334.39	45.31893	-88.5997
235	48	13	629748	539139	629747.77	539139.39	45.31718	-88.5998

GPS coordinates for the aquatic plant survey conducted on July 16, 2006 on Townsend Flowage, Oconto County, WI (cont.).

Plotid	Plotrow	Plotcol	Xcoord	Ycoord	Easting	Northing	Latitude	Longitude
236	10	14	629813	541609	629812.77	541609.39	45.33939	-88.5984
237	11	14	629813	541544	629812.77	541544.39	45.33881	-88.5984
238	12	14	629813	541479	629812.77	541479.39	45.33822	-88.5984
239	13	14	629813	541414	629812.77	541414.39	45.33764	-88.5985
240	14	14	629813	541349	629812.77	541349.39	45.33705	-88.5985
241	15	14	629813	541284	629812.77	541284.39	45.33647	-88.5985
242	16	14	629813	541219	629812.77	541219.39	45.33588	-88.5985
243	17	14	629813	541154	629812.77	541154.39	45.33530	-88.5985
244	18	14	629813	541089	629812.77	541089.39	45.33472	-88.5985
245	31	14	629813	540244	629812.77	540244.39	45.32711	-88.5987
246	32	14	629813	540179	629812.77	540179.39	45.32653	-88.5987
247	33	14	629813	540114	629812.77	540114.39	45.32594	-88.5987
248	34	14	629813	540049	629812.77	540049.39	45.32536	-88.5988
249	35	14	629813	539984	629812.77	539984.39	45.32477	-88.5988
250	36	14	629813	539919	629812.77	539919.39	45.32419	-88.5988
251	37	14	629813	539854	629812.77	539854.39	45.32360	-88.5988
252	38	14	629813	539789	629812.77	539789.39	45.32302	-88.5988
253	39	14	629813	539724	629812.77	539724.39	45.32243	-88.5988
254	40	14	629813	539659	629812.77	539659.39	45.32185	-88.5988
255	41	14	629813	539594	629812.77	539594.39	45.32126	-88.5989
256	42	14	629813	539529	629812.77	539529.39	45.32068	-88.5989
257	43	14	629813	539464	629812.77	539464.39	45.32009	-88.5989
258	44	14	629813	539399	629812.77	539399.39	45.31951	-88.5989
259	45	14	629813	539334	629812.77	539334.39	45.31892	-88.5989
260	46	14	629813	539269	629812.77	539269.39	45.31834	-88.5989
261	47	14	629813	539204	629812.77	539204.39	45.31775	-88.5989
262	48	14	629813	539139	629812.77	539139.39	45.31717	-88.5990
263	11	15	629878	541544	629877.77	541544.39	45.33880	-88.5976
264	12	15	629878	541479	629877.77	541479.39	45.33821	-88.5976
265	13	15	629878	541414	629877.77	541414.39	45.33763	-88.5976
266	14	15	629878	541349	629877.77	541349.39	45.33704	-88.5976
267	15	15	629878	541284	629877.77	541284.39	45.33646	-88.5976
268	16	15	629878	541219	629877.77	541219.39	45.33587	-88.5977
269	17	15	629878	541154	629877.77	541154.39	45.33529	-88.5977
270	18	15	629878	541089	629877.77	541089.39	45.33470	-88.5977
271	19	15	629878	541024	629877.77	541024.39	45.33412	-88.5977
272	20	15	629878	540959	629877.77	540959.39	45.33354	-88.5977
273	21	15	629878	540894	629877.77	540894.39	45.33295	-88.5977
274	22	15	629878	540829	629877.77	540829.39	45.33237	-88.5978
275	32	15	629878	540179	629877.77	540179.39	45.32652	-88.5979
276	33	15	629878	540114	629877.77	540114.39	45.32593	-88.5979
277	34	15	629878	540049	629877.77	540049.39	45.32535	-88.5979
278	35	15	629878	539984	629877.77	539984.39	45.32476	-88.5979
279	36	15	629878	539919	629877.77	539919.39	45.32418	-88.5980
280	37	15	629878	539854	629877.77	539854.39	45.32359	-88.5980
281	38	15	629878	539789	629877.77	539789.39	45.32301	-88.5980
282	39	15	629878	539724	629877.77	539724.39	45.32242	-88.5980

GPS coordinates for the aquatic plant survey conducted on July 16, 2006 on Townsend Flowage, Oconto County, WI (cont.).

Plotid	Plotrow	Plotcol	Xcoord	Ycoord	Easting	Northing	Latitude	Longitude
283	40	15	629878	539659	629877.77	539659.39	45.32184	-88.5980
284	41	15	629878	539594	629877.77	539594.39	45.32125	-88.5980
285	42	15	629878	539529	629877.77	539529.39	45.32067	-88.5980
286	43	15	629878	539464	629877.77	539464.39	45.32008	-88.5981
287	45	15	629878	539334	629877.77	539334.39	45.31891	-88.5981
288	46	15	629878	539269	629877.77	539269.39	45.31833	-88.5981
289	47	15	629878	539204	629877.77	539204.39	45.31774	-88.5981
290	48	15	629878	539139	629877.77	539139.39	45.31716	-88.5981
291	15	16	629943	541284	629942.77	541284.39	45.33645	-88.5968
292	16	16	629943	541219	629942.77	541219.39	45.33586	-88.5968
293	17	16	629943	541154	629942.77	541154.39	45.33528	-88.5968
294	18	16	629943	541089	629942.77	541089.39	45.33469	-88.5969
295	19	16	629943	541024	629942.77	541024.39	45.33411	-88.5969
296	20	16	629943	540959	629942.77	540959.39	45.33352	-88.5969
297	21	16	629943	540894	629942.77	540894.39	45.33294	-88.5969
298	22	16	629943	540829	629942.77	540829.39	45.33236	-88.5969
299	23	16	629943	540764	629942.77	540764.39	45.33177	-88.5969
300	24	16	629943	540699	629942.77	540699.39	45.33119	-88.5970
301	27	16	629943	540504	629942.77	540504.39	45.32943	-88.5970
302	32	16	629943	540179	629942.77	540179.39	45.32651	-88.5971
303	33	16	629943	540114	629942.77	540114.39	45.32592	-88.5971
304	34	16	629943	540049	629942.77	540049.39	45.32534	-88.5971
305	35	16	629943	539984	629942.77	539984.39	45.32475	-88.5971
306	36	16	629943	539919	629942.77	539919.39	45.32417	-88.5971
307	37	16	629943	539854	629942.77	539854.39	45.32358	-88.5971
308	38	16	629943	539789	629942.77	539789.39	45.32300	-88.5972
309	39	16	629943	539724	629942.77	539724.39	45.32241	-88.5972
310	40	16	629943	539659	629942.77	539659.39	45.32183	-88.5972
311	41	16	629943	539594	629942.77	539594.39	45.32124	-88.5972
312	42	16	629943	539529	629942.77	539529.39	45.32066	-88.5972
313	43	16	629943	539464	629942.77	539464.39	45.32007	-88.5972
314	16	17	630008	541219	630007.77	541219.39	45.33585	-88.5960
315	17	17	630008	541154	630007.77	541154.39	45.33527	-88.5960
316	18	17	630008	541089	630007.77	541089.39	45.33468	-88.5960
317	19	17	630008	541024	630007.77	541024.39	45.33410	-88.5960
318	20	17	630008	540959	630007.77	540959.39	45.33351	-88.5961
319	21	17	630008	540894	630007.77	540894.39	45.33293	-88.5961
320	22	17	630008	540829	630007.77	540829.39	45.33234	-88.5961
321	23	17	630008	540764	630007.77	540764.39	45.33176	-88.5961
322	24	17	630008	540699	630007.77	540699.39	45.33117	-88.5961
323	25	17	630008	540634	630007.77	540634.39	45.33059	-88.5961
324	26	17	630008	540569	630007.77	540569.39	45.33001	-88.5961
325	27	17	630008	540504	630007.77	540504.39	45.32942	-88.5962
326	28	17	630008	540439	630007.77	540439.39	45.32884	-88.5962
327	29	17	630008	540374	630007.77	540374.39	45.32825	-88.5962
328	32	17	630008	540179	630007.77	540179.39	45.32650	-88.5962
329	33	17	630008	540114	630007.77	540114.39	45.32591	-88.5963

GPS coordinates for the aquatic plant survey conducted on July 16, 2006 on Townsend Flowage, Oconto County, WI (cont.).

Plotid	Plotrow	Plotcol	Xcoord	Ycoord	Easting	Northing	Latitude	Longitude
330	34	17	630008	540049	630007.77	540049.39	45.32533	-88.5963
331	35	17	630008	539984	630007.77	539984.39	45.32474	-88.5963
332	36	17	630008	539919	630007.77	539919.39	45.32416	-88.5963
333	37	17	630008	539854	630007.77	539854.39	45.32357	-88.5963
334	38	17	630008	539789	630007.77	539789.39	45.32299	-88.5963
335	39	17	630008	539724	630007.77	539724.39	45.32240	-88.5963
336	40	17	630008	539659	630007.77	539659.39	45.32182	-88.5964
337	41	17	630008	539594	630007.77	539594.39	45.32123	-88.5964
338	42	17	630008	539529	630007.77	539529.39	45.32065	-88.5964
339	43	17	630008	539464	630007.77	539464.39	45.32006	-88.5964
340	18	18	630073	541089	630072.77	541089.39	45.33467	-88.5952
341	19	18	630073	541024	630072.77	541024.39	45.33409	-88.5952
342	20	18	630073	540959	630072.77	540959.39	45.33350	-88.5952
343	21	18	630073	540894	630072.77	540894.39	45.33292	-88.5952
344	22	18	630073	540829	630072.77	540829.39	45.33233	-88.5953
345	23	18	630073	540764	630072.77	540764.39	45.33175	-88.5953
346	24	18	630073	540699	630072.77	540699.39	45.33116	-88.5953
347	25	18	630073	540634	630072.77	540634.39	45.33058	-88.5953
348	31	18	630073	540244	630072.77	540244.39	45.32707	-88.5954
349	32	18	630073	540179	630072.77	540179.39	45.32649	-88.5954
350	33	18	630073	540114	630072.77	540114.39	45.32590	-88.5954
351	34	18	630073	540049	630072.77	540049.39	45.32532	-88.5954
352	35	18	630073	539984	630072.77	539984.39	45.32473	-88.5955
353	36	18	630073	539919	630072.77	539919.39	45.32415	-88.5955
354	37	18	630073	539854	630072.77	539854.39	45.32356	-88.5955
355	38	18	630073	539789	630072.77	539789.39	45.32298	-88.5955
356	39	18	630073	539724	630072.77	539724.39	45.32239	-88.5955
357	40	18	630073	539659	630072.77	539659.39	45.32181	-88.5955
358	41	18	630073	539594	630072.77	539594.39	45.32122	-88.5955
359	42	18	630073	539529	630072.77	539529.39	45.32064	-88.5956
360	43	18	630073	539464	630072.77	539464.39	45.32005	-88.5956
361	19	19	630138	541024	630137.77	541024.39	45.33408	-88.5944
362	20	19	630138	540959	630137.77	540959.39	45.33349	-88.5944
363	21	19	630138	540894	630137.77	540894.39	45.33291	-88.5944
364	22	19	630138	540829	630137.77	540829.39	45.33232	-88.5944
365	23	19	630138	540764	630137.77	540764.39	45.33174	-88.5944
366	24	19	630138	540699	630137.77	540699.39	45.33115	-88.5945
367	30	19	630138	540309	630137.77	540309.39	45.32765	-88.5945
368	31	19	630138	540244	630137.77	540244.39	45.32706	-88.5946
369	32	19	630138	540179	630137.77	540179.39	45.32648	-88.5946
370	33	19	630138	540114	630137.77	540114.39	45.32589	-88.5946
371	34	19	630138	540049	630137.77	540049.39	45.32531	-88.5946
372	35	19	630138	539984	630137.77	539984.39	45.32472	-88.5946
373	36	19	630138	539919	630137.77	539919.39	45.32414	-88.5946
374	37	19	630138	539854	630137.77	539854.39	45.32355	-88.5947
375	38	19	630138	539789	630137.77	539789.39	45.32297	-88.5947
376	39	19	630138	539724	630137.77	539724.39	45.32238	-88.5947

GPS coordinates for the aquatic plant survey conducted on July 16, 2006 on Townsend Flowage, Oconto County, WI (cont.).

Plotid	Plotrow	Plotcol	Xcoord	Ycoord	Easting	Northing	Latitude	Longitude
377	40	19	630138	539659	630137.77	539659.39	45.32180	-88.5947
378	41	19	630138	539594	630137.77	539594.39	45.32121	-88.5947
379	42	19	630138	539529	630137.77	539529.39	45.32063	-88.5947
380	19	20	630203	541024	630202.77	541024.39	45.33407	-88.5936
381	20	20	630203	540959	630202.77	540959.39	45.33348	-88.5936
382	21	20	630203	540894	630202.77	540894.39	45.33290	-88.5936
383	22	20	630203	540829	630202.77	540829.39	45.33231	-88.5936
384	31	20	630203	540244	630202.77	540244.39	45.32705	-88.5937
385	32	20	630203	540179	630202.77	540179.39	45.32647	-88.5937
386	33	20	630203	540114	630202.77	540114.39	45.32588	-88.5938
387	34	20	630203	540049	630202.77	540049.39	45.32530	-88.5938
388	35	20	630203	539984	630202.77	539984.39	45.32471	-88.5938
389	36	20	630203	539919	630202.77	539919.39	45.32413	-88.5938
390	37	20	630203	539854	630202.77	539854.39	45.32354	-88.5938
391	38	20	630203	539789	630202.77	539789.39	45.32296	-88.5938
392	39	20	630203	539724	630202.77	539724.39	45.32237	-88.5939
393	40	20	630203	539659	630202.77	539659.39	45.32179	-88.5939
394	41	20	630203	539594	630202.77	539594.39	45.32120	-88.5939
395	42	20	630203	539529	630202.77	539529.39	45.32062	-88.5939
396	32	21	630268	540179	630267.77	540179.39	45.32645	-88.5929
397	33	21	630268	540114	630267.77	540114.39	45.32587	-88.5929
398	34	21	630268	540049	630267.77	540049.39	45.32529	-88.5929
399	35	21	630268	539984	630267.77	539984.39	45.32470	-88.5930
400	36	21	630268	539919	630267.77	539919.39	45.32412	-88.5930
401	37	21	630268	539854	630267.77	539854.39	45.32353	-88.5930
402	38	21	630268	539789	630267.77	539789.39	45.32295	-88.5930
403	39	21	630268	539724	630267.77	539724.39	45.32236	-88.5930
404	40	21	630268	539659	630267.77	539659.39	45.32178	-88.5930
405	41	21	630268	539594	630267.77	539594.39	45.32119	-88.5931
406	33	22	630333	540114	630332.77	540114.39	45.32586	-88.5921
407	34	22	630333	540049	630332.77	540049.39	45.32527	-88.5921
408	35	22	630333	539984	630332.77	539984.39	45.32469	-88.5921
409	36	22	630333	539919	630332.77	539919.39	45.32410	-88.5921
410	37	22	630333	539854	630332.77	539854.39	45.32352	-88.5922
411	38	22	630333	539789	630332.77	539789.39	45.32294	-88.5922
412	39	22	630333	539724	630332.77	539724.39	45.32235	-88.5922
413	40	22	630333	539659	630332.77	539659.39	45.32177	-88.5922
414	41	22	630333	539594	630332.77	539594.39	45.32118	-88.5922
415	33	23	630398	540114	630397.77	540114.39	45.32585	-88.5913
416	34	23	630398	540049	630397.77	540049.39	45.32526	-88.5913
417	35	23	630398	539984	630397.77	539984.39	45.32468	-88.5913
418	36	23	630398	539919	630397.77	539919.39	45.32409	-88.5913
419	37	23	630398	539854	630397.77	539854.39	45.32351	-88.5913
420	38	23	630398	539789	630397.77	539789.39	45.32292	-88.5913
421	39	23	630398	539724	630397.77	539724.39	45.32234	-88.5914
422	40	23	630398	539659	630397.77	539659.39	45.32176	-88.5914
423	33	24	630463	540114	630462.77	540114.39	45.32584	-88.5904

GPS coordinates for the aquatic plant survey conducted on July 16, 2006 on Townsend Flowage, Oconto County, WI (cont.).

Plotid	Plotrow	Plotcol	Xcoord	Ycoord	Easting	Northing	Latitude	Longitude
424	34	24	630463	540049	630462.77	540049.39	45.32525	-88.5905
425	38	24	630463	539789	630462.77	539789.39	45.32291	-88.5905
426	33	25	630528	540114	630527.77	540114.39	45.32583	-88.5896

GPS coordinates for the aquatic plant survey conducted on July 16, 2006 on McCaslin Creek, Oconto County, WI (cont.).

Plotid	Plotrow	Plotcol	Xcoord	Ycoord	Easting	Northing	Latitude	Longitude
1	--	--	--	--	--	--	45.31705	-88.6091
2	--	--	--	--	--	--	45.31663	-88.6096
3	--	--	--	--	--	--	45.31662	-88.6104
4	--	--	--	--	--	--	45.31588	-88.6110
5	--	--	--	--	--	--	45.31535	-88.6115
6	--	--	--	--	--	--	45.31507	-88.6121
7	--	--	--	--	--	--	45.31482	-88.6126
8	--	--	--	--	--	--	45.31442	-88.6133
9	--	--	--	--	--	--	45.31415	-88.6139
10	--	--	--	--	--	--	45.31393	-88.6142
11	--	--	--	--	--	--	45.31348	-88.6146
12	--	--	--	--	--	--	45.31303	-88.6130
13	--	--	--	--	--	--	45.31258	-88.6158
14	--	--	--	--	--	--	45.31232	-88.6162
15	--	--	--	--	--	--	45.31167	-88.6173
16	--	--	--	--	--	--	45.31145	-88.6171
17	--	--	--	--	--	--	45.31197	-88.6163
18	--	--	--	--	--	--	45.31252	-88.6156
19	--	--	--	--	--	--	45.31288	-88.6150
20	--	--	--	--	--	--	45.31342	-88.6143
21	--	--	--	--	--	--	45.31382	-88.6137
22	--	--	--	--	--	--	45.31440	-88.6128
23	--	--	--	--	--	--	45.31487	-88.6120
24	--	--	--	--	--	--	45.31552	-88.6110
25	--	--	--	--	--	--	45.31597	-88.6103
26	--	--	--	--	--	--	45.31633	-88.6097
27	--	--	--	--	--	--	45.31663	-88.6092
28	--	--	--	--	--	--	45.31707	-88.6086
29	--	--	--	--	--	--	45.31705	-88.6078
30	--	--	--	--	--	--	45.31680	-88.6083
31	--	--	--	--	--	--	45.31660	-88.6092
32	--	--	--	--	--	--	45.31607	-88.6096
33	--	--	--	--	--	--	45.31573	-88.6104
34	--	--	--	--	--	--	45.31520	-88.6110
35	--	--	--	--	--	--	45.31478	-88.6115
36	--	--	--	--	--	--	45.31440	-88.6123
37	--	--	--	--	--	--	45.31423	-88.6128
38	--	--	--	--	--	--	45.31385	-88.6132
39	--	--	--	--	--	--	45.31362	-88.6136
40	--	--	--	--	--	--	45.31337	-88.6140
41	--	--	--	--	--	--	45.31298	-88.6146
42	--	--	--	--	--	--	45.31262	-88.6150
43	--	--	--	--	--	--	45.31212	-88.6154
44	--	--	--	--	--	--	45.31175	-88.6158
45	--	--	--	--	--	--	45.31160	-88.6164
46	--	--	--	--	--	--	45.31118	-88.6170

Appendix B

- Townsend Flowage aquatic plant survey data from July 16, 2006.
- McCaslin Creek aquatic plant survey data from July 16, 2006.

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	*Brasenia schreberi* ,Watershield	*Ceratophyllum demersum* ,Coontail	*Chara* ,Muskgrasses	*Elodea canadensis* ,Common waterweed	*Lemna trisulca* ,Forked duckweed	*Myriophyllum sibericum* ,Northern water milfoil	*Najas flexilis* ,Bushy pondweed	*Nitella* sp.,Nitella	*Nuphar variegata* ,Spatterdock	*Nymphaea odorata* ,White water lily	*Potamogeton gramineus* ,Variable pondweed	*Potamogeton illinoensis* ,Illinois pondweed	*Potamogeton natans* ,Floating-leaf pondweed	*Potamogeton praelongis* ,White-stem pondweed
1																	
2	4.1	M	R		1		2			1							
3																	
4	4.1	M	R		1		1		2	1							
5	5.9	M	R		1					1							
6	6.3	M	R				1		2								
7	4	M	R				2										
8	8.6	M	R		1		1										
9																	
10	6.3	M	R				1		1			1					1
11	6.5	M	R		1		1	1	1	2							
12	6.5	M	R		1				1								
13	6.8	M	R		1		1										
14	8.5	M	R														1
15	7.8	M	R														
16	9	M	R							1							
17																	
18																	
19	7	M	R		1												
20	9.2	M	R														
21	9.6	M	R							1							
22	8.8	M	R		1		1			1					1		
23	9.4	M	R		1				1								
24	3	M	R	1	1		1			1							
25	9.9	M	R		1												
26	5.4	M	R	1			1		1		1	1					
27	8.2	M	R		1		1		1								
28																	
29																	
30	2.1	M	R		1		1	1	2	1							
31	4.7	M	R							1							
32	7	M	R		1				2								
33	6.2	M	R		1				1	1		1					
34	7.4	M	R							2							

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	Potamogeton pusillus,Small pondweed	*Potamogeton richardsonii* ,Clasping-leaf pondweed	*Potamogeton zosteriformis* ,Flat-stem pondweed	*Ranunculus aquatilis* ,Stiff water crowfoot	*Stuckenia pectinata* ,Sago pondweed	*Utricularia vulgaris* ,Common	*Vallisneria americana* ,Wild celery	Wolffia colulmbiana, Watermeal	Filamentous Algae					
1																	
2	4.1	M	R	1													
3																	
4	4.1	M	R			1											
5	5.9	M	R	1	1	1											
6	6.3	M	R	1	1	1											
7	4	M	R							1							
8	8.6	M	R	1		1			1								
9																	
10	6.3	M	R			1											
11	6.5	M	R			1				1							
12	6.5	M	R	1		1											
13	6.8	M	R		1												
14	8.5	M	R	2	1		1										
15	7.8	M	R		1	1											
16	9	M	R	1	2	1											
17																	
18																	
19	7	M	R	1													
20	9.2	M	R		1	1											
21	9.6	M	R	1													
22	8.8	M	R	1			1										
23	9.4	M	R	1		1											
24	3	M	R						1								
25	9.9	M	R		1	1											
26	5.4	M	R	1					1								
27	8.2	M	R	1		1				1							
28																	
29																	
30	2.1	M	R	1													
31	4.7	M	R			1				1							
32	7	M	R	1													
33	6.2	M	R		1					1							
34	7.4	M	R	1	1	1											

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	*Brasenia schreberi* ,Watershield	*Ceratophyllum demersum* ,Coontail	*Chara* ,Muskgrasses	*Elodea canadensis* ,Common waterweed	*Lemna trisulca* ,Forked duckweed	*Myriophyllum sibericum* ,Northern water milfoil	*Najas flexilis* ,Bushy pondweed	*Nitella* sp.,Nitella	*Nuphar variegata* ,Spatterdock	*Nymphaea odorata* ,White water lily	*Potamogeton gramineus* ,Variable pondweed	*Potamogeton illinoensis* ,Illinois pondweed	*Potamogeton natans* ,Floating-leaf pondweed	*Potamogeton praelongis* ,White-stem pondweed
35	6.7	M	R		1					2							1
36	7.4	M	R		1				1	2							
37																	
38	1.8	M	R	1	3			1				1					
39	1.9	M	R		1			1	1			1	1	1			
40	4.2	M	R		1	1	1		2								
41	4.7	M	R		1		1		1	1							
42	9.2	M	R		1			1	1	1							
43	6.5	M	R		1		1		1	2							
44	4.3	M	R		1					1	1						
45	8.4	M	R				1										
46	7.6	M	R		1		1		1	1							
47	6.6	M	R		1												
48	4.4	M	R		1					1							
49																	
50																	
51	3.2	M	R		3		1	1				1					
52	4.2	M	R		1		1										
53	4.1	M	R		1		1			1	1		1			1	
54	4.5	M	R	1	1							1	1	1			
55	4.5	M	R		1		1	1					1				
56	2.8	M	R		1	3	1										
57	3.9	M	R		1	2	1			1							
58	5.5	M	R				1		1	1							
59	1.4	S	R									2		1			
60	7.9	M	R				1	1	1	1							
61	9.3	M	R			1	1			1							
62	7.2	M	R		1		1	1	1	2							
63	6.3	M	R		1	1	1	1		2					1		
64	6.6	M	R		1	1	1			2							
65	7.7	M	R							1					1		
66	8.6	M	R		1					1							
67	6.3	M	R			1				1			1				
68	4.6	M	R			1											

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	Potamogeton pusillus,Small pondweed	*Potamogeton richardsonii* ,Clasping-leaf pondweed	*Potamogeton zosteriformis* ,Flat-stem pondweed	*Ranunculus aquatilis* ,Stiff water crowfoot	*Stuckenia pectinata* ,Sago pondweed	*Utricularia vulgaris* ,Common	*Vallisneria americana* ,Wild celery	Wolffia colulmbiana, Watermeal	Filamentous Algae
35	6.7	M	R		1	1						
36	7.4	M	R	1	1							
37												
38	1.8	M	R					1				
39	1.9	M	R	1								
40	4.2	M	R	1								
41	4.7	M	R	1		1						
42	9.2	M	R	1	1							
43	6.5	M	R		1	1						
44	4.3	M	R	2								1
45	8.4	M	R		1							
46	7.6	M	R	1	1	2						
47	6.6	M	R	1	1	1						
48	4.4	M	R	1								
49												
50												
51	3.2	M	R									
52	4.2	M	R									
53	4.1	M	R	1					1			
54	4.5	M	R						1			
55	4.5	M	R	1					1	1		
56	2.8	M	R	1		1						
57	3.9	M	R	1						1		
58	5.5	M	R	2		1						
59	1.4	S	R		1					1		
60	7.9	M	R	3								
61	9.3	M	R	1		1						
62	7.2	M	R		1							
63	6.3	M	R		1							
64	6.6	M	R									1
65	7.7	M	R									
66	8.6	M	R		1							
67	6.3	M	R									
68	4.6	M	R	2		1						

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	*Brasenia schreberi* ,Watershield	*Ceratophyllum demersum* ,Coontail	*Chara* ,Muskgrasses	*Elodea canadensis* ,Common waterweed	*Lemna trisulca* ,Forked duckweed	*Myriophyllum sibericum* ,Northern water milfoil	*Najas flexilis* ,Bushy pondweed	*Nitella* sp.,Nitella	*Nuphar variegata* ,Spatterdock	*Nymphaea odorata* ,White water lily	*Potamogeton gramineus* ,Variable pondweed	*Potamogeton illinoensis* ,Illinois pondweed	*Potamogeton natans* ,Floating-leaf pondweed	*Potamogeton praelongis* ,White-stem pondweed
69	2.9	M	R	1			1		1	1							
70																	
71	8.8	M	R		1		1			2							
72																	
73	2	M	R	1	3		1	1		1		1					
74	3.2	M	R	1	3		1	1		1		1					1
75	4.3	M	R				2	1		1		1	1				
76	5.6	M	R				3									1	
77	3.2	M	R		2					1		1	1				
78																	
79																	
80	4.2	M	R		1				1	1		1		1		1	
81	2.3	M	R	1	1							1	1				
82	3.4	M	R		1		1		1	1		1	1				
83	3.7	M	R		2	3	1			1							
84	1.7	M	R		1			1	2			1					
85	5	M	R		2	3	1								1		
86	2.4	M	R		1	1											
87	9	S	R			1				1							
88	8.9	M	R			1	1	1		1			1				
89	7	M	R			1			1								
90	5.8	M	R		1	1	1	1		1							
91	5.2	M	R			1	1		1	1							
92	2.2	M	R		1	1											
93	2	M	R		1	1	1						1	1		1	
94	4.4	M	R			1	1			1							
95																	
96	2.5	M	R	1	3		1			1		1					1
97	3.6	M	R		1		1	1	1			1	1				
98	3.5	M	R		1			1				1	1				
99	3.3	M	R		1		1	1				1	1				
100																	
101	4.1	M	R		1							1		1		1	
102																	

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	Potamogeton pusillus,Small pondweed	*Potamogeton richardsonii* ,Clasping-leaf pondweed	*Potamogeton zosteriformis* ,Flat-stem pondweed	*Ranunculus aquatilis* ,Stiff water crowfoot	*Stuckenia pectinata* ,Sago pondweed	*Utricularia vulgaris* ,Common	*Vallisneria americana* ,Wild celery	Wolffia colulmbiana, Watermeal	Filamentous Algae					
69	2.9	M	R	1	1		1			1							
70																	
71	8.8	M	R	1	1												
72																	
73	2	M	R	1													
74	3.2	M	R														
75	4.3	M	R														
76	5.6	M	R	1													
77	3.2	M	R	1					1								
78																	
79																	
80	4.2	M	R	1													
81	2.3	M	R						1								
82	3.4	M	R	1													
83	3.7	M	R	1						1							
84	1.7	M	R	1						1							
85	5	M	R	1													
86	2.4	M	R	1	1					1							
87	9	S	R	1						1							
88	8.9	M	R									1					
89	7	M	R	1													
90	5.8	M	R	1	1	1											
91	5.2	M	R			1											
92	2.2	M	R							1		1					
93	2	M	R		1												
94	4.4	M	R	1						1							
95																	
96	2.5	M	R		1	1											
97	3.6	M	R						1								
98	3.5	M	R						1								
99	3.3	M	R							1							
100																	
101	4.1	M	R						1								
102																	

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	*Brasenia schreberi* ,Watershield	*Ceratophyllum demersum* ,Coontail	*Chara* ,Muskgrasses	*Elodea canadensis* ,Common waterweed	*Lemna trisulca* ,Forked duckweed	*Myriophyllum sibericum* ,Northern water milfoil	*Najas flexilis* ,Bushy pondweed	*Nitella* sp.,Nitella	*Nuphar variegata* ,Spatterdock	*Nymphaea odorata* ,White water lily	*Potamogeton gramineus* ,Variable pondweed	*Potamogeton illinoensis* ,Illinois pondweed	*Potamogeton natans* ,Floating-leaf pondweed	*Potamogeton praelongis* ,White-stem pondweed
103																	
104																	
105																	
106																	
107	5	M	R	1	1							1				1	
108	1	M	R				2			1		1				1	1
109	2	M	R				1		1	1		1	1		1		
110	0.9	M	R		1		1			1					1		
111	7.3	M	R		1		1			2							
112	5.8	M	R		1		1		1	1							
113	5.3	M	R				1		1	1							
114	1.6	M	R	1		1		1	1			1				1	
115	2.4	M	R					1	1								
116	3.9	M	R					1	2					1			1
117	3.7	M	R						1								1
118	6.5	M	R				1	1	1								
119	9.5	M	R				1	1		1							
120	8.2	M	R														
121	7	M	R				1		1	1							
122	3.4	M	R		1	1	1			2							
123	2.8	M	R						1	1				1	1		
124	3	M	R			1				1							
125																	
126																	
127	3.1	M	R		2		1	1			1					1	
128	3.3	M	R		2						1	1					
129	3.9	M	R		1		1		1			1				1	
130	3.7	M	R				1			1		1					
131	2.9	M	R		1		1	1	1		1	1				1	
132	2.4	M	R					1	1		1	1				1	
133	3.3	M	R				1			2		1					
134	3.1	M	R		1				2		1	1				1	
135	3	M	R				1		1		1	1					
136	3.5	M	R						2		1	1					

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	Potamogeton pusillus,Small pondweed	*Potamogeton richardsonii* ,Clasping-leaf pondweed	*Potamogeton zosteriformis* ,Flat-stem pondweed	*Ranunculus aquatilis* ,Stiff water crowfoot	*Stuckenia pectinata* ,Sago pondweed	*Utricularia vulgaris* ,Common	*Vallisneria americana* ,Wild celery	Wolffia colulmbiana, Watermeal	Filamentous Algae
103												
104												
105												
106												
107	5	M	R	1								
108	1	M	R	1								
109	2	M	R	1						1		
110	0.9	M	R	2		1						
111	7.3	M	R							1		
112	5.8	M	R	1								
113	5.3	M	R	1								
114	1.6	M	R									
115	2.4	M	R									1
116	3.9	M	R	1						1		
117	3.7	M	R	1						1		
118	6.5	M	R							1		
119	9.5	M	R	1								
120	8.2	M	R	1	1							
121	7	M	R		1					1		
122	3.4	M	R		1					1		
123	2.8	M	R							1		
124	3	M	R	1								
125												
126												
127	3.1	M	R			1						
128	3.3	M	R									
129	3.9	M	R			1						
130	3.7	M	R			1						
131	2.9	M	R	1	1	1						
132	2.4	M	R	1	1							
133	3.3	M	R			1						
134	3.1	M	R									
135	3	M	R		1							
136	3.5	M	R			1						

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	*Brasenia schreberi* ,Watershield	*Ceratophyllum demersum* ,Coontail	*Chara* ,Muskgrasses	*Elodea canadensis* ,Common waterweed	*Lemna trisulca* ,Forked duckweed	*Myriophyllum sibericum* ,Northern water milfoil	*Najas flexilis* ,Bushy pondweed	*Nitella* sp.,Nitella	*Nuphar variegata* ,Spatterdock	*Nymphaea odorata* ,White water lily	*Potamogeton gramineus* ,Variable pondweed	*Potamogeton illinoensis* ,Illinois pondweed	*Potamogeton natans* ,Floating-leaf pondweed	*Potamogeton praelongis* ,White-stem pondweed
137	3.2	M	R		1		1				1				1		
138	3.6	M	R		1		1		1	1							
139	6.5	M	R		1		1		1	1		1					
140	7.4	M	R		1		1		1	2							
141	8.2	M	R				1		1								
142	4.2	M	R		1		1		1								
143	8.8	M	R			1				1	3						
144	4.3	M	R				1		1	3							
145	2.7	S	R					1									
146	2.5	M	R				1		2	1							
147	2.3	M	R						2	1					1		
148	7.7	M	R		1		1		1	2							
149	7.8	M	R		1	1		1									
150	9.4	M	R		1		1			1							
151	6.9	M	R		1		1		1	1							
152	9.1	M	R			1				1	1						
153	5.1	M	R				1		1	1							
154	2.9	M	R					1	3	1							
155																	
156	2.9	M	R				1	1	1								
157	3	M	R		1		1	1		1	1	1				1	
158	3.1	M	R					1	1				1		1	1	
159	5.6	M	R				1				1				1		
160	3.8	M	R		1				1			1					
161	3.6	M	R				1		1	1		1					
162	3.4	M	R						1	1		1				1	
163	3.7	M	R		1		1		1	1		1				1	
164	4.1	M	R		1		1		1			1					
165	3.5	M	R	1			1		1			1				1	
166	6.5	M	R		1		1			1							
167	9.5	M	R				1		1								
168	9.6	M	R		1	2	1		1	2							
169	9.6	M	R		1	1	1	1		2							
170	8.8	M	R		1		1			2	1						

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	Potamogeton pusillus,Small pondweed	*Potamogeton richardsonii* ,Clasping-leaf pondweed	*Potamogeton zosteriformis* ,Flat-stem pondweed	*Ranunculus aquatilis* ,Stiff water crowfoot	*Stuckenia pectinata* ,Sago pondweed	*Utricularia vulgaris* ,Common	*Vallisneria americana* ,Wild celery	Wolffia colulmbiana, Watermeal	Filamentous Algae					
137	3.2	M	R			1											
138	3.6	M	R	2		1											
139	6.5	M	R	1		1				1							
140	7.4	M	R	1													
141	8.2	M	R														
142	4.2	M	R	3													
143	8.8	M	R	1													
144	4.3	M	R	1													
145	2.7	S	R														
146	2.5	M	R	1						1							
147	2.3	M	R	1						1							
148	7.7	M	R	1													
149	7.8	M	R	1						1							
150	9.4	M	R														
151	6.9	M	R	1													
152	9.1	M	R														
153	5.1	M	R														
154	2.9	M	R	1						1							
155																	
156	2.9	M	R								1						
157	3	M	R			1		1			1						
158	3.1	M	R														
159	5.6	M	R														
160	3.8	M	R														
161	3.6	M	R	1	1												
162	3.4	M	R	1													
163	3.7	M	R		1												
164	4.1	M	R		1	1											
165	3.5	M	R		1												
166	6.5	M	R	2													
167	9.5	M	R	2		1											
168	9.6	M	R	1													
169	9.6	M	R	1													
170	8.8	M	R							1							

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	*Brasenia schreberi* ,Watershield	*Ceratophyllum demersum* ,Coontail	*Chara* ,Muskgrasses	*Elodea canadensis* ,Common waterweed	*Lemna trisulca* ,Forked duckweed	*Myriophyllum sibericum* ,Northern water milfoil	*Najas flexilis* ,Bushy pondweed	*Nitella* sp.,Nitella	*Nuphar variegata* ,Spatterdock	*Nymphaea odorata* ,White water lily	*Potamogeton gramineus* ,Variable pondweed	*Potamogeton illinoensis* ,Illinois pondweed	*Potamogeton natans* ,Floating-leaf pondweed	*Potamogeton praelongis* ,White-stem pondweed
171	8.1	M	R				1			1							
172	9.8	M	R		1		1			1							
173	7.3	M	R		1		1		1	2							
174	7.8	M	R		1		1			1							
175	7.3	M	R			1	1	1	1	1							1
176	6	M	R				1		1	1							
177	10.4	M	R		1		1		1	1							
178	6.1	M	R						1	1							
179	9.9	M	R		1					2	1						
180	5.7	M	R		1	1	1		1	1							1
181	4.3	M	R						1					1			
182																	
183																	
184	3.2	M	R		1		1										
185	5.5	M	R		1		1					1					
186	4.5	M	R		1		2			1							
187	4.5	M	R		1		1		1	1							1
188	4.6	M	R		1		1		1	1	1						1
189	5.8	M	R		1		1		1	1							
190	5.2	M	R		1		1		1	2							
191	3.9	M	R				1		1	1							
192	8.3	M	R		1		1		1	1							
193	8.5	M	R		1	1	1			2							
194	20.5	M	R		1												
195	22.8	M	R														
196	12.6	M	R		1												
197	8.5	M	R		1		1	1		1							
198	9.7	M	R		1				1	1							
199	10.5	M	R		1		1			2							
200	10.2	M	R							1							
201	9.8	M	R							1							
202	6.6	M	R			1			1	1					1		
203	9.4	M	R				1			1	1						
204	12.5	M	R		1					1							

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	Potamogeton pusillus,Small pondweed	*Potamogeton richardsonii* ,Clasping-leaf pondweed	*Potamogeton zosteriformis* ,Flat-stem pondweed	*Ranunculus aquatilis* ,Stiff water crowfoot	*Stuckenia pectinata* ,Sago pondweed	*Utricularia vulgaris* ,Common	*Vallisneria americana* ,Wild celery	Wolffia colulmbiana, Watermeal	Filamentous Algae					
171	8.1	M	R		1					1							
172	9.8	M	R	2													
173	7.3	M	R	2													
174	7.8	M	R	1	2												
175	7.3	M	R	1	1												
176	6	M	R														
177	10.4	M	R	1													
178	6.1	M	R	1						2							
179	9.9	M	R														
180	5.7	M	R	1													
181	4.3	M	R							1							
182																	
183																	
184	3.2	M	R							1							
185	5.5	M	R	1		1											
186	4.5	M	R			1											
187	4.5	M	R	1	1	1											
188	4.6	M	R		1			1									
189	5.8	M	R	1	1												
190	5.2	M	R		1					1							
191	3.9	M	R		1	1				1							
192	8.3	M	R	2													
193	8.5	M	R	1													
194	20.5	M	R														
195	22.8	M	R														
196	12.6	M	R														
197	8.5	M	R	1													
198	9.7	M	R	1													
199	10.5	M	R	1													
200	10.2	M	R	1													
201	9.8	M	R	1		1											
202	6.6	M	R	2													
203	9.4	M	R	1													
204	12.5	M	R	1													

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	*Brasenia schreberi* ,Watershield	*Ceratophyllum demersum* ,Coontail	*Chara* ,Muskgrasses	*Elodea canadensis* ,Common waterweed	*Lemna trisulca* ,Forked duckweed	*Myriophyllum sibericum* ,Northern water milfoil	*Najas flexilis* ,Bushy pondweed	*Nitella* sp.,Nitella	*Nuphar variegata* ,Spatterdock	*Nymphaea odorata* ,White water lily	*Potamogeton gramineus* ,Variable pondweed	*Potamogeton illinoensis* ,Illinois pondweed	*Potamogeton natans* ,Floating-leaf pondweed	*Potamogeton praelongis* ,White-stem pondweed
205	4.5	M	R		1		1	1		2							
206	9.2	M	R				1			2							
207	5.9	M	R						1	1							1
208	3.4	M	R				1		1	1							
209	4.6	M	R				2			1							
210	3.3	M	R				1		1								
211	2.9	M	R		1		1		1		2						
212	5	M	R		1		1		1								
213	4.1	M	R		1		1				1			1			
214	5.2	M	R				1			1	1			1			
215	5.3	M	R				1		1	2	1			1			
216	4.8	M	R		1		1		1			1					
217	9	M	R				1	1		1							1
218	17.9	M	R		1												
219	19.8	M	R														
220	11.5	M	R								1						
221	9.4	M	R		1		1		1	1							
222	8.8	M	R							1							1
223	12.6	M	R		1			1		1							
224	10.8	M	R		1	1	1			1							
225	11.1	M	R				1			1							1
226	10.4	M	R							1							
227	12.5	M	R				1			1							
228	7.5	M	R		1		1		1	2							
229	7	M	R						1	1	2						
230	8.1	M	R				1			1							
231	11.7	M	R		1		1		1	1	1						
232	8.1	M	R				1			1							
233	3.9	M	R		1		1		1	1						1	
234	4.4	M	R		1		2		2	1							
235	3.2	M	R		1		2		1	1				1	1		
236	6.1	M	R	1			1		1	1							
237	3.8	M	R				1		1								
238	5	M	R		1		1		1	1	1						

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	Potamogeton pusillus,Small pondweed	*Potamogeton richardsonii* ,Clasping-leaf pondweed	*Potamogeton zosteriformis* ,Flat-stem pondweed	*Ranunculus aquatilis* ,Stiff water crowfoot	*Stuckenia pectinata* ,Sago pondweed	*Utricularia vulgaris* ,Common	*Vallisneria americana* ,Wild celery	Wolffia colulmbiana, Watermeal	Filamentous Algae					
205	4.5	M	R		1												
206	9.2	M	R	1													
207	5.9	M	R	1													
208	3.4	M	R	3													
209	4.6	M	R	1													
210	3.3	M	R	1	1	2											
211	2.9	M	R		1	1											
212	5	M	R		1												
213	4.1	M	R		1												
214	5.2	M	R					1									
215	5.3	M	R														
216	4.8	M	R			1		1		1							
217	9	M	R	1													
218	17.9	M	R														
219	19.8	M	R														
220	11.5	M	R		1												
221	9.4	M	R	1	2												
222	8.8	M	R		1												
223	12.6	M	R	1		1											
224	10.8	M	R	1													
225	11.1	M	R	1													
226	10.4	M	R														
227	12.5	M	R	1													
228	7.5	M	R	1	2					1							
229	7	M	R	1													
230	8.1	M	R	1													
231	11.7	M	R														
232	8.1	M	R														
233	3.9	M	R	1	1	1											
234	4.4	M	R														
235	3.2	M	R	1	1	1											
236	6.1	M	R			1											
237	3.8	M	R	1	2												
238	5	M	R														

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	*Brasenia schreberi* ,Watershield	*Ceratophyllum demersum* ,Coontail	*Chara* ,Muskgrasses	*Elodea canadensis* ,Common waterweed	*Lemna trisulca* ,Forked duckweed	*Myriophyllum sibericum* ,Northern water milfoil	*Najas flexilis* ,Bushy pondweed	*Nitella* sp.,Nitella	*Nuphar variegata* ,Spatterdock	*Nymphaea odorata* ,White water lily	*Potamogeton gramineus* ,Variable pondweed	*Potamogeton illinoensis* ,Illinois pondweed	*Potamogeton natans* ,Floating-leaf pondweed	*Potamogeton praelongis* ,White-stem pondweed
239	4.8	M	R	1	2		1										
240	5.2	M	R				1		1	2					1		
241	2	M	R	1					1								
242	8.6	M	R				1		1	1							
243	13.8	M	R								1						
244	9.8	M	R				1			1					1		
245	9.4	M	R							1							1
246	10.6	M	R		1		1			1							
247	12.3	M	R		1		1			1	1						
248	11.6	M	R		1		1			1	1						
249	11.6	M	R		1					2							1
250	10.4	M	R		1					1							
251	11.6	M	R		1		1		1	1							
252	11.1	M	R		1		1		1	2							
253	7.4	M	R							1							
254	9.8	M	R														
255	11.2	M	R		1		1		1	1							
256	13.7	M	R			1				1							
257	7.2	M	R				1		2								
258	13.8	M	R		1		1		1	1							
259	11.4	M	R							1							
260	3.1	M	R		1		1		1	3							
261	3.5	M	R		1		1			1							
262	3.1	M	R		1	1	1			2							
263	3.7	M	R						1	1							1
264	5.9	M	R						1	1							
265	5.7	M	R				1			2							
266	5.5	M	R		1		1			2							
267	4	M	R				2			1							1
268	3.8	M	R	1		1	1										
269	2.2	M	R	1			1	1									
270	2.9			1			1	1	3								
271	3.1	M	R	1			1		2	1	1						
272	9.2	M	R		1		1		1	2							

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	Potamogeton pusillus,Small pondweed	*Potamogeton richardsonii* ,Clasping-leaf pondweed	*Potamogeton zosteriformis* ,Flat-stem pondweed	*Ranunculus aquatilis* ,Stiff water crowfoot	*Stuckenia pectinata* ,Sago pondweed	*Utricularia vulgaris* ,Common	*Vallisneria americana* ,Wild celery	Wolffia colulmbiana, Watermeal	Filamentous Algae
239	4.8	M	R		2							
240	5.2	M	R			1						
241	2	M	R			1						
242	8.6	M	R	1						1		
243	13.8	M	R			1						
244	9.8	M	R	1	1							
245	9.4	M	R	1	1							
246	10.6	M	R		1							
247	12.3	M	R	1								
248	11.6	M	R									
249	11.6	M	R	1	1							
250	10.4	M	R	1								
251	11.6	M	R	1	3							
252	11.1	M	R									
253	7.4	M	R	1	1							
254	9.8	M	R		1					1		
255	11.2	M	R	1								
256	13.7	M	R									
257	7.2	M	R		1					1		
258	13.8	M	R	1								
259	11.4	M	R	1								
260	3.1	M	R							1		
261	3.5	M	R									
262	3.1	M	R		1					1		
263	3.7	M	R		1							
264	5.9	M	R	1	1							
265	5.7	M	R		1							
266	5.5	M	R							1		
267	4	M	R	1	1					1		
268	3.8	M	R							2		
269	2.2	M	R									1
270	2.9			1						1		
271	3.1	M	R			1				1		
272	9.2	M	R	1								

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	*Brasenia schreberi* ,Watershield	*Ceratophyllum demersum* ,Coontail	*Chara* ,Muskgrasses	*Elodea canadensis* ,Common waterweed	*Lemna trisulca* ,Forked duckweed	*Myriophyllum sibericum* ,Northern water milfoil	*Najas flexilis* ,Bushy pondweed	*Nitella* sp.,Nitella	*Nuphar variegata* ,Spatterdock	*Nymphaea odorata* ,White water lily	*Potamogeton gramineus* ,Variable pondweed	*Potamogeton illinoensis* ,Illinois pondweed	*Potamogeton natans* ,Floating-leaf pondweed	*Potamogeton praelongis* ,White-stem pondweed
273	10.8	M	R			3	1		1								
274	9.8	M	R			3											
275	11.2	M	R														
276	11.8	M	R			1	1				1						
277	11.8	M	R							1	1						
278	11.6	M	R			1				1							
279	11.4	M	R		1					2							
280	12.1	M	R		1					1							1
281	14.7	M	R		1		1			1							1
282	11.4	M	R							1							
283	15.2	M	R						1		1						1
284	5.7	M	R			1				1							
285	9.2	M	R			1				1							
286	9.5	M	R						1	1							
287	11.2	M	R							1	1						
288	6.4	M	R						1								
289	6.7	M	R				1		1								
290	7	M	R		1		1			1							1
291	5.1	M	R		1		1		1	1							
292	5	M	R		1		1		1								
293	6.3	M	R				2		1	1							
294	6.3	M	R		1		1			2							
295	5.8	M	R				3			2							
296	5.9	M	R				1		1	1							
297	4.1	M	R				1		1								
298	9.6	M	R		1				1	1							
299	9.7	M	R		1		1			1	1						
300	10.6	M	R														
301	10.2	M	R		1		1		1	2							
302	11.1	M	R		1		1		1		1						
303	11.5	M	R		1		1			1							
304	12.4	M	R		1		1										
305	12.7	M	R		1		1			1							
306	17.8	M	R														

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	Potamogeton pusillus,Small pondweed	*Potamogeton richardsonii* ,Clasping-leaf pondweed	*Potamogeton zosteriformis* ,Flat-stem pondweed	*Ranunculus aquatilis* ,Stiff water crowfoot	*Stuckenia pectinata* ,Sago pondweed	*Utricularia vulgaris* ,Common	*Vallisneria americana* ,Wild celery	Wolffia colulmbiana, Watermeal	Filamentous Algae					
273	10.8	M	R	1	1	1											
274	9.8	M	R														
275	11.2	M	R	1	1												
276	11.8	M	R	1													
277	11.8	M	R														
278	11.6	M	R	1													
279	11.4	M	R	1													
280	12.1	M	R		1												
281	14.7	M	R	1													
282	11.4	M	R	1													
283	15.2	M	R		1												
284	5.7	M	R	1						1							
285	9.2	M	R	1						1							
286	9.5	M	R	1						1							
287	11.2	M	R														
288	6.4	M	R		1												
289	6.7	M	R	1	1												
290	7	M	R		1												
291	5.1	M	R		1	1											
292	5	M	R		1												
293	6.3	M	R														
294	6.3	M	R	3	1												
295	5.8	M	R		1												
296	5.9	M	R														
297	4.1	M	R														
298	9.6	M	R	1													
299	9.7	M	R	3						1							
300	10.6	M	R	1													
301	10.2	M	R	1	1												
302	11.1	M	R	1	1												
303	11.5	M	R														
304	12.4	M	R	1													
305	12.7	M	R	1													
306	17.8	M	R														

Entry

Entry	sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	*Brasenia schreberi* ,Watershield	*Ceratophyllum demersum* ,Coontail	*Chara* ,Muskgrasses	*Elodea canadensis* ,Common waterweed	*Lemna trisulca* ,Forked duckweed	*Myriophyllum sibericum* ,Northern water milfoil	*Najas flexilis* ,Bushy pondweed	*Nitella* sp.,Nitella	*Nuphar variegata* ,Spatterdock	*Nymphaea odorata* ,White water lily	*Potamogeton gramineus* ,Variable pondweed	*Potamogeton illinoensis* ,Illinois pondweed	*Potamogeton natans* ,Floating-leaf pondweed	*Potamogeton praelongis* ,White-stem pondweed
Lake: Townsend Flowage	307	14.1	M	R		1		1			2							
County: Oconto	308	11.9	M	R							1							
WBIC: 0465000	309	14.9	M	R		1	1				1							
	310	6.8	M	R		1				1	1							
Survey Date: July 16, 2006	311	7.7	M	R							1							
	312	6.9	M	R				2		1	2							
	313	7.9	M	R		1		1			2							
	314	7.6	M	R		1		1										
	315	6.5	M	R		1		1			1	1				1		
	316	7.1	M	R		1		1										
	317	6.8	M	R				1			2					1		
	318	8	M	R		1		1			1					1		1
	319	7.3	M	R				1				2						
	320	10.1	M	R		1				1		2						
	321	6.8	M	R		1				1	1							
	322	3.4	M	R				1		1	2							
	323	8.8	M	R		1					1							
	324	9.1	M	R		1	1	1										
	325	9	M	R		1												
	326	10	M	R		1	2											
	327	11	M	R		1		1										
	328	10.8	M	R		1		1										1
	329	12.5	M	R				1				1						
	330	18.1	M	R		1												
	331	18.2	M	R														
	332	18.4	M	R		1												
	333	17.2	M	R								3						
	334	17	M	R								2						
	335	12.4	M	R				1			1							
	336	6.6	M	R		1				1								1
	337	6.7	M	R		1				1	1							
	338	6.7	M	R				1		1	1							
	339	7	M	R		1		1			2							
	340	6.8	M	R		1		1		1	1							1

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	Potamogeton pusillus,Small pondweed	*Potamogeton richardsonii* ,Clasping-leaf pondweed	*Potamogeton zosteriformis* ,Flat-stem pondweed	*Ranunculus aquatilis* ,Stiff water crowfoot	*Stuckenia pectinata* ,Sago pondweed	*Utricularia vulgaris* ,Common	*Vallisneria americana* ,Wild celery	Wolffia colulmbiana, Watermeal	Filamentous Algae					
307	14.1	M	R	1													
308	11.9	M	R	1	1	1											
309	14.9	M	R														
310	6.8	M	R														
311	7.7	M	R	1													
312	6.9	M	R	1		1											
313	7.9	M	R		1												
314	7.6	M	R	1													
315	6.5	M	R	1													
316	7.1	M	R	1	1												
317	6.8	M	R		1												
318	8	M	R			1											
319	7.3	M	R	1	1	1											
320	10.1	M	R			1											
321	6.8	M	R		1	1											
322	3.4	M	R							1							
323	8.8	M	R														
324	9.1	M	R	2													
325	9	M	R		1	1											
326	10	M	R			1											
327	11	M	R	1		1											
328	10.8	M	R		1												
329	12.5	M	R														
330	18.1	M	R														
331	18.2	M	R														
332	18.4	M	R														
333	17.2	M	R	1													
334	17	M	R														
335	12.4	M	R							1							
336	6.6	M	R			1											
337	6.7	M	R	1	1												
338	6.7	M	R	1													
339	7	M	R														
340	6.8	M	R		1												

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	*Brasenia schreberi* ,Watershield	*Ceratophyllum demersum* ,Coontail	*Chara* ,Muskgrasses	*Elodea canadensis* ,Common waterweed	*Lemna trisulca* ,Forked duckweed	*Myriophyllum sibericum* ,Northern water milfoil	*Najas flexilis* ,Bushy pondweed	*Nitella* sp.,Nitella	*Nuphar variegata* ,Spatterdock	*Nymphaea odorata* ,White water lily	*Potamogeton gramineus* ,Variable pondweed	*Potamogeton illinoensis* ,Illinois pondweed	*Potamogeton natans* ,Floating-leaf pondweed	*Potamogeton praelongis* ,White-stem pondweed
341	7.1	M	R				1		1	1							
342	7.2	M	R		1		1			1							
343	6.7	M	R				1		1	1							
344	9.6	M	R		1												
345	7.6	M	R		1		2			2							1
346	6.9	M	R														
347	10.7	M	R		1		1										
348	10.6	M	R		1		1			2							
349	15.9	M	R		1		1			2							
350	15.9	M	R							2							
351	18.9	M	R		1												
352	19.6	M	R		1												
353	18.9	M	R														
354	17.7	M	R														
355	18.4	M	R														
356	13.7	M	R							1							
357	6.9	M	R						1								
358	6.8	M	R						1	1							
359	7.4	M	R				1										
360	6.6	M	R		1				1	1							
361	7.2	M	R		1		1		1	1					1		
362	3.8	M	R		1				1	1							
363	6.4	M	R		1												
364	6.2	M	R		1		1		1								1
365	4.2	M	R		1					1							
366	8	M	R		1					1							
367	5.5	M	R		2		1			2							
368	9.9	M	R		1					1							
369	12.4	M	R		1					1							
370	12.9	M	R							2							
371	16.3	M	R		1					1							
372	22.1	M	R														
373	22.6	M	R														
374	22.3	M	R														

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	Potamogeton pusillus,Small pondweed	*Potamogeton richardsonii* ,Clasping-leaf pondweed	*Potamogeton zosteriformis* ,Flat-stem pondweed	*Ranunculus aquatilis* ,Stiff water crowfoot	*Stuckenia pectinata* ,Sago pondweed	*Utricularia vulgaris* ,Common	*Vallisneria americana* ,Wild celery	Wolffia colulmbiana, Watermeal	Filamentous Algae					
341	7.1	M	R	1													
342	7.2	M	R		1	1											
343	6.7	M	R			1											
344	9.6	M	R	1		1											
345	7.6	M	R														
346	6.9	M	R		1	1											
347	10.7	M	R	1		1											
348	10.6	M	R														
349	15.9	M	R														
350	15.9	M	R														
351	18.9	M	R														
352	19.6	M	R														
353	18.9	M	R														
354	17.7	M	R														
355	18.4	M	R														
356	13.7	M	R							1							
357	6.9	M	R	1	1												
358	6.8	M	R		1												
359	7.4	M	R	1													
360	6.6	M	R														
361	7.2	M	R	1	1												
362	3.8	M	R							1							
363	6.4	M	R							1							
364	6.2	M	R	2	1					1							
365	4.2	M	R	1						1							
366	8	M	R														
367	5.5	M	R		1												
368	9.9	M	R														
369	12.4	M	R		1												
370	12.9	M	R														
371	16.3	M	R														
372	22.1	M	R														
373	22.6	M	R														
374	22.3	M	R														

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	*Brasenia schreberi* ,Watershield	*Ceratophyllum demersum* ,Coontail	*Chara* ,Muskgrasses	*Elodea canadensis* ,Common waterweed	*Lemna trisulca* ,Forked duckweed	*Myriophyllum sibericum* ,Northern water milfoil	*Najas flexilis* ,Bushy pondweed	*Nitella* sp.,Nitella	*Nuphar variegata* ,Spatterdock	*Nymphaea odorata* ,White water lily	*Potamogeton gramineus* ,Variable pondweed	*Potamogeton illinoensis* ,Illinois pondweed	*Potamogeton natans* ,Floating-leaf pondweed	*Potamogeton praelongis* ,White-stem pondweed
375	19.9	M	R														
376	15.1	M	R		1					2							
377	5.8	M	R				1		2								
378	4.2	M	R				1		1								
379	6.9	M	R						1	1							
380	6.5	M	R		1					1							
381	10.1	M	R		1		1			2							
382	9.6	M	R		1		1			3							
383	10.1	M	R				1			2							
384	11.2	M	R							1							1
385	11.3	M	R							1							
386	13.3	M	R		1		1			1							
387	15.9	M	R														
388	20.9	M	R														
389	21.8	M	R														
390	20.7	M	R														
391	16.7	M	R							1							
392	15.3	M	R							1							
393	9.9	M	R		1		1			1							
394	11.5	M	R							1							
395	11.4	M	R		1					1							
396	12.3	M	R							1							
397	16.8	M	R							1							
398	22.2	M	R														
399	23.2	M	R														
400	20	M	R														
401	16.3	M	R							1							
402	11.3	M	R		1		1			1							
403	10.1	M	R							1							1
404	11.4	M	R		1		1			1							
405	12	M	R		2												
406	14.8	M	R							1							
407	16.6	M	R		1						1						
408	16.7	M	R														

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	Potamogeton pusillus,Small pondweed	*Potamogeton richardsonii* ,Clasping-leaf pondweed	*Potamogeton zosteriformis* ,Flat-stem pondweed	*Ranunculus aquatilis* ,Stiff water crowfoot	*Stuckenia pectinata* ,Sago pondweed	*Utricularia vulgaris* ,Common	*Vallisneria americana* ,Wild celery	Wolffia colulmbiana, Watermeal	Filamentous Algae
375	19.9	M	R									
376	15.1	M	R									
377	5.8	M	R	1								
378	4.2	M	R									
379	6.9	M	R	3								
380	6.5	M	R									
381	10.1	M	R		1							
382	9.6	M	R									
383	10.1	M	R									
384	11.2	M	R		1							
385	11.3	M	R		1							
386	13.3	M	R			1						
387	15.9	M	R									
388	20.9	M	R									
389	21.8	M	R									
390	20.7	M	R									
391	16.7	M	R									
392	15.3	M	R									
393	9.9	M	R									
394	11.5	M	R		1							
395	11.4	M	R			2						
396	12.3	M	R	1	1							
397	16.8	M	R									
398	22.2	M	R									
399	23.2	M	R									
400	20	M	R									
401	16.3	M	R									
402	11.3	M	R	1	1							
403	10.1	M	R		1							
404	11.4	M	R									
405	12	M	R	1								
406	14.8	M	R	1								
407	16.6	M	R									
408	16.7	M	R									

Entry	sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	*Brasenia schreberi* ,Watershield	*Ceratophyllum demersum* ,Coontail	*Chara* ,Muskgrasses	*Elodea canadensis* ,Common waterweed	*Lemna trisulca* ,Forked duckweed	*Myriophyllum sibericum* ,Northern water milfoil	*Najas flexilis* ,Bushy pondweed	*Nitella* sp.,Nitella	*Nuphar variegata* ,Spatterdock	*Nymphaea odorata* ,White water lily	*Potamogeton gramineus* ,Variable pondweed	*Potamogeton illinoensis* ,Illinois pondweed	*Potamogeton natans* ,Floating-leaf pondweed	*Potamogeton praelongis* ,White-stem pondweed
Lake: Townsend Flowage	409	14.4	M	R		1					1							
County: Oconto	410	12.2	M	R		1				1	1							
WBIC: 0465000	411	5.5	M	R				1			1					1		
	412	8.2	M	R		1		1				2						
Survey Date: July 16, 2006	413	4.4	M	R														
	414	11.2	M	R		1		1		1		1						
	415	11.3	M	R				1										
	416	11.9	M	R								2						
	417	11.5	M	R								1						
	418	9.9	M	R		1						1						
	419	3.2	M	R						1					1			
	420	4.4	S	R														
	421	4.6	M	R		1		1										
	422	8.6	M	R				1		1								
	423	7	M	R				1		1								
	424	6.3	M	R		1		1		1								
	425																	
	426	5.9	M	R		1				1	1							

Entry

Lake: Townsend Flowage
County: Oconto
WBIC: 0465000

Survey Date: July 16, 2006

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	Potamogeton pusillus,Small pondweed	*Potamogeton richardsonii* ,Clasping-leaf pondweed	*Potamogeton zosteriformis* ,Flat-stem pondweed	*Ranunculus aquatilis* ,Stiff water crowfoot	*Stuckenia pectinata* ,Sago pondweed	*Utricularia vulgaris* ,Common	*Vallisneria americana* ,Wild celery	Wolffia colulmbiana, Watermeal	Filamentous Algae					
409	14.4	M	R	1						1							
410	12.2	M	R							1							
411	5.5	M	R	1													
412	8.2	M	R			1											
413	4.4	M	R														
414	11.2	M	R			1											
415	11.3	M	R														
416	11.9	M	R														
417	11.5	M	R														
418	9.9	M	R	1	1												
419	3.2	M	R							1							
420	4.4	S	R														
421	4.6	M	R	2	1	1											
422	8.6	M	R	1						1							
423	7	M	R							1							
424	6.3	M	R			2											
425																	
426	5.9	M	R							1							

Entry

Lake: McCaslin Creek
County: Oconto
WBIC: n/a

Survey Date: July 16, 2006

Species present not sampled:
purple loostrife

sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	*Ceratophyllum demersum* ,Coontail	*Chara* ,Muskgrasses	*Elodea canadensis* ,Common waterweed	*Lemna trisulca* ,Forked duckweed	*Myriophyllum sibericum* ,Northern water milfoil	*Najas flexilis* ,Bushy pondweed	*Nitella* sp.,Nitella	*Nuphar variegata* ,Spatterdock	*Nymphaea odorata* ,White water lily	Potamogeton amplifolius,Large-leaf pondweed	*Potamogeton gramineus* ,Variable pondweed	*Potamogeton illinoensis* ,Illinois pondweed	*Potamogeton natans* ,Floating-leaf pondweed	*Potamogeton praelongis* ,White-stem pondweed	Potamogeton pusillus,Small pondweed
1	10.6	M	R	1						2								
2	4.7	M	R	1		1												1
3	6.7	M	R					1	1									
4	5.9	M	R			1		2										1
5	2.8	M	R	1		1		3			1							
6	4.9	M	R	1		2		1	1		1	1						1
7	5	M	R	1				1										1
8	3.8	M	R	1		1		1				1						
9	4.5	M	R	1		1		1	1	1	1							
10	1.8	M	R	1		1	1	1			1							1
11	5	M	R	1		1		1		1						1	1	
12	4.3	M	R			1		3				1				1		
13	5.4	M	R	1							1							
14	5.7	M	R	1		1	1			1	1	1						
15	5.6	M	R	1		1				2								
16	4.1	M	R	1		1		1							1	1		
17	6.6	M	R			2		1		1					1			
18	7.4	M	R	1		1		1		2								1
19	7.1	M	R	1		1		1										1
20	8.2	M	R	1		1		1										
21	8.8	M	R	1		1				2								1
22	7.3	M	R	1						2								
23	7.4	M	R	1				1	1	1			1					
24	8.2	M	R	1						3								
25	8.3	M	R	1					1	1								
26	8.4	M	R			1		1	1	2			1					
27	9.9	M	R	1		1			1	1								
28	6.5	M	R					1	1				1					1
29	8.2	M	R			1			1									1
30	6.3	M	R					1					1					1
31	6.4	M	R		1	1		1	1									1
32	7.6	M	R			1		1	1									2
33	6.1	M	R	1		1		1	1									1
34	9.9	M	R	1				1		3								

Entry	sampling point	*Potamogeton richardsonii* ,Clasping-leaf pondweed	*Potamogeton zosteriformis* ,Flat-stem pondweed	*Vallisneria americana* ,Wild celery
Lake: McCaslin Creek	1			
County: Oconto	2			
WBIC: n/a	3			
	4			
Survey Date: July 16, 2006	5		1	1
	6			
	7			
	8		1	
	9			
	10			
Species present not	11		1	
sampled:	12		1	
purple loostrife	13		1	
	14		1	
	15			
	16	1	1	
	17	1		
	18			
	19		1	
	20		1	1
	21		1	
	22			
	23		1	
	24		1	
	25			
	26		1	
	27			
	28		1	
	29			1
	30			1
	31			1
	32		1	1
	33			1
	34			

Entry	sampling point	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock	Sampled holding rake pole (P) or rake rope (R)?	*Ceratophyllum demersum* ,Coontail	*Chara* ,Muskgrasses	*Elodea canadensis* ,Common waterweed	*Lemna trisulca* ,Forked duckweed	*Myriophyllum sibericum* ,Northern water milfoil	*Najas flexilis* ,Bushy pondweed	*Nitella* sp.,Nitella	*Nuphar variegata* ,Spatterdock	*Nymphaea odorata* ,White water lily	Potamogeton amplifolius,Large-leaf pondweed	*Potamogeton gramineus* ,Variable pondweed	*Potamogeton illinoensis* ,Illinois pondweed	*Potamogeton natans* ,Floating-leaf pondweed	*Potamogeton praelongis* ,White-stem pondweed	Potamogeton pusillus,Small pondweed
Lake: McCaslin Creek	36	7.6	M	R					1		1								1
County: Oconto	37	6.5	M	R	1		1		1										1
WBIC: n/a	38	7.5	M	R	1				1										
	39	6.7	M	R					1			1	1						
Survey Date: July 16, 2006	40	7.4	M	R	1		1		2			1						1	1
	41	7.8	M	R	1				1		1								
	42	7.1	M	R					1		1					1			1
Species present not	43	5.9	M	R	1		1				1								
sampled:	44	4.5	M	R	1		1		1		1								
purple loostrife	45	5.3	M	R	1		1		1			1					1		
	46	3.5	M	R	1		2								1				1

Entry	sampling point	*Potamogeton richardsonii* ,Clasping-leaf pondweed	*Potamogeton zosteriformis* ,Flat-stem pondweed	*Vallisneria americana* ,Wild celery															
Lake: McCaslin Creek	36			1															
County: Oconto	37			1															
WBIC: n/a	38																		
	39			1															
Survey Date: July 16, 2006	40		1	1															
	41			1															
	42		1																
Species present not	43																		
sampled:	44																		
purple loostrife	45																		
	46		1																

Appendix C

- Townsend Flowage Floristic Quality Index (FQI) analysis

Townsend Flowage Floristic Quality Index (FQI) analysis table.

Lake	Townsend Flowage
Year	2006
County	Oconto
Township(N)	33
Range(E)	15
Section	14,15,22,23,27

Species	Common Name	C	species present=1	
Brasenia schreberi	Watershield	7	1	7
Ceratophyllum demersum	Coontail	3	1	3
Chara	Muskgrasses	7	1	7
Elodea canadensis	Common waterweed	3	1	3
Lemna trisulca	Forked Duckweed	6	1	6
Myriophyllum sibericum	Northern water-milfoil	7	1	7
Najas flexilis	Bushy pondweed	6	1	6
Nitella	Nitella	7	1	7
Nuphar variegata	Spatterdock	6	1	6
Nymphaea odorata	White water lily	6	1	6
Potamogeton amplifolius	Large-leaf pondweed	7	1	7
Potamogeton gramineus	Variable pondweed	7	1	7
Potamogeton illinoensis	Illinois pondweed	6	1	6
Potamogeton natans	Floating-leaf	5	1	5
Potamogeton praelongis	White-stem pondweed	8	1	8
Potamogeton pusillus	Small pondweed	7	1	7
Potamogeton richardsonii	Clasping-leaf pondweed	5	1	5
Potamogeton zosteriformis	Flat-stem pondweed	6	1	6
Ranunculus aquatilis	Stiff water crowfoot	7	1	7
Stuckenia pectinata	Sogo pondweed	3	1	3
Utricularia vulgaris	Common bladderwort	7	1	7
Vallisneria americana	Wild celery	6	1	6
Wolffia columbiana	Common watermeal	5	1	5
N			23	
mean C				5.96
FQI				28.57

Appendix D

- The Importance of Aquatic Plants

The Importance of Aquatic Plants

Plant information was gathered from Borman et al. (1997), Eggers and Reed (1997), Fasset (1940), Fink (1994), Nichols and Vennie (1991), and Whitley et al. (1999). Images obtained from Schmidt and Kannenberg (1998) and Borman et al. (1997).

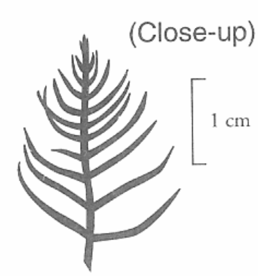
Submersed Plants – Plants that tend to grow with their leaves under water.

Bushy pondweed (*Najas flexilis*) also known as **slender naiad** has a finely branched stem that grows from a rootstock. Leaves are short (1-4 cm), pointed and grow in pairs. Slender naiad is an annual and must grow from seed each year. It tends to establish well in disturbed areas. Slender naiad is one of waterfowl's favorite foods and considered very important. Waterfowl, marsh birds, and muskrats relish seeds, leaves and stems. Slender naiad stabilizes bottom sediment and offers cover for fish.

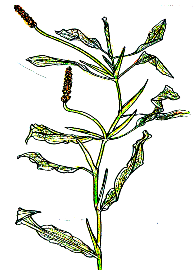
Coontail *(Ceratophyllum demersum)* produces whorls of narrow, toothed leaves on a long trailing stem that often resembles the tail of a raccoon. The leaves tend to be more crowded toward the tip. Coontail blankets the bottom, which helps to stabilize bottom sediments. Tolerant to nutrient rich environments, coontail filters a high amount of phosphorus out of the water column. Coontail provides a home for invertebrates and juvenile fish. Seeds are consumed by waterfowl, but are not of high preference.

Common waterweed or **Elodea** (*Elodea canadensis*) is made up of slender stems with small, lance-shaped leaves that attach directly to the stem. Leaves are found in whorls of two or three and are more crowded toward the stem tip. The branching stems of elodea provide valuable cover for fish and are home for many insects that fish feed upon. Elodea also provides food for muskrats and waterfowl.

Northern Watermilfoil (*Myriophyllum sibericum*) produces whorls of feather-like leaflets from a fairly stout stem. Northern watermilfoil is identified by its 5 to 12 pairs of leaflets that become progressively longer near the base of the leaf – giving the leaf a candelabra-like appearance. The leaves and fruit of this plant are eaten by a variety of waterfowl. Its finely divided leaves are habitat for numerous invertebrates that fish feed upon. Northern watermilfoil is an indicator of good water quality, as the plant seldom survives in more eutrophic environments.

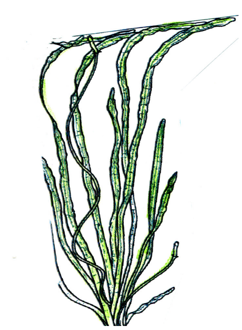


Although **native pondweeds** (*Potamogeton spp.*) may vary in appearance, there are a number of key features members of this genus have in common. Pondweed leaves are alternate with a noticeable midvein. The nutlets, leaves, and stipules of a particular species can often be used to reliably identify it. The pondweeds grow in a wide range of aquatic habitats. They all emerge from rhizomes, which help the plants overwinter. The pondweeds are a valuable food source for waterfowl and a number of mammals. They also provide a home for fish and invertebrates.



Musk grasses (*Chara* spp.) and **Nitella** (*Nitella* spp.) are both complex forms of algae that resemble higher plants. Musk grasses are identified by a pungent, skunk-like odor and whorls of toothed branched leaves, while Nitella lacks the skunky smell and has smooth stems and branches. Ecologically, these plants provide shelter and foraging opportunities for juvenile fish. Waterfowl love to feast on these species when the plants bear their seed-like oogonia. These species serve an important role in stabilizing bottom sediments, tying up nutrients in the water column, and maintaining water clarity.

Wild Celery (*Vallisneria americana*) also known as **eelgrass** has long ribbon-like leaves that emerge in clusters. Leaves have a prominent central stripe and leaf tips tend to float gracefully at the water's surface. In the fall, a vegetative portion of the rhizome will break free and float to other locations. Wild celery is considered one of the best all natural waterfowl foods. The entire plant is relished by waterfowl, especially canvasbacks. Eelgrass beds serve as an important food source for sea ducks, marsh birds, and shore birds. Fish also find wild celery to be a popular hiding spot.



Appendix E

- Townsend Flowage dissolved oxygen and temperature data – May – August 2006

Townsend Flowage Dissolved Oxygen and Temperature Data 2006

North Basin

Depth	May 1, 2006			June 21, 2006		
(ft)	Temp (F.)	D.O. (mg/l)	% Sat.	Temp (F.)	D.O. (mg/l)	% Sat.
0	55.4	8.73	83.6	78.0	8.00	103.7
1	55.1	8.69	83.5	76.5	8.19	104.5
2	54.7	8.61	82.3	75.9	8.33	105.6
3	54.5	8.60	82.3	74.8	8.54	106.8
4	54.1	8.55	78.2	74.6	8.59	107.1
5	53.9	8.43	77.6	74.2	8.48	105.3
6	53.2	8.21	75.1	74.0	8.48	105.1
7	52.9	7.43	67.5	73.7	8.08	100.0
8	52.7	6.79	62.2	73.1	9.08	110.7
9				71.0	6.37	71.0
10				69.6	0.76	9.0

Depth	July 25, 2006			August 24, 2006		
(ft)	Temp (F.)	D.O. (mg/l)	% Sat.	Temp (F.)	D.O. (mg/l)	% Sat.
0	70.6	9.20	110.2	73.2	8.23	96.0
1	63.5	9.80	102.5	73.1	7.99	92.5
2	66.5	9.62	111.0	73.1	8.09	93.9
3	67.2	10.2	118.3	72.8	8.43	98.5
4	66.9	10.8	127.4	72.8	8.77	101.1
5	66.8	7.50	133.0	72.8	8.80	102.0
6	67.0	11.8	134.8	72.6	8.46	97.5
7	66.5	11.7	128.4	72.2	7.11	89.9
8	67.0	6.20	69.2	72.0	7.25	84.0
9				71.8	7.17	81.4
10						

Townsend Flowage Dissolved Oxygen and Temperature Data 2006

South Basin

Depth	May 1, 2006			June 21, 2006		
(ft)	Temp (F.)	D.O. (mg/l)	% Sat.	Temp (F.)	D.O. (mg/l)	% Sat.
0	54.7	8.84	86.9	73.7	8.19	100.1
2	54.4	8.83	86.7	73.5	8.23	101.3
4	54.2	8.86	86.7	73.4	8.23	101.3
6	54.1	8.87	86.7	73.4	8.22	101.2
8	53.9	8.89	86.6	73.4	8.22	101.1
10	53.9	8.87	86.3	73.3	8.27	101.6
12	53.7	8.89	86.5	69.4	8.62	101.3
14	53.7	8.89	86.5	63.9	8.15	90.1
16	53.5	8.93	86.6	59.1	4.58	48.0
18	53.6	8.88	86.0	57.3	0.90	9.1
20	53.6	8.82	85.7	56.5	0.21	1.9
22	53.6	8.79	85.5	55.9	0.02	0.1
24	53.7	8.58	81.6	55.1	0.00	0.0
26	53.5	3.37	36.1			

Depth	July 25, 2006			August 24, 2006		
(ft)	Temp (F.)	D.O. (mg/l)	% Sat.	Temp (F.)	D.O. (mg/l)	% Sat.
0				72.8	7.36	85.2
2	77.9	7.06	93.1	72.8	7.39	85.1
4	77.4	7.47	95.9	72.8	7.36	85.4
6	77.4	7.63	98.0	72.8	7.32	84.5
8	77.0	7.68	98.3	72.8	7.33	84.9
10	76.7	7.79	99.8	72.8	7.18	83.1
12	76.7	7.80	99.5	72.8	7.33	84.9
14	75.6	7.35	91.6	72.5	6.99	80.6
16	68.8	5.08	57.0	72.3	7.42	84.3
18	65.0	1.91	21.4	72.1	7.01	64.5
20	61.3	0.77	6.8	68.8	0.27	2.7
22	58.9	0.46	5.0	64.6	0.15	1.6
24	57.6	0.28	3.4	62.1	0.12	1.3
26	56.9	0.13	1.1	60.1	0.04	0.4

Appendix F

- Description of soil types within the watershed of Townsend Flowage, Oconto County, WI

Description of soil types within the watershed of Townsend Flowage, Oconto County, WI

Soil type	Percent of Watershed	Description
Padus fine sandy loam, 1 to 6 percent slopes	16.5%	Well drained loamy soil. Low available water capacity. Potentially highly erodible. Prime farmland.
Kennan fine sandy loam, 6 to 15 percent slopes	11.3%	Well drained loamy soil. Moderate available water capacity. Potentially highly erodible. Farmland of state wide importance.
Kennan loam, 6 to 15 percent slopes, stony	8.7%	Well drained loamy soil. Moderate available water capacity. Potentially highly erodible. Not prime farmland.
Padus fine sandy loam, 6 to 15 percent slopes	7.6%	Well drained loamy soil. Low available water capacity. Potentially highly erodible. Farmland of state wide importance.
Seelyeville and Markey mucks, 0 to 1 percent slopes	6.1%	This map unit contains main components: SEELYEVILLE - Very poorly drained organic soil. Frequently ponded. Very high available water capacity. This soil is hydric. MARKEY - Very poorly drained organic over sandy soil. Frequently ponded. Very high available water capacity. This soil is hydric. Not highly erodible. Not prime farmland.
Keweenaw sandy loam, 15 to 45 percent slopes, stony	5.5%	Well drained sandy soil. Low available water capacity. Highly erodible. Not prime farmland.
Kennan fine sandy loam, 2 to 6 percent slopes	5.3%	Well drained loamy soil. Moderate available water capacity. Not highly erodible. Prime farmland.
Pence sandy loam, 15 to 35 percent slopes	4.5%	Well drained sandy soil. Low available water capacity. Highly erodible. Not prime farmland.
Water	4.5%	N/A
Kennan silt loam, 2 to 6 percent slopes, stony	4.0%	Well drained loamy soil. Moderate available water capacity. Not highly erodible. Prime farmland.
Seelyeville, Cathro, and Markey mucks	3.9%	This map unit contains main components: SEELYEVILLE - Very poorly drained organic soil. Frequently ponded. Very high available water capacity. This soil is hydric. CATHRO - Very poorly drained organic over loamy soil. Frequently ponded. Very high available water capacity. This soil is hydric. MARKEY - Very poorly drained organic over sandy soil. Frequently ponded. Very high available water capacity. This soil is hydric. Not highly erodible. Not prime farmland.
Pence sandy loam, 6 to 15 percent slopes	3.8%	Well drained sandy soil. Low available water capacity. Potentially highly erodible. Not prime farmland.
Padus fine sandy loam, 15 to 35 percent slopes	2.1%	Well drained loamy soil. Low available water capacity. Highly erodible. Not prime farmland.
Hatley silt loam, 2 to 6 percent slopes, stony	1.5%	Somewhat poorly drained loamy soil. Moderate available water capacity. Not highly erodible. Farmland of state wide importance.
Menahga sand, 0 to 6 percent slopes	1.4%	Excessively drained sandy soil. Low available water capacity. Not highly erodible. Not prime farmland.
Fence very fine sandy loam, 2 to 6 percent slopes	1.4%	Well drained silty soil. High available water capacity. Not highly erodible. Prime farmland.
Worcester loam, 0 to 3 percent slopes	1.3%	Somewhat poorly drained loamy soil. Low available water capacity. Not highly erodible. Prime farmland where drained.

N/A = soil desciption not available

Description of soil types within the watershed of Townsend Flowage, Oconto County, WI (cont.)

Soil type	Percent of Watershed	Description
Saprists and Aquents, ponded	1.3%	This map unit contains main components: SAPRISTS - Very poorly drained organic soil. Frequently ponded. Frequently flooded. Moderate available water capacity. This soil is hydric. AQUENTS - Very poorly drained sandy soil. Frequently ponded. Frequently flooded. Low available water capacity. This soil is hydric. Not highly erodible. Not prime farmland.
Pence sandy loam, 1 to 6 percent slopes	1.1%	Well drained sandy soil. Low available water capacity. Potentially highly erodible. Farmland of state wide importance.
Kennan fine sandy loam, 15 to 30 percent slopes	0.9%	Well drained loamy soil. Moderate available water capacity. Highly erodible. Not prime farmland.
Wabeno-Goodman silt loams, 6 to 15 percent slopes, very stony	0.8%	N/A
Rousseau fine sand, 1 to 6 percent slopes	0.7%	Moderately well drained sandy soil. Low available water capacity. Not highly erodible. Not prime farmland.
Wabeno-Goodwit silt loams, 1 to 6 percent slopes, very stony	1.0%	N/A
Wainola loamy fine sand, 0 to 3 percent slopes	0.6%	Somewhat poorly drained sandy soil. Low available water capacity. This soil is not hydric,. Not highly erodible. Farmland of state wide importance.
Minocqua mucky fine sandy loam, 0 to 2 percent slopes	0.5%	Poorly and very poorly drained loamy over sandy soil. Frequently ponded. Low available water capacity. This soil is hydric. Not highly erodible. Not prime farmland.
Cormant loamy fine sand, 0 to 1 percent slopes	0.5%	Very poorly drained sandy soil. Frequently ponded. Low available water capacity. This soil is hydric. Not highly erodible. Not prime farmland.
Antigo silt loam, 6 to 15 percent slopes	0.5%	Well drained silty over sandy soil. Moderate available water capacity. Potentially highly erodible. Farmland of state wide importance.
Wabeno-Mudlake silt loams, 1 to 15 percent slopes, very stony	0.4%	N/A
Oesterle silt loam	0.3%	Somewhat poorly drained loamy soil. Moderate available water capacity. Not highly erodible. Prime farmland where drained.
Pelkie loamy fine sand, 1 to 3 percent slopes	0.3%	Moderately well drained sandy soil. Occasionally flooded. Low available water capacity. Not highly erodible. Not prime farmland.
Menahga sand, 6 to 15 percent slopes	0.3%	Excessively drained sandy soil. Low available water capacity. Potentially highly erodible. Not prime farmland.
Pence sandy loam, 15 to 45 percent slopes	0.2%	Well drained sandy soil. Low available water capacity. Highly erodible. Not prime farmland.
Minocqua, Cable, and Sherry mucks	0.2%	This map unit contains main components: MINOCQUA - Poorly drained loamy over sandy soil. Frequently ponded. Moderate available water capacity. This soil is hydric. CABLE - Poorly and very poorly drained loamy soil. Frequently ponded. Moderate available water capacity. This soil is hydric. SHERRY - Poorly and very poorly drained loamy soil. Frequently ponded. High available water capacity. This soil is hydric. Not highly erodible. Not prime farmland.
N/A = soil desciption not available		

Description of soil types within the watershed of Townsend Flowage, Oconto County, WI (cont.)

Soil type	Percent of Watershed	Description
Padus-Wabeno silt loams, 1 to 6 percent slopes, very stony	0.2%	N/A
Shiocton very fine sandy loam, 0 to 3 percent slopes	0.2%	Somewhat poorly drained silty soil. High available water capacity. Not highly erodible. Prime farmland where drained.
Capitola muck, 0 to 2 percent slopes, very stony	0.2%	N/A
Comstock silt loam	0.1%	Somewhat poorly drained silty soil. High available water capacity. Not highly erodible. Prime farmland where drained.
Antigo silt loam, 2 to 6 percent slopes	0.1%	Well drained silty over sandy soil. Moderate available water capacity. Potentially highly erodible. Prime farmland.
Padus-Soperton silt loams, 15 to 35 percent slopes, very stony	0.1%	N/A
Laona-Sarona sandy loams, 15 to 35 percent slopes, very stony	0.1%	N/A
Soperton-Goodman silt loams, 15 to 35 percent slopes, very stony	0.1%	N/A
Keweenaw loamy fine sand, 15 to 35 percent slopes	0.1%	Well drained sandy soil. Low available water capacity. Potentially highly erodible. Not prime farmland.
Scott Lake silt loam	0.05%	Moderately well drained loamy soil. Moderate available water capacity. Not highly erodible. Prime farmland.
Crystal Lake silt loam, 0 to 6 percent slopes	0.04%	Moderately well drained silty soil. Very high available water capacity. Not highly erodible. Prime farmland.
Padus-Wabeno silt loams, 6 to 15 percent slopes, very stony	0.02%	N/A
Winterfield fine sandy loam, 0 to 2 percent slopes	0.02%	Somewhat poorly drained sandy soil. Frequently flooded. Low available water capacity. Not highly erodible. Not prime farmland.
Waupaca very fine sandy loam, 0 to 2 percent slopes	0.01%	Poorly drained silty soil. Frequently ponded. Frequently flooded. Moderate available water capacity. This soil is hydric. Not highly erodible. Prime farmland where drained and protected from flooding.

N/A = soil desciption not available

Appendix G

- Sediment management options for lake organizations

Management of Existing Sediments

Sediment management practices can be carried out either by reducing sediments on-site or by physically removing sediments from the lake. A limited number of options are available to reduce accumulated sediments in lakes. Of these, physical sediment removal (dredging) is the most frequently chosen option. The table on the following page provides a comparison of sediment reduction options.

Sediment Removal and Disposal

Dredging
The dredging of sediments is a commonly used method for maintaining navigation in surface waters. Historically dredging was a crude and inefficient method of sediment removal. With the assistance of today's GPS technology, dredge operators are able to achieve much greater efficiency, saving time and money while providing safer navigation. The selection of the dredging technique and equipment should be based on the accuracy and speed of sediment removal and the impact of resuspended matter to the environment. Two types of dredges that are frequently used are mechanical dredges and hydraulic dredges.

Mechanical Dredges
Mechanical dredges remove lake sediments by physically digging the desired materials from the bottom and disposing of the dredged materials. Mechanical dredges are rugged devices often mounted on barges and secured in place with specialized anchors or pilings called *spuds*. These barge-mounted dredges allow the operators to work in tightly confined areas. Dredged materials are removed by large *dipper* or *clamshell* buckets which then place the materials into a barge, called a *dump scow*. The dump scow is used to transport the dredged materials to a predetermined disposal location. Mechanical dredging operates most efficiently when two or more large barges are used in tandem. Once one barge is filled and is transported to the disposal site, another barge can take its place. This allows for minimal interruptions in the dredging operations. Mechanical dredges are best suited for use with denser, consolidated materials including rocks and large debris. This method of sediment removal is not efficient at removing loose materials such as finer sediments that can easily wash from the dredge bucket.

Hydraulic Dredges
Hydraulic dredges remove lake sediments by sucking a mixture of dredged materials and water from the lakebed. Like mechanical dredges, hydraulic dredges are often mounted on barges. Two types of hydraulic dredges are the *pipeline* and *hopper* dredges.

Pipeline dredges suck dredge materials through a large intake pipe and discharge directly into a barge or other the disposal site. Most pipeline dredges have a *cutterhead*, a mechanical devise with rotating blades or teeth used to break up or loosen the sediment materials. As a result, cutterhead pipeline dredges are able to excavate most materials. Pipeline dredges can be operated continuously and can be, as a result, very cost efficient. Cutterhead pipeline dredges work best where the cutterhead is buried deep in the

Comparison of Sediment Management Options for Lake Organizations

Option	Advantages	Disadvantages
Dredging	Useful in maintaining navigational lanes	Often causes resuspension of sediments and declines in water quality
	Sediments quickly removed from waterbody	Associated with increases in nutrients and pollutants; impacts to wildlife
	Efficient at providing safe navigation	Sediment removal may only be short-term fix
		Must dispose of potentially polluted dredged materials
		Does not address sources of sediment accumulation
Mechanical Dredging	Able to operate in tightly confined areas	Not suited for high traffic areas
	Can operate continuously if in conjunction with multiple barges	Not efficient at removing fine or loose materials
	Rugged; works best for hard, consolidated materials	Produces large quantities of sediment resuspension
	Can be used to remove rocks and debris	
Hydraulic Dredging	Able to remove finer materials more efficiently	Efficiency dependent upon mixture of dredged material and water
	Results in decreased sediment resuspension	
Cutterhead Pipeline Dredging (Hydraulic)	Operate continuously, cost efficient	Pipes can clog if large amounts of debris are present
	Able to break up hard materials	Pipelines may obstruct navigation
Hopper Dredging (Hydraulic)	Mobile; useful in high traffic areas	Dredged materials discharged from ship, not removed from waterbody
		Cannot be used in confined or shallow areas
		Does not operate continuously; stop dredging during transit to disposal site
Aeration Systems	Designed to improve dissolved oxygen profile and breakdown organic sediments	Sediment reduction slow in comparison to removal by dredging
	Increase habitat for fish and other aquatic animals	Do not impact accumulation of inorganic sediments
	Can prevent fish kills	Unable to remove contaminated sediments
	Reduce concentrations of metals and nutrients in the water	
	Reduce hydrogen sulfide, ammonia, methane and carbon dioxide	
Watershed and Lakeshore Erosion Controls	Designed to reduce rates of sedimentation and soil and shoreline erosion	Preventative maintenance; do not address accumulated sediments
	Can lead to improved water quality, filter nutrients and trap sediments	Will not directly affect internal nutrient cycling
	Can improve fish and wildlife habitat, aesthetics	

sediment. The amount of water removed should be controlled during operation for best efficiency. Water that is pumped with the dredge material must be contained on site until a reasonable amount of solids settle out. The water can then be discharged back into the water body.

Hopper dredges are self-propelled ships with large hoppers or containment areas. These dredges suck dredge material from the lakebed through intake pipes called *drag arms*. These arms have difficulty dredging denser, consolidated materials. Dredged materials are stored onboard. As a result, hopper dredges are limited to deeper water. Again, water is drained and discharged back to the waterbody from the vessel. Once the containment areas are full, the barge is moved to an in-water disposal site and the dredged materials are discharged through the bottom of the ship. Although hopper dredges can quickly move to disposal sites, because they are self-propelled, dredging operations must stop during transport, affecting operation and cost efficiencies.

Environmental Impacts of Dredging

Removal of sediments from lakes is an established management technique *intended* to enhance sport fisheries, manage aquatic plants, and improve navigation. However, data available on the effects of dredging on lake ecosystems is limited. By its nature, dredging causes physical changes to the lake ecosystem both in terms of the sediments and the water column. Sediment resuspension and increases in nutrient and other pollution levels are constant concerns associated with dredging operations (Marsh, 2003). Research has suggested that physical sediment removal can be detrimental to certain wildlife species including populations of reptiles and amphibians (Aresco and Gunzburger, 2004). Whenever possible, the best management practices available should be utilized to reduce sediment resuspension during dredging.

One of the most challenging problems associated with dredging is in the disposal of the dredged materials. If the sediments to be removed have relatively low concentrations of compounds such as heavy metals and/or organic pollutants, they can be applied to agricultural soils as a fertilizer or soil conditioner. As a result, sediment analysis is required before any dredging operation can be approved. Ideally, disposal on nutrient poor soils can be of great benefit and can compensate, to some extent, for the cost of the dredging operation.

Regardless of possible contamination, sediment resuspension and relocation are two of the most significant environmentally damaging results of dredging. Rates of sediment resuspension are higher for mechanical dredging that for hydraulic dredging. This is simply due to the techniques used in these two approaches. Because mechanical dredging is inefficient at removing the finer loose sediments, they become easily resuspended. Ranges for total suspended solids (TSS) concentrations near mechanical *and* hydraulic dredging operations rarely if ever reach levels of acute (short-term) lethal toxicity. However, levels do often exceed chronic (long-term) sublethal toxicity levels. This means that although there often are no immediate lethal effects to the biota of a lake, there are other less than lethal

stresses placed on the lake community in the long term. There are a number of control options that can be used to reduce the incidence of both chemical and physical impacts. These include physical controls (silt curtains, silt booms, settling chambers, etc.), operational controls, and specialty dredging equipment. Improper implementation of these practices can affect their performance (Stivers et al., 2004, Rokosch and Berb, 2003).

On-site Sediment Reduction

Artificial Aeration Systems
Lakes naturally get much of their oxygen from the atmosphere through a process called diffusion. Artificial aeration systems can increase a lake's oxygen levels by forcefully exposing much of the lake to the atmosphere. Various aeration systems are available. These systems work by either injecting air or mechanically mixing water. The most effective aeration systems used in lake sediment management are injection (diffusion) systems. The purpose of an aeration system in sediment management is to increase the dissolved oxygen content at the water-sediment interface and encourage the rapid breakdown of organic matter in the sediment. This method does not involve physical removal of sediments, but instead boosts natural biological and chemical processes to reduce organic sediments through decomposition. Many lakes in Wisconsin have benefited from noticeable decreases in sediments as a result of aeration. However, it should be noted that it may take years to see a noticeable reduction in sediments through this method.

Obtaining a Permit to Dredge

If dredging is chosen as an option, there are a number of steps that need to be taken in order to obtain a permit for dredging.

The first step is to determine if the waterway has a special designation that might affect the permit requirements. As part of the permit review process any designations will be taken into account.

There are two types of permits issued for dredging; the general and the individual permit. In addition, some small dredging projects (3,000 cubic yards) can qualify for a permit exemption. A majority of dredging projects require an Individual (Chapter 30) Permit.

The individual permit is available online (http://dnr.wi.gov/org/water/fhp/waterway/permits/pack09a.pdf) as well as the associated fee sheet (http://dnr.wi.gov/org/water/fhp/waterway/permits/feesheet.pdf). Most projects require a fee of approximately $500. Five copies of the permit must be submitted to the Wisconsin DNR.

As part of the Individual Permit requirements an Environmental Assessment (EA) would need to be completed in accordance with NR 150 Wis. Admin. Code. An EA is intended to be used as a means to determine the environmental consequence, or impact of a proposed project or activity (Jain et al., 2002). The EA would need to be completed by a consultant which would cost additional consulting fees. The EA is sent to the Wisconsin DNR for their review. It is required that there be 30 day public notice period and possibly a public information meeting. If during the review, the DNR determines the proposed project may cause serious impact to the environment, an Environmental Impact Statement may be required. This happens on rare occasions, but a lake organization should be prepared for the possibility of this requirement.

In addition, a Wisconsin Pollution Discharge and Elimination System (WPDES) permit is required for the disposal of the dredged materials as well as a US Army Corps of Engineers (USACOE) general permit authorizing the project. However one of the five copies of the individual permit application sent to the Wisconsin DNR is in turn sent to the USACOE. Therefore there is not a separate application needed for the Corps' permit.

In general the permit process can take six months or more to complete. A dredging project can be a long, costly, and inconvenient process. It is important that the lake organization be aware of the process and the amount of work required to obtain a permit and to complete a dredging project of this magnitude.

Undertaking an dredging project

Most often, dredging projects are not completed due to a lack of money, a lack of an appropriate disposal site, permit denial or the lack of persistent local coordination. The question often arises regarding how long the effects of dredging will last. Although each situation is unique, the effects of most projects can be expected to last as long as ten years.

A thorough review of the physical steps needed to conduct a dredge should be completed before undertaking such a project. Dredging projects require locating or constructing both a staging area and a disposal site. If a pipeline system is used, it can affect a number of property owners. A decision will need to be made regarding the specifics of the dredging process as well as the disposal options. The dredging contractor hired will assist in making these decisions. The contractor may request that boats and piers be removed from the dredging sites in order to better navigate the area. As a result, general use of the area being dredged will likely be restricted for a number of days.

Cost is also a common concern in any dredging project. Many dredging projects cost between $10 - $20 per cubic yard to remove dredged material. This estimate is for sediment removal only. This estimate does not include the costs for the disposal site and staging area preparations, or the cost for the permit and EA process. Expect to pay between $10,000 and $15,000 for the EA process. The cost for the EA will vary depending upon the contractor hired to complete it.

Appendix H

- Threat of exotic aquatic species to Townsend Flowage

Exotic Species

Although no exotic species were found within the waters of Townsend Flowage, it is important that members of the Townsend Flowage Association familiarize themselves with some of the possible threats posed by invasive species. The following descriptions are given to promote awareness of exotic species.

Eurasian Watermilfoil

Eurasian watermilfoil (*Myriophyllum spicatum*) produces long spaghetti-like stems that often grow up to the water's surface. Leaves are feather-like and resemble bones on a fish. 3-5 leaves are arranged in whorls around the stem, and each leaf contains 12-21 pairs of leaflets. At mid-summer small reddish flower spikes may emerge above the water's surface. Perhaps the most distinguishing characteristic though, is the plant's ability to form dense, impenetrable beds that inhibit boating, swimming, fishing, and hunting.

Eurasian watermilfoil is native to Europe, Asia and Northern Africa. Of the eight milfoil (*Myriophyllum*) species found in Wisconsin, Eurasian watermilfoil is the only exotic. The plant was first introduced into U.S. waters in 1940. By 1960, it had reached Wisconsin's lakes. Since then, its expansion has been exponential (Brakken, 2000).

Eurasian watermilfoil begins growing earlier than native plants, giving it a competitive advantage. The dense surface mats formed by the plant block sunlight and have been found to displace nearly all native submergent plants. Over 200 studies link declines in native plants with increases in Eurasian watermilfoil (Madsen, 2001). The resultant loss of plant diversity degrades fishery habitat (Pullman, 1993), and reduces foraging opportunities for waterfowl and aquatic mammals. Eurasian watermilfoil has been found to reduce predatory success of fish such as largemouth bass (Engel, 1985), and spawning success for trout (*Salmonidae spp.*) (Newroth, 1985).

The continued spread of Eurasian watermilfoil can produce significant economic consequences. In the Truckee River Watershed below Lake Tahoe, located in western Nevada and northeastern California, economic damages caused by Eurasian watermilfoil to the recreation industry have been projected at $30 to $45 million annually (Eiswerth et al., 2003). In Tennessee Valley Authority Reservoirs, Eurasian watermilfoil was found to depress real estate values, stop recreational activities, clog municipal and industrial water intakes and increase mosquito breeding (Smith, 1971).

Eurasian watermilfoil has been found to reduce water quality in lakes by several means. Dense mats of Eurasian watermilfoil have been found to alter temperature and oxygen profiles – producing anoxic conditions in bottom water layers (Unmuth et al., 2000). These anoxic conditions can cause localized die-offs of mollusks and other invertebrates.

Eurasian watermilfoil has also been found to increase phosphorus concentration in lakes through accelerated internal nutrient cycling (Smith and Adams, 1986). Increased phosphorus concentrations released by dead and dying Eurasian watermilfoil have been linked to algae blooms and reduced water clarity.

Eurasian Watermilfoil Management Options

Historically, management of Eurasian watermilfoil has included mechanical, biological, and chemical means. It is important to consider each of these control measures before management efforts on any water body are undertaken. After weighing the pros and cons of each option, the wisest course of action should be chosen.

Hand pulling
Hand pulling of Eurasian watermilfoil is a useful tool when the extent of milfoil occurs at very low frequencies. For this method to be successful care must be taken to remove the entire root mass along with the plant or else it will quickly regenerate. If a pioneering population of Eurasian watermilfoil was found in a small location in Townsend Flowage, this method may be a useful management tool. However, if it is unsuccessful at reducing or eliminating milfoil from the Flowage, other management options should be considered. This is still a viable option for riparian property owners. Without obtaining a permit, individuals can hand pull aquatic plants in a 30-foot strip along their property extending out as far as necessary. If *exotic* plants are singled out for hand removal, there are no restrictions on the extent of hand-pulling. If large amounts of milfoil are present, it will be labor intensive. If individuals choose to hand pull, care should be taken to properly identify Eurasian watermilfoil and minimize its fragmentation.

Mechanical harvesting
Mechanical control methods include hand cutters and boat-mounted mechanical weed harvesters (Nichols, 1974). While these methods provide temporary nuisance relief, they are rarely recommended as control methods for Eurasian watermilfoil. Eurasian watermilfoil can reproduce effectively through fragmentation (Borman et al. 1997). Free-floating plant matter left from cutting operations can spread quickly and encourage additional infestations within the lake or in neighboring lakes. Because a harvesting program is already in place on the Flowage, care should be taken if Eurasian watermilfoil is found in the near future. If possible, harvesting in areas of infestation should be suspended until additional control efforts are implemented to remove the milfoil. Although harvesting does remove plant matter, a source of nutrients to the lake, it is unlikely that harvesting will induce a shift back to a native plant-dominated community if milfoil were to be introduced to the Flowage. It is not recommended that Eurasian watermilfoil be controlled long-term through mechanical harvesting.

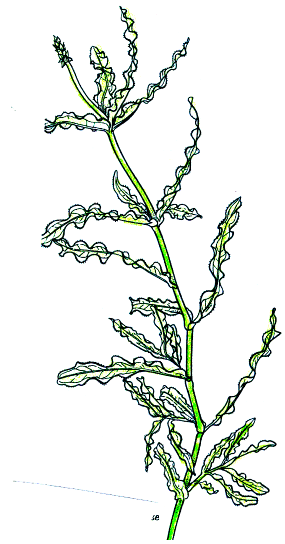
Milfoil weevils
There has been considerable research on biological vectors, such as insects, and their ability to affect a decline in Eurasian watermilfoil populations. Of these, the milfoil weevil (*Euhrychiopsis lecontei*) has received the most attention. Native milfoil weevil populations have been associated with declines in Eurasian watermilfoil in natural lakes

in Vermont (Creed and Sheldon, 1995), New York (Johnson et al., 2000) and Wisconsin (Lilie, 2000). While numerous lakes have attempted stocking milfoil weevils in hopes of controlling milfoil in a more natural manner, this method has not proven successful in Wisconsin. A twelve-lake study called "The Wisconsin Milfoil Weevil Project" (Jester et al. 1999) conducted by the University of Wisconsin, Stevens Point in conjunction with the Wisconsin DNR researched the efficacy of weevil stocking. This report concluded that milfoil weevil densities were not elevated, and that Eurasian watermilfoil was unaffected by weevil stocking in any of the study lakes. Recently, however, work carried out on a number of Portage County lakes has shown some promise at enhancing milfoil weevil populations. In order for weevils to be successful in reducing the extent of Eurasian watermilfoil, a number of environmental criteria are needed, including the availability of proper year-round habitat. In the event of milfoil infestation, a survey of existing weevils should be conducted to determine the likelihood of success if weevils were chosen as a management tool.

Until more evidence that suggests weevil stocking is an effective control agent for Eurasian watermilfoil, this method should be discouraged as a control option for most lakes.

Herbicides
Herbicides have been the most widely used and often most successful tools for controlling Eurasian watermilfoil. The two herbicide groups most commonly employed are fluridone (Avast®, Sonar®) and 2,4-D (Aquacide®, Aquakleen®, Navigate®, and Weedar 64®). Whole-lake fluridone treatments have been conducted on several Wisconsin Lakes. While initial results were encouraging (species selectivity, 95-100% initial control), continued monitoring found that desired long-term control was not achieved (Cason, 2002). In addition, for fluridone to be most effective, a relatively long contact time is needed. 2,4-D herbicides, on the other hand, have been very effective at controlling Eurasian watermilfoil in hundreds of Wisconsin lakes. 2,4-D is a herbicide which rapidly breaks down and does not persist in the environment. When applied at labeled rates, 2,4-D has been shown to be an effective tool at selectively controlling Eurasian watermilfoil.

Curly-leaf Pondweed



Curly-leaf pondweed (*Potamogeton crispus*) has oblong leaves that are 2-4 inches long and attach to a slightly flattened stem in an alternate pattern. The most distinguishing characteristics are the curled appearance of the leaves, and the serrated leaf edges. Curly-leaf pondweed also produces a seed-like turion, which resembles a miniature pinecone. Curly-leaf pondweed produces turions in early summer allowing the plant to regenerate annually. Turion production begins when water temperatures reach into the 60's.

This exotic pondweed is a cold-water specialist. Curly-leaf pondweed can begin growing under the ice, giving it a competitive advantage over native plants, which are still lying dormant. By mid-summer when water temperatures reach the upper 70° F range, it begins to die off.

Curly-leaf pondweed has been found in the U.S. since at least 1910. A native of Europe, Asia, Africa and Australia, this plant is now found throughout much of U.S. (Baumann et al., 2000).

As with Eurasian watermilfoil, curly-leaf pondweeds aggressive early season growth allows it to out compete native species and grow to nuisance levels. Because the plant dies back during the peak of the growing season for other plants though, it is better able to coexist with native species than Eurasian watermilfoil. Perhaps the most significant problem associated with curly-leaf pondweed involves internal nutrient cycling. The die-off and decomposition of the plant during the warmest time of year often leads to a sudden nutrient release in the water. This often leads to nuisance algae blooms and poor water quality.

Curly-leaf Pondweed Management Options

Curly-leaf pondweed has primarily been managed through mechanical and chemical means. If curly-leaf pondweed were to be introduced into Townsend Flowage, the following control options should be considered to determine the best course of action.

Hand pulling
As with Eurasian watermilfoil, this method may be appropriate for riparian property owners on the Townsend Flowage. Hand pulling is most effective when curly-leaf pondweed is discovered in its pioneering stage. If it has existed long enough to produce turions, hand pulling may become a long-term, labor-intensive process. To be most effective, as with other curly-leaf pondweed control options, early response is recommended. .

Mechanical harvesting and cutting
Both mechanical harvesting and hand cutting are commonly used to control curly-leaf pondweed. Cutting the plant provides temporary nuisance relief and may increase recreational opportunities on the lake. And although harvesting may not encourage dispersal of the plant, as it does with Eurasian watermilfoil, it is unlikely to provide any long-term control.

Herbicides
The herbicide most often used to control curly-leaf pondweed is Aquathol®. Aquathol® is an endothall salt-based herbicide which also rapidly breaks down. While endothall herbicides are effective on a broad range of aquatic monocots, early season applications made at low rates are highly species-selective for curly-leaf pondweed. While herbicides effectively kill the parent plant, the turions are resistant to herbicides, allowing curly-leaf pondweed to regenerate annually.

Studies conducted by the Army Corps of Engineers have found that conducting treatments of curly-leaf pondweed using Aquathol® when water temperatures are in the 50-60° F range will kill plants before turions form, thus providing long-term control. Researchers found that conducting two or more treatments over consecutive seasons for established curly-leaf pondweed populations will target both the standing crop of the pondweed as well as the resulting regrowth from the turions (Skogerboe and Poovey, 2002). These findings make Aquathol® the tool of choice for controlling curly-leaf pondweed in the lakes of Wisconsin.

Purple Loosestrife

Purple loosestrife (*Lythrum salicaria*) forms bright purple flowers in a spike atop stems that reach 2 to 7 feet in height. Lance-shaped leaves are arranged oppositely along the stem. Purple loosestrife can be found in a wide variety of habitats from shallow water to moist soils. Like Eurasian watermilfoil it is a very aggressive plant that can displace many native wetland plants including cattails (*Typha spp.*). Purple loosestrife plants produce hundreds of thousands of tiny seeds. When purple loosestrife is cut, seeds stick to mowing equipment and are spread to new locations. This invasive plant causes significant economic damage by clogging waterways and irrigation canals. Unlike cattails, purple loosestrife has little food or cover value for wildlife (Borman et. al. 1997).

Purple Loosestrife Management Options

Only one small patch of purple loosestrife was found growing along McCaslin Creek. Although it had not become a large nuisance, the Association and individual property owners should still be aware of control options to stop the spread of this exotic in the State. There are several methods that are commonly used for purple loosestrife control including digging or hand pulling, cutting, herbicide treatments and biological controls.

Manual removal
Digging and hand pulling are most effective for small infestations. Individual property owners are encouraged to use this method if they are able. Cutting involves removal and destruction of flowers and seed heads to inhibit plant propagation. Since cut plants tend to re-grow and since seeds present in the soils can sprout new plants, this method may need to be done for a number of years before desired control is achieved.

Herbicides
Herbicide treatments are the least labor intensive of methods. The preferred herbicide is glyphosate (Eagre®, Rodeo®). This compound rapidly biodegrades upon contact with soil or water. As a result, there are no water use restrictions following treatment. Because it is non-selective, each individual plant must be sprayed, as opposed to broadcast applications. Glyphosate is extremely effective in controlling purple loosestrife at a very low cost of treatment. The biggest disadvantage is that seeds in the soil will sprout new

plants, requiring annual treatments for a number of years before desired control is achieved. A DNR permit is required for treatment; however the fee is waived. This option should be considered if the distribution of purple loosestrife increases significantly.

Loosestrife beetles

Two species of leaf-eating beetles (*Galerucella calmariensis* and *G. pusilla*) are currently available from the Wisconsin DNR in an effort to control purple loosestrife by biological means. Research has shown that these insects are almost exclusively dependent upon purple loosestrife and do not threaten native plants. Although, as with most biological control agents, these insects will not eradicate loosestrife, but may significantly weaken the population and allow native species to reclaim infested areas. According to the WDNR, tests have shown significant declines in loosestrife as a result of biological control. The District should consider using biological control for loosestrife. The purple loosestrife control program established through the DNR provides a parent stock of beetles to individuals who are willing to raise the insects in a controlled environment until they are able to reproduce. Once the young have matured, they are released and are able to begin control of the purple loosestrife. As with other exotic plant control project, annual monitoring should be employed to assess the success of control measures. If significant progress is not made, alternative management options can be considered to control purple loosestrife.

Zebra Mussels

Zebra mussels (*Dreissena polymorpha*) are small (1/4" to 2") mollusks with elongated shells marked by alternating light and dark markings. They produce dense elastic strands, called byssal threads, by which they can securely attach to nearly any surface, often forming barnacle-like incrustations. Mussels spawn in the early spring when water temperatures reach 54º F. Fertilized eggs develop into microscopic free-swimming larvae called veligers. After three to four weeks, the surviving veligers settle onto firm objects where they quickly attach themselves. Within a year the young grow into adults that can live four to six years.

Zebra mussels were introduced to the Great Lakes region in the late 1980s through discharged ballast water of ships traveling the Saint Lawrence Seaway. These ships originated from European ports. Zebra mussels are native to the Ukraine and Russia near the Black and Caspian Seas. Since the 1700s zebra mussels have spread throughout European river systems.

Although zebra mussels do not cause much harm to the surrounding environment, they can negatively impact recreation and business by clogging water intake pipes, encrust boat hulls and piers, and wash up on beaches.

Zebra Mussel Management Options

Currently there is no lake-wide control option that isn't deadly to other aquatic life forms. In some areas of Europe and Lake Erie large populations of diving ducks have been shown to significantly decrease the population of zebra mussels each year. However, given the zebra mussel's high reproductive capacity, populations are able to recover each summer. In addition, diving duck populations in the Great Lakes region are low since they are only prevalent in the region during winter and summer migrations.

A number of fish species have been known to feed on zebra mussels. These include the freshwater drum, round goby, yellow perch, catfish, and carp. Certain fish species will feed on the adults while others eat the free-swimming juveniles. Although fish predation occurs, it is not significant enough to significantly decrease zebra mussel populations.

In recent years scientists have noted that native freshwater sponges in Lake Michigan appear to be increasing in number and attaching themselves to zebra mussels. In doing so, the sponges can kill the zebra mussels by cutting off the mussel's food and water supply.

Some success has been achieved by manually removing mussels from a lake. Although this method can dramatically reduce populations, it does not eradicate the mussels. In addition, it should be noted that this option is also very labor intensive.
Earlier this year a quarry in Virginia was able to eradicate zebra mussels from its waters. This was accomplished by applying a solution of potassium chloride over a three-week period in January. At the rate the solution was applied, it did not pose a risk to the environment or humans. This option would be most effective in small contained systems where cost does not prohibit control efforts.

Current research is focused on studying the environmental cues and physiological pathways that coordinate zebra mussel spawning. If the timing of male and female spawning can be disrupted, the numbers of fertilized eggs would be greatly reduced.

Appendix I

- Protecting lake water quality in Townsend Flowage

Protecting Lake Water Quality

Elevated nutrient inputs from human activities around Townsend Flowage can adversely affect both water clarity and water quality. Although water quality in Townsend Flowage appears generally to be high, a number of practices can be carried out to ensure water quality is maintained. The most significant contributions of nutrients to Townsend Flowage are likely from direct runoff from areas closest to the lake. The following are options for water quality enhancement which both the Association as a whole and individual lakefront property owners can undertake to improve Townsend Flowage.

Nutrient Management Options

The first steps taken in managing nutrients in a lake should be to control external sources of nutrients. These can include: encouraging the use of phosphorus-free fertilizers; improving agricultural practices, reducing run-off, and restoring vegetation buffers around waterways.

Lawn care practices
Mowed grass up to the water's edge is a poor choice for the well being of the lake. Studies show that a mowed lawn can cause 7 times the amount of phosphorus and 18 times the amount of sediment to enter a water body than an area of land with naturally occurring vegetation (Korth and Dudiak, 2003). Lawn grasses also tend to have shallow root systems that cannot protect the shoreline as well as deeper-rooted native vegetation (Henderson et al., 1998).

Landowners living in close proximity to the water, in particular, those with shoreline property, should be discouraged from using lawn fertilizers. Fertilizers contain nutrients, including phosphorus and nitrogen which can wash directly into the lake. While elevated levels of phosphorus can cause unsightly algae blooms, nitrogen inputs have been shown to increase weed growth. Landowners are encouraged to perform a soil test before fertilizing. A soil test will help determine if there is a need for fertilizer. The local UW-Extension office can assist in having soil tested. If there is a need to fertilize a lawn, a fertilizer that does not include phosphorus should be used. Most lawns in Wisconsin don't need additional phosphorus. The numbers on a bag of fertilizer are the percentages of available nitrogen, phosphorus and potassium found in the bag. Phosphorus free fertilizers will have a 0 for the middle number (e.g. 10-0-3).

To further reduce nutrient loading, avoid raking twigs, leaves, and grass clippings into the lake. They contain both nitrogen and phosphorus. The best disposal for organic matter, like leaves and grass clippings is to compost them. Composted material can then be used for gardening.

Vegetative buffer zones
There are beneficial alternatives to the traditional mowed lawn. The best alternative is to leave the natural shoreline undisturbed. If clearing is necessary to access and view the lake, consider very selective removal of vegetation.

Restoring a vegetative buffer zone is also an important alternative. A recommended buffer zone consists of native vegetation that may extend from 25 – 100 feet or more from the water's edge onto land, and 25 – 50 feet into the water. A buffer should cover between 50% and 75% of the shoreline frontage (Henderson et al., 1998). In most cases this still allows plenty of room for a dock, swimming area, and lawn. Buffer zones are made up of a mixture of native trees, shrubs, and other upland and aquatic plants.

Shoreline vegetation serves as an important filter against nutrient loading and trapping loose sediment. A buffer provides excellent fish and wildlife habitat, including nesting sites for birds, and spawning habitat for fish. Properly vegetated shorelines also play a key role in bank stabilization. A number of resources are available to assist property owners in creating beneficial buffer zones. These include descriptions of native beneficial plant species and where they can be found locally.

Shoreline plant restoration

Shoreline vegetation can benefit lake ecology tremendously. A properly vegetated shoreline provides habitat for a variety of birds, furbearers, amphibians, and reptiles. Much of the shoreline and emergent vegetation in Townsend Flowage appears to have been destroyed by lakefront development. An example of this can be seen in the picture on the next page. These structures, often referred to as sea walls can provide some shoreline stabilization, but are detrimental to a number of plant and animal species. In particular, species such as reptiles and amphibians move frequently to and from the water. These sea walls deny the level of access these species require. Benefits to lake water quality, fishery and wildlife could be achieved by restoring shoreline plants in Townsend Flowage. Lakefront habitat improvement is often done on a property-by-property basis. In recent years many new techniques have been developed for restoring lakefronts. This type of work often incorporates many attractive flowering plants and adds a great deal of aesthetic appeal to lakefronts as well. Studies have also shown that providing complex habitats through shoreline features such as plants and erosion control devices can result in significant increases in fish species richness (Jennings et al., 1999).

Erosion control

Erosion is a natural process, but it's for the benefit of the landowner and health of the lake that erosion control practices be carried out to slow the process as much as possible. Sedimentation into the lake causes nutrient pollution, turbid water conditions, eliminates fish spawning habitat, and increases eutrophication. Evidence of erosion on Townsend Flowage can be seen in the photo below. Shoreline owners are encouraged to leave existing vegetation, which is a great shore stabilizer. The placement of logs, brush mats, and rock riprap are also options against erosion. When riprap is used it is recommended that desirable shrubs and aquatic plants be planted within the riprap. The plantings serve as nutrient filters and habitat. Before any shoreline stabilization project is initiated, it is recommended that property owners contact the local Wisconsin DNR office for project approval and to obtain any necessary permits.

Reduced impacts from boating
Boat traffic can cause an increase in suspended solids especially in shallow areas of lakes (Hill, 2004). Studies have shown that maximum increases in turbidity occur between 2 and 24 hours following boating activities. The full effects of heavy boating depend upon a number of factors including propeller size, boat speed, draft, and sediment characteristics (Asplund, 1996). Silty sediments tend to have the highest susceptibility to resuspension and the highest potential for the reintroduction of nutrients into the water column. Studies have also focused on algae (chlorophyll a) concentrations but found no significant changes following boating activity. This is due primarily to an indeterminate time lag which occurs between the release of nutrients and the subsequent increase in algal growth. It has also been suggested that disturbances to the native plant communities due to watercraft use can accelerate the spread of opportunistic exotic plant species such as Eurasian watermilfoil and curly leaf pondweed (Asplund and Cook, 1997).

Wisconsin statutes require boaters to maintain no-wake speeds within 100 feet of shorelines, other boats, or fixed structures, including boat docks and swimming platforms. However, it is difficult to enforce such regulations and even slow boat traffic can have a negative impact on sediments and plant communities in shallow areas. This not only has a negative impact to the lake but can also damage boats. It is recommended that the Townsend Flowage Association take the opportunity to educate Association members and lake users alike of the impacts boating can have on a lake.

Septic system maintenance
Septic systems are known to contribute nutrients to a lake. It is the responsibility of lakeshore property owners to ensure that septic systems are properly functioning. A failing septic system can contaminate both surface and ground water. Each home can contribute up to 2 lbs of phosphorus annually. If located in a groundwater discharge area, failing septic systems can be a particularly significant source of nutrient loading in a lake. Systems should be professionally inspected every 3 years, and pumped every 2-5 years depending on operating circumstances (EPA, 2002). Avoid flushing toxic chemicals into the system. This can harm important bacteria that live in your tank and naturally break down wastes. Avoid planting trees, compacting soil, or directing additional surface runoff on top of the drain field.

Informational resources for property owners
The following list contains a number of valuable references that property owners and the Association can utilize to further explore options for water quality and shoreline habitat improvements.

Lakescaping for Wildlife and Water Quality. This 180-page booklet contains numerous color photos and diagrams. Many consider it the bible of shoreline restoration. It is available from the Minnesota Bookstore (651-297-3000) for $19.95.

The Living Shore. This video describes buffer zone construction and gives information on selecting and establishing plants. May be available at local library, or order from the Wisconsin Association of Lakes (800-542-LAKE) for $17.00.

A Fresh Look at Shoreland Restoration. A four-page pamphlet that describes shoreland restorations options. Available from UW Extension (#GWQ027) or WDNR (#DNR-FH-055).

What is a Shoreland Buffer? A pamphlet that discusses both ecological and legal issues pertaining to riparian buffer zones. Available from UW Extension (#GWQ028) or WDNR (#DNR-FH-223).

Life on the Edge…Owning Waterfront Property. A guide to maintaining shorelands for lakefront property owners. Available from UW Extension-Lakes Program, College of Natural Resources, University of Wisconsin, Stevens Point, WI 54481, for $4.50.

The Water's Edge. A guide to improving fish and wildlife habitat on your waterfront property. Available from WDNR (#PUB-FH-428-00).

Appendix J

- Available grant opportunities for lake organizations

Grant Programs

State grant programs

A number of State-funded grants are available to qualified lake organizations for a variety of lake management and improvement projects. Grants which the Townsend Flowage Association may benefit from include: Lake Management Planning and Protection grants, Aquatic Invasive Species Control grants, and the Recreational Boating Facilities grant.

Lake Management Planning Grants
This program has been established for the purpose of assisting with lake management. Eligible applicants can apply for funding to collect and analyze information needed to protect and restore lakes and their watersheds. Small and large-scale grants are available. This program funds up to 75% of the cost of the project. Grant awards cannot exceed $10,000 per grant for large-scale projects and $3,000 per grant for small-scale projects.

Eligible projects include:

- Gathering and analysis of physical, chemical, and biological information on lakes.
- Describing present and potential land uses within lake watersheds and on shorelines.
- Reviewing jurisdictional boundaries and evaluating ordinances that relate to zoning, sanitation, or pollution control or surface use.
- Assessments of fish, aquatic life, wildlife, and their habitats. Gathering and analyzing information from lake property owners, community residents, and lake users.
- Developing, evaluating, publishing, and distributing alternative courses of action and recommendations in a lake management plan.

Lake Management Protection Grants
The Lake Management Protection Grant program awards funds up to 75 percent of project costs with a maximum grant amount of $200,000. Eligible projects include the purchase of land or conservation easements, restoration of wetlands and shorelands, development of local regulations or ordinances to protect lakes, and lake management plan implementation projects.

Recreational Boating Facilities Grants
The DNR's Waterways Commission provides grant money for a variety of projects designed to improve recreation on Wisconsin lakes. The DNR provides cost sharing of up to 50 percent for eligible costs. Organizations can apply for funds to provide safe recreational boating facilities, conduct feasibility studies, purchase aquatic weed harvesting equipment, purchase navigation aids, dredge waterways, and chemically treat Eurasian watermilfoil.

Aquatic Invasive Species (AIS) Control Grants
This grant program is designed to assist management units in the control of aquatic invasive species. The WDNR awards cost-sharing grants for up to 50% of the costs of projects to control invasive species. These grants are awarded to projects that fall within three major categories:

1. Education, Prevention and Planning
2. Early Detection and Rapid Response
3. Controlling Established Infestations

These funds are currently available only to units of government including Lake Districts.

For more details on each of these and other grant programs, visit the DNR's grant program website at http://www.dnr.state.wi.us/org/caer/cfa/grants/index.html.

National Fish and Wildlife Foundation

The National Fish and Wildlife Foundation funds projects to conserve and restore fish, wildlife, and native plants through matching grant programs. The Foundation awards grants to projects that address priority actions promoting fish and wildlife conservation and the habitats on which they depend. Federal, state, and local governments, educational institutions, and nonprofit organizations can apply for the 50% matching grant throughout the year.

Pulling Together Initiative
The National Fish and Wildlife Foundation's Pulling Together Initiative (PTI) grant program provides support on a competitive basis for the development of long-term weed management projects within the scope of an integrated pest management strategy. The goals of PTI are:

- To prevent, manage, or eradicate invasive and noxious plants through a coordinated program of public/private partnerships.
- To increase public awareness of the adverse impacts of invasive and noxious plants.

PTI grants are financed by funds from federal agencies, which must be matched by cash or in-kind contributions from state, local, and private partners on at least a 1:1 basis. All proposals are reviewed by a national steering committee composed of weed management experts from government, industry, academia, and non-profit organizations.