Note: Methodology, explanation of analysis and biological background on Spider Lake studies are contained within the Manitowish Waters Chain-wide Management Plan document.

8.3 Spider Lake

An Introduction to Spider Lake

Spider Lake, Vilas County, is a deep, lowland drainage lake with a maximum depth of 43 feet, a mean depth of 20 feet, and a surface area of approximately 283 acres. The lake is fed via Island Lake to the east and Manitowish Lake to the south, and empties into downstream Stone Lake. The lake is currently in a mesotrophic state, and its watershed encompasses approximately 134,039 acres. In 2012, 40 native aquatic plant species were located in the lake, of which wild celery (*Vallisneria americana*) was the most common. Three non-native plants, curly-leaf pondweed, purple loosestrife, and common forget-me-not were observed growing in or along the shorelines of Island Lake in 2012.

Field Survey Notes

Fairly dense curly-leaf pondweed observed between Spider and Island Lakes, within a narrow channel.

Photo 8.3 Spider Lake, Vilas County

Lake at a Glance* – Spider Lake

Morphology	
Acreage	283
Maximum Depth (ft)	43
Mean Depth (ft)	20
Volume (acre-feet)	5,660
Shoreline Complexity	6.5
Vegetation	
Curly-leaf Survey Date	May 30, 2012
Comprehensive Survey Date	July 25, 2012
Number of Native Species	40
Threatened/Special Concern Species	Vasey's pondweed (*Potamogeton vaseyi*)
Exotic Plant Species	Curly-leaf pondweed; Purple loosestrife; Common forget-me-not
Simpson's Diversity	0.92
Average Conservatism	6.6
Water Quality	
Wisconsin Lake Classification	Deep, Lowland Drainage
Trophic State	Mesotrophic
Limiting Nutrient	Phosphorus
Watershed to Lake Area Ratio	472:1

**These parameters/surveys are discussed within the Chain-wide portion of the management plan.*

8.3.1 Spider Lake Water Quality

Water quality data was collected from Spider Lake on six occasions in 2012/2013. Onterra staff sampled the lake for a variety of water quality parameters including total phosphorus, chlorophyll-*a*, Secchi disk clarity, temperature, and dissolved oxygen. Please note that the data in these graphs represent concentrations and depths taken during the growing season (April-October), summer months (June-August) or winter (February-March) as indicated with each dataset. Furthermore, unless otherwise noted the phosphorus and chlorophyll-*a* data represent only surface samples. In addition to sampling efforts completed in 2012/2013, any historical data was researched and are included within this report as available.

Unfortunately, very limited data exists for two water quality parameters of interest – total phosphorus and chlorophyll-*a* concentrations. In 2012, average summer phosphorus concentrations (11.7 µg/L) were less than the median value (23.0 µg/L) for other deep, lowland drainage lakes in the state (Figure 8.3.1-1). This value is also lower than the value for other lakes within the Northern Lakes and Forests ecoregion. A weighted value from all available data ranks as *Excellent* for a deep, lowland drainage lake.

Total phosphorus surface values from 2012 are compared with bottom-lake samples collected during this same time frame in Figure 8.3.1-2. As displayed in this figure, on several occasions surface and bottom total phosphorus concentrations were similar. However on some occasions, namely during July and August of 2012, the bottom phosphorus concentrations were much greater than the relatively low surface concentrations. During these periods, anoxic conditions were recorded near the bottom of the lake through measurement of dissolved oxygen (refer to Figure 8.3.1-6 and associated text). This is an indication of hypolimnetic nutrient recycling, or internal nutrient loading, which is a process discussed further in the Manitowish Waters Chain-wide document. While this process may be contributing some phosphorus to Spider Lake's water column, the impacts of nutrient loading are not apparent in the lake's overall water quality; as previously mentioned, Spider Lake's surface water total phosphorus values are slightly lower than the median value for comparable lakes in Wisconsin, and rank as *Excellent* overall.

Similar to what has been observed with the total phosphorus dataset, summer average chlorophyll-*a* concentrations (4.3 µg/L) were slightly lower than the median value (7.0 µg/L) for other lakes of this type (Figure 8.3.1-3), as well as lower than the median for all lakes in the ecoregion. Both of these parameters, total phosphorus and chlorophyll-*a*, rank within a TSI category of *Excellent*, indicating the lake has enough nutrients for production of aquatic plants, algae, and other organisms but not so much that a water quality issue is present. During 2012 visits to the lake, Onterra ecologists recorded field notes describing very good water conditions.

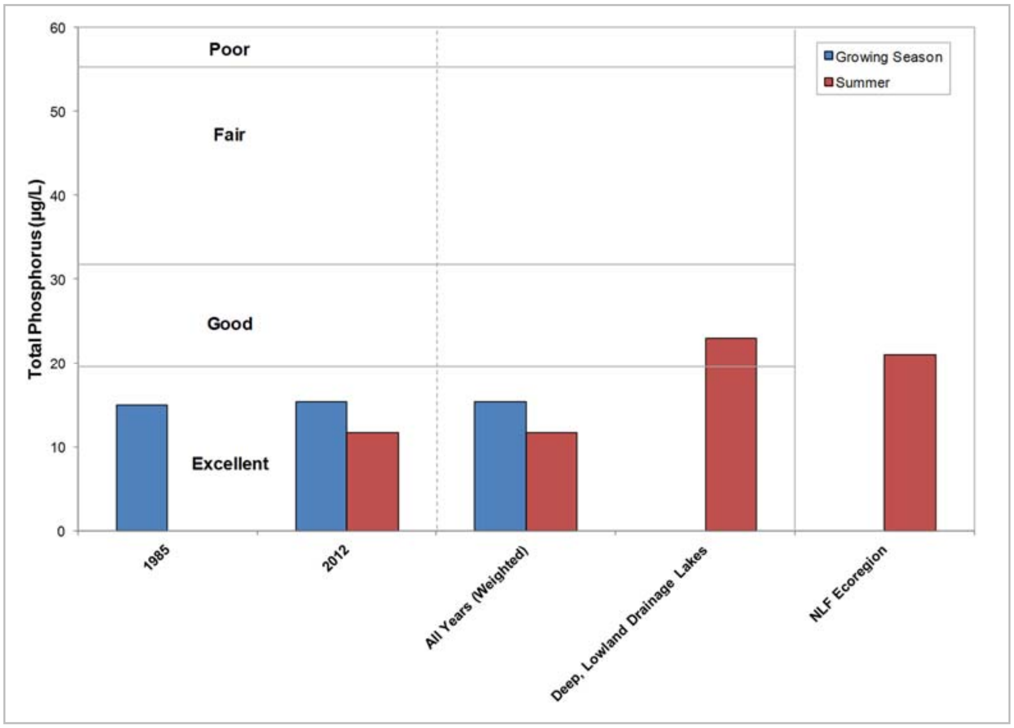

Figure 8.3.1-1. Spider Lake, state-wide deep, lowland drainage lakes, and regional total phosphorus concentrations. Mean values calculated with summer month surface sample data. Water Quality Index values adapted from WDNR PUB WT-913.

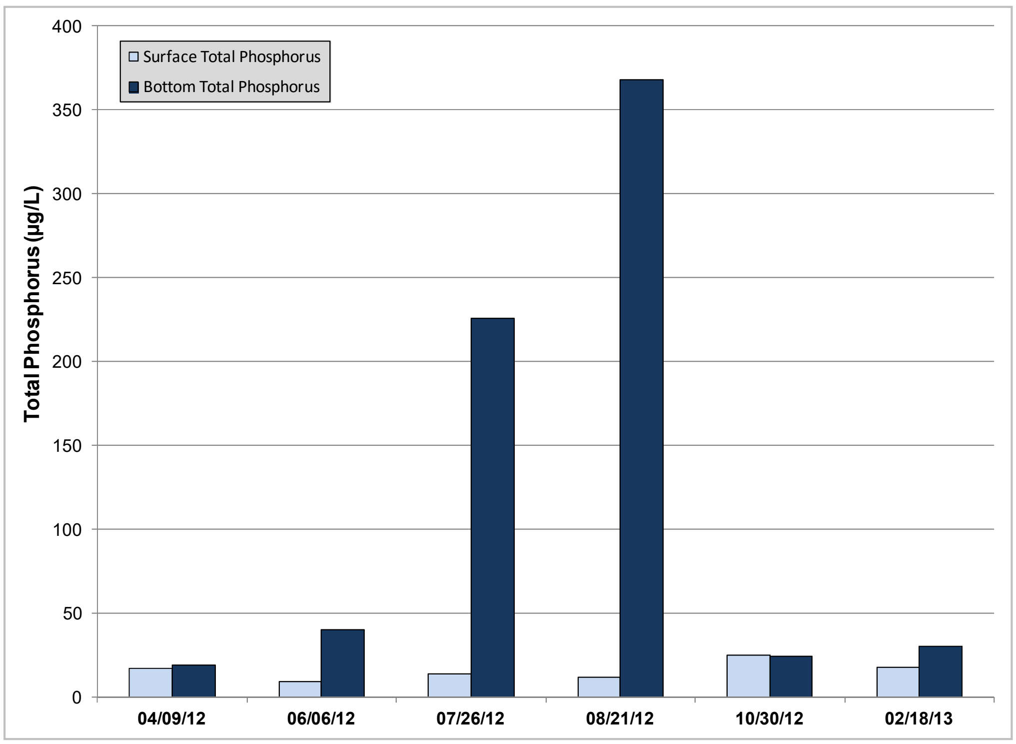

Figure 8.3.1-2. Spider Lake surface and bottom total phosphorus values, 2012-2013. Anoxia was observed in the hypolimnion of the lake during July and August sampling visits.

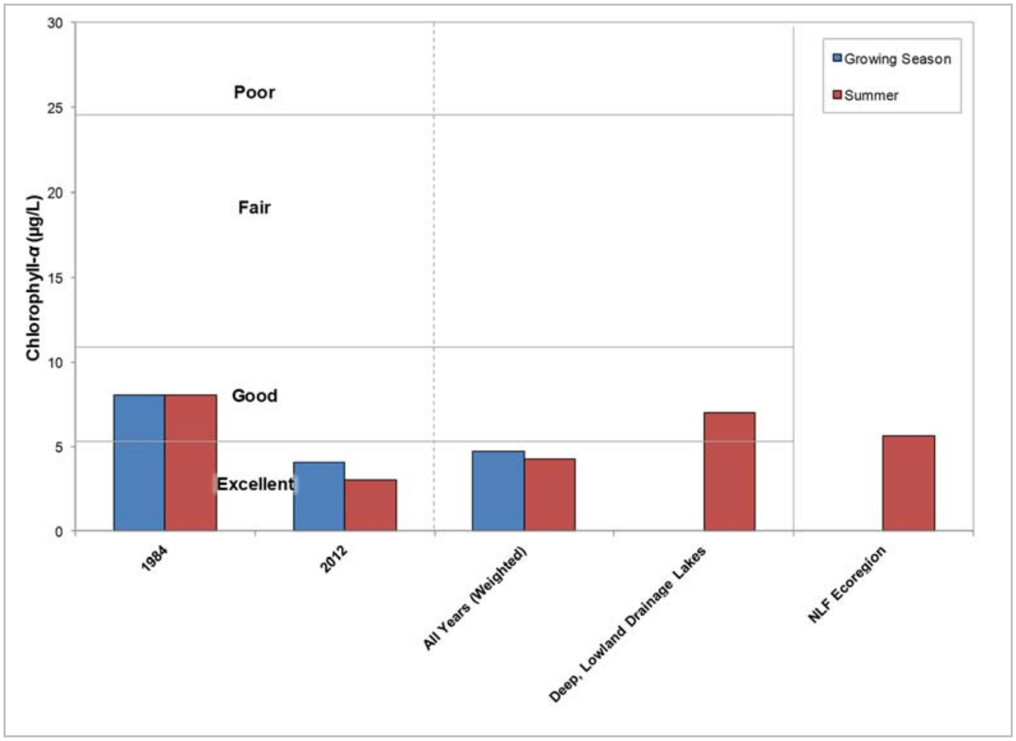

Figure 8.3.1-3. Spider Lake, state-wide deep, lowland drainage lakes, and regional chlorophyll-*a* concentrations. Mean values calculated with summer month surface sample data. Water Quality Index values adapted from WDNR PUB WT-913.

From the examination of the available Secchi disk clarity data, several conclusions can be drawn. First, the clarity of Spider Lake's water can be described as *Excellent* during the summer months in which data has been collected (Figure 8.3.1-4). A weighted average over this timeframe is greater than the median value for other deep, lowland drainage lakes in the state and is also larger than the regional median. Secondly, there is no apparent trend in the clarity of the water in Spider Lake; the data indicate that clarity may differ from one year to the next, but has not gotten "worse" or "better" over this time period.

Secchi disk clarity is influenced by many factors, including plankton production and suspended sediments, which themselves vary due to several environmental conditions such as precipitation, sunlight, and nutrient availability. In Spider Lake as well as the other lakes in the Manitowish Waters Chain of Lakes, a natural staining of the water plays a role in light penetration, and thus water clarity, as well. The waters of Spider Lake contain naturally occurring organic acids that are washed into the lake from nearby wetlands. The acids are not harmful to humans or aquatic species; they are by-products of decomposing terrestrial and wetland plant species. This natural staining may reduce light penetration into the water column, which reduces visibility and also reduces the growing depth of aquatic vegetation within the lake.

"True color" measures the dissolved organic materials in water. Water samples collected in April and July of 2012 were measured for this parameter, and were found to be 15 and 10 Platinum-cobalt units (Pt-co units, or PCU), respectively. Lillie and Mason (1983) categorized lakes with 0-40 PCU as having "low" color, 40-100 PCU as "medium" color, and >100 PCU as high color.

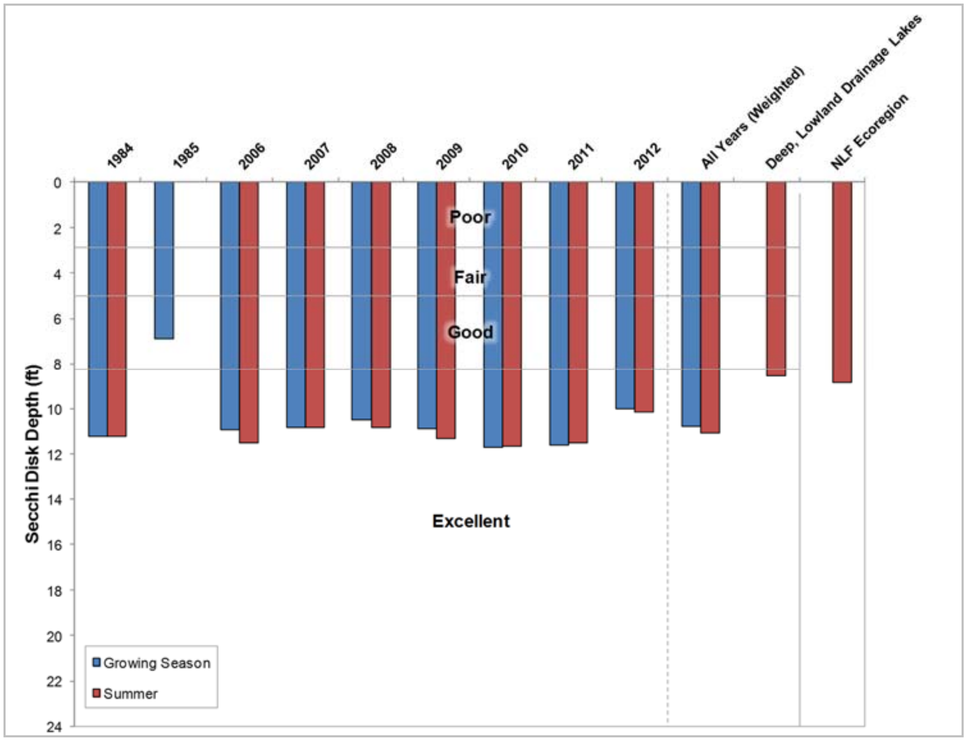

Figure 8.3.1-4. Spider Lake, state-wide deep, lowland drainage lakes, and regional Secchi disk clarity values. Mean values calculated with summer month surface sample data. Water Quality Index values adapted from WDNR PUB WT-913.

Spider Lake Trophic State

The TSI values calculated with Secchi disk, chlorophyll-*a*, and total phosphorus values range in values spanning from lower mesotrophic to eutrophic (Figure 8.3.1-5). In general, the best values to use in judging a lake's trophic state are the biological parameters; therefore, relying primarily on total phosphorus and chlorophyll-*a* TSI values, it can be concluded that Spider Lake is in a mesotrophic state.

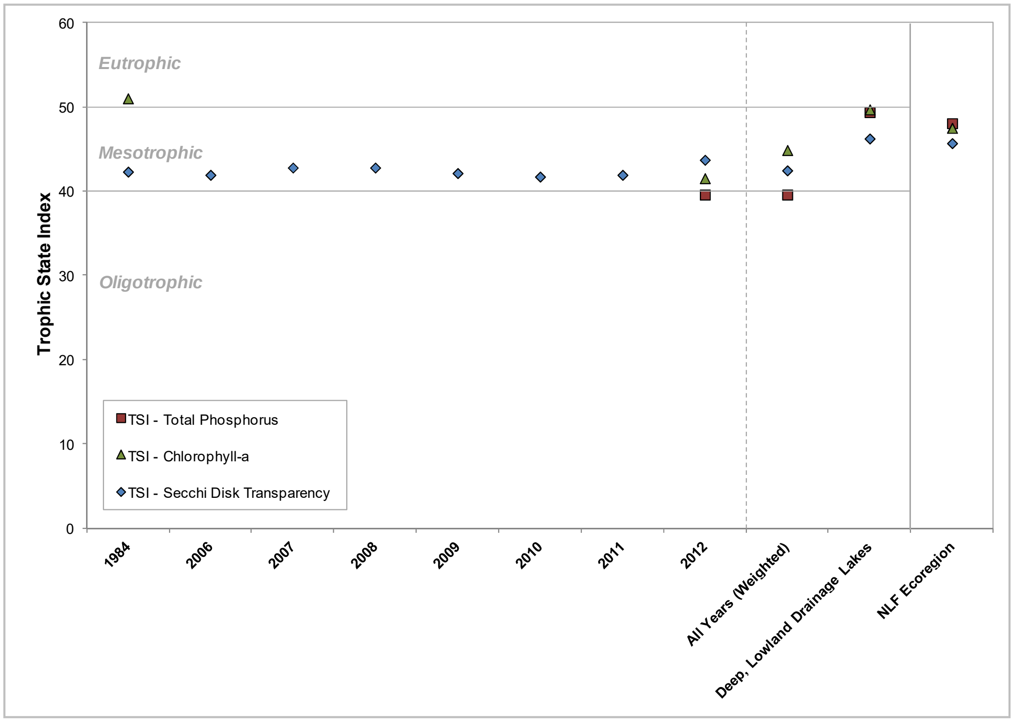

Figure 8.3.1-5. Spider Lake, state-wide deep, lowland drainage lakes, and regional Trophic State Index values. Values calculated with summer month surface sample data using WDNR PUB-WT-193.

Dissolved Oxygen and Temperature in Spider Lake

Dissolved oxygen and temperature profiles were created during each water quality sampling trip made to Spider Lake by Onterra staff. Graphs of those data are displayed in Figure 8.3.1-6 for all sampling events.

Spider Lake mixes thoroughly during the spring and fall, when changing air temperatures and gusty winds help to mix the water column. During the summer months, the bottom of the lake becomes void of oxygen and temperatures remain fairly cool as they were in the spring months. This occurrence is not uncommon in deep Wisconsin lakes, where wind energy is not sufficient during the summer to mix the entire water column – only the upper portion. During this time, bacteria break down organic matter that has collected at the bottom of the lake and in doing so utilize any available oxygen.

The lake mixes completely again in the fall, re-oxygenating the water in the lower part of the water column. During the winter months, the coldest temperatures are found just under the overlying ice, while oxygen gradually diminishes once again towards the bottom of the lake. In February of 2013, oxygen levels remained sufficient throughout most of the water column to support most aquatic life in northern Wisconsin lakes.

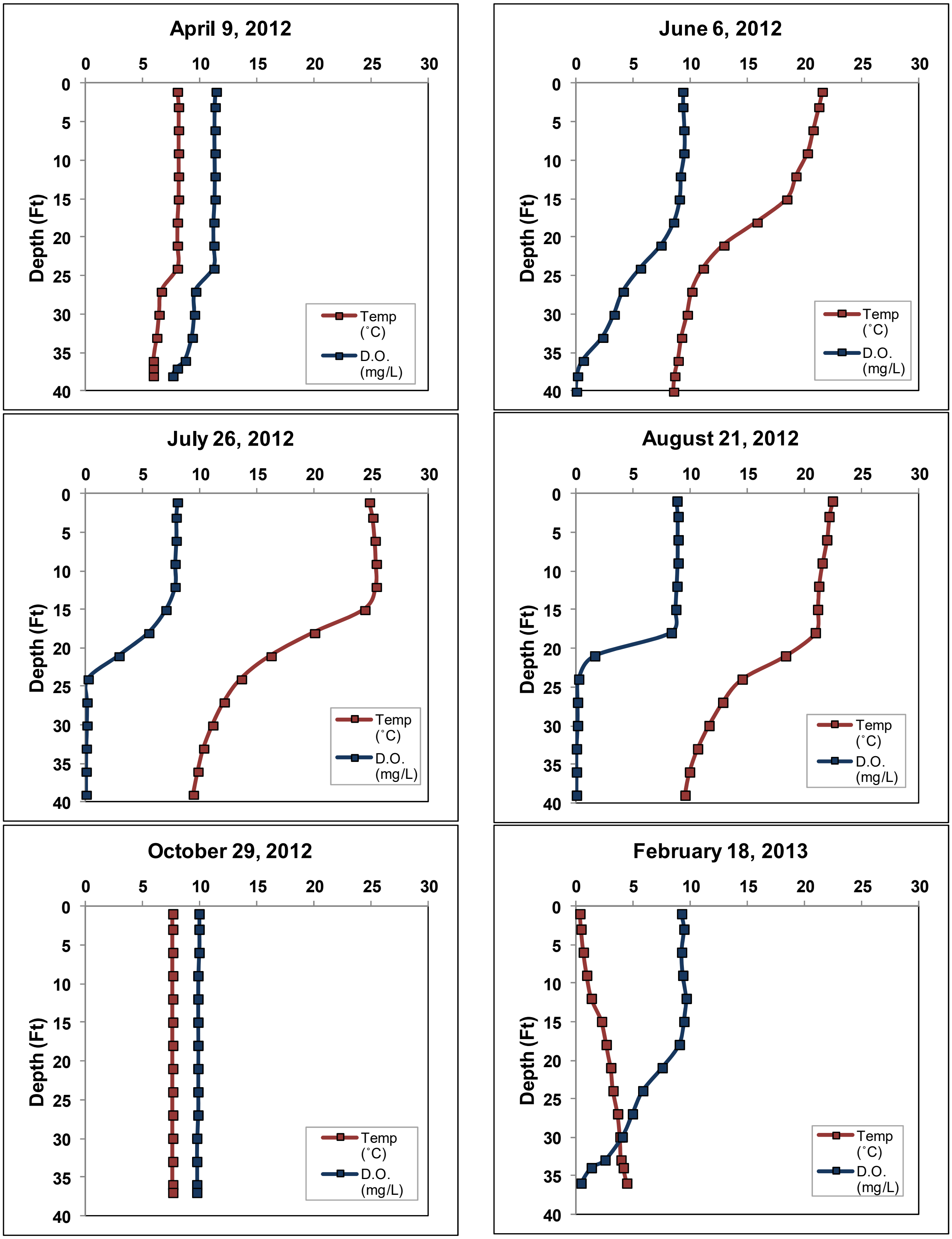

Figure 8.3.1-6. Spider Lake dissolved oxygen and temperature profiles.

Additional Water Quality Data Collected at Spider Lake

The water quality section is centered on lake eutrophication. However, parameters other than water clarity, nutrients, and chlorophyll-*a* were collected as part of the project. These other parameters were collected to increase the understanding of Spider Lake's water quality and are recommended as a part of the WDNR long-term lake trends monitoring protocol. These parameters include; pH, alkalinity, and calcium.

As the Chain-wide Water Quality Section explains, the pH scale ranges from 0 to 14 and indicates the concentration of hydrogen ions (H^+) within the lake's water and is thus an index of the lake's acidity. Spider Lake's surface water pH was measured at roughly 8.8 during April and 7.7 during July of 2012. These values are near or slightly above neutral and fall within the normal range for Wisconsin lakes. Fluctuations in pH with respect to seasonality is common; in-lake processes such as photosynthesis by plants act to reduce acidity by carbon dioxide removal while decomposition of organic matter add carbon dioxide to water, thereby increasing acidity.

A lake's pH is primarily determined by the amount of alkalinity that is held within the water. Alkalinity is a lake's capacity to resist fluctuations in pH by neutralizing or buffering against inputs such as acid rain. Lakes with low alkalinity have higher amounts of the bicarbonate compound (HCO_3^-) while lakes with a higher alkalinity have more of the carbonate compound of alkalinity ($CO_3^=$). The carbonate form is better at buffering acidity, so lakes with higher alkalinity are less sensitive to acid rain than those with lower alkalinity. The alkalinity in Spider Lake was measured at 47 and 45 mg/L as $CaCO_3$ in April and July of 2012, respectively. This indicates that the lake has a substantial capacity to resist fluctuations in pH and has a low sensitivity to acid rain.

Samples of calcium were also collected from Spider Lake during 2012. Calcium is commonly examined because invasive and native mussels use the element for shell building and in reproduction. Invasive mussels typically require higher calcium concentrations than native mussels. The commonly accepted pH range for zebra mussels is 7.0 to 9.0, so Spider Lake's pH of 7.7 – 8.8 falls within this range. Lakes with calcium concentrations of less than 12 mg/L are considered to have very low susceptibility to zebra mussel establishment. The calcium concentration of Spider Lake was found to be 12.9 mg/L in April and 12.6 mg/L in July of 2012, which is at the bottom end of the optimal range for zebra mussels. Plankton tows were completed by Onterra staff during the summer of 2012 and these samples were processed by the WDNR for larval zebra mussels. *Results to be included within the next draft.*

8.3.2 Spider Lake Watershed Assessment

Spider Lake's watershed is 134,039 acres in size. Compared to Spider Lake's size of 283 acres, this makes for an incredibly large watershed to lake area ratio of 472:1.

Exact land cover calculation and modeling of nutrient input to Spider Lake will be completed towards the end of this project (in 2015-2016). By this time, the latest satellite imagery (and thus the most accurate land cover delineation) will be available. Additionally, when water quality sampling of the upper reaches of the chain is completed, these results will be input to predictive models and thus make the modeling of nutrient input to the entire chain more accurate.

8.3.3 Spider Lake Shoreland Condition

Shoreland Development

As mentioned previously in the Chain-wide Shoreland Condition Section, one of the most sensitive areas of the watershed is the immediate shoreland area. This area of land is the last source of protection for a lake against surface water runoff, and is also a critical area for wildlife habitat. In late summer of 2012, Spider Lake's immediate shoreline was assessed in terms of its development. Spider Lake has stretches of shoreland that fit all of the five shoreland assessment categories. In all, 6.5 miles of natural/undeveloped and developed-natural shoreline were observed during the survey (Figure 8.3.3-1). This constitutes about 52% of Spider Lake's shoreline. These shoreland types provide the most benefit to the lake and should be left in their natural state if at all possible. During the survey, 2.1 miles of urbanized and developed–unnatural shoreline (17%) was observed. If restoration of the Spider Lake shoreline is to occur, primary focus should be placed on these shoreland areas as they currently provide little benefit to, and actually may harm, the lake ecosystem. Spider Lake Map 1 displays the location of these shoreline lengths around the entire lake.

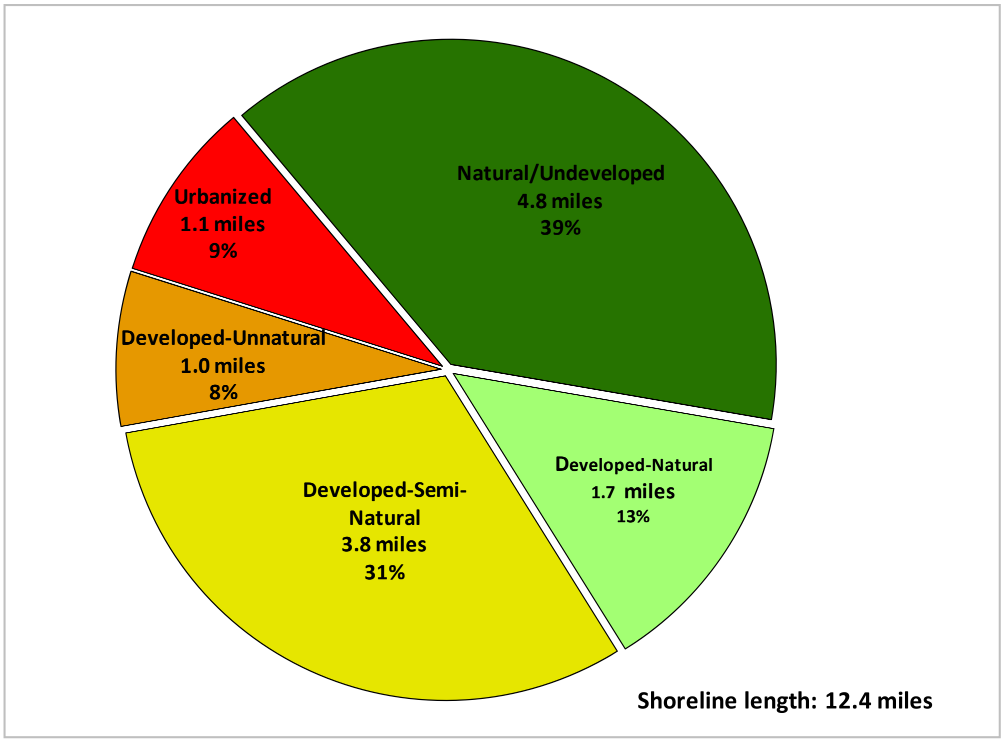

Figure 8.3.3-1. Spider Lake shoreland categories and total lengths. Based upon a late summer 2012 survey. Locations of these categorized shorelands can be found on Spider Lake Map 1.

Coarse Woody Habitat

A survey for coarse woody habitat was conducted in conjunction with the shoreland assessment (development) survey. Coarse woody habitat was identified, and classified in several size categories (2-8 inches diameter, >8 inches diameter and cluster) as well as four branching categories: no branches, minimal branches, moderate branches, and full canopy. As discussed in the Manitowish Waters Chain-wide document, research indicates that fish species prefer some branching as opposed to no branching on coarse woody habitat, and increasing complexity is positively correlated with higher fish species richness, diversity and abundance.

During this survey, 83 total pieces of coarse woody habitat were observed along 12.4 miles of shoreline, which gives Spider Lake a coarse woody habitat to shoreline mile ratio of 7:1 (Figure 8.3.3-2). Locations of coarse woody habitat are displayed on Spider Lake Map 2. To put this into perspective, Wisconsin researchers have found that in completely undeveloped lakes, an average of 345 coarse woody habitat structures may be found per mile (Christensen et al. 1996).

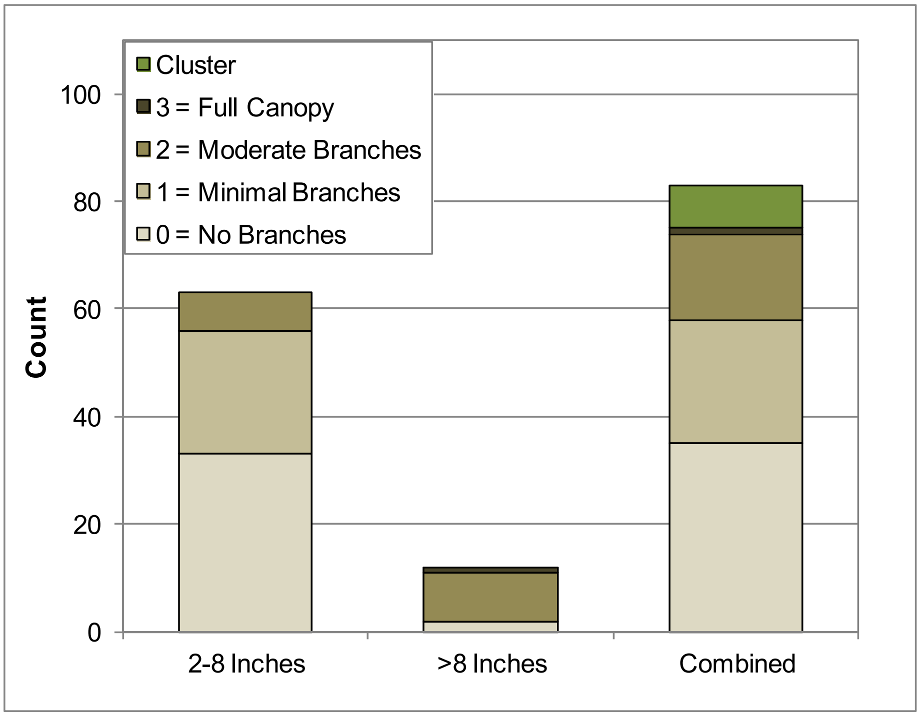

Figure 8.3.3-2. Spider Lake coarse woody habitat survey results. Based upon a late summer 2012 survey. Locations of Spider Lake coarse woody habitat can be found on Spider Lake Map 2.

8.3.4 Spider Lake Aquatic Vegetation

An early season aquatic invasive species survey was conducted on Spider Lake on May 30, 2012. While the intent of this survey is to locate <u>*any*</u> potential non-native species within the lake, the primary focus is to locate occurrences of curly-leaf pondweed which should be at or near its peak growth at this time. During this meander-based survey of the littoral zone, Onterra ecologists did not locate any occurrences of curly-leaf pondweed or any other submersed non-native aquatic plant species.

The aquatic plant point-intercept survey was conducted on Spider Lake on July 25, 2012 by Onterra. The floating-leaf and emergent plant community mapping survey was completed on that same day to map these community types. During all surveys, 40 species of native aquatic plants were located in Spider Lake (Table 8.3.4-1). 32 of these species were sampled directly during the point-intercept survey and are used in the analysis that follows, while eight species were observed incidentally during visits to Spider Lake. Four exotic species, purple loosestrife (*Lythrum salicaria*), common forget-me-not (*Myosotis scorpioides*) and curly-leaf pondweed (*Potamageton crispus*) were observed within and along Spider Lake also. Exotic species inventories and management actions are discussed within the Chain-wide plan document.

Aquatic plants were found growing to a depth of 14 feet. As discussed later on within this section, many of the plants found in this survey indicate that the overall community is healthy, diverse and in one species case somewhat rare. Of the 281 point-intercept locations sampled within the littoral zone, roughly 45% contained aquatic vegetation. Spider Lake Map 3 indicates that most of the point-intercept locations that contained aquatic vegetation are located in shallow bays that are more likely to hold organic substrates. Approximately 63% of the point-intercept sampling locations where sediment data was collected at were sand, 17% consisted of a fine, organic substrate (muck) and 20% were determined to be rocky (Chain-wide Fisheries Section, Table 3.5-5).

Table 8.3.4-1. Aquatic plant species located in Spider Lake during 2012 plant surveys.

Life Form	Scientific Name	Common Name	Coefficient of Conservatism (c)	2012 Onterra
Emergent	*Carex retrorsa*	Retrorse sedge	6	I
	Carex crinita	Fringed sedge	6	I
	Carex vesicaria	Blister sedge	7	I
	Eleocharis palustris	Creeping spikerush	6	X
	Equisetum fluviatile	Water horsetail	7	X
	Juncus effusus	Soft rush	4	I
	Lythrum salicaria	Purple loosestrife	Exotic	I
	Myosotis scorpioides	Common forget-me-not	Exotic	I
	Scirpus cyperinus	Wool grass	4	I
	Sagittaria rigida	Stiff arrowhead	8	X
	Schoenoplectus acutus	Hardstem bulrush	5	X
	Schoenoplectus tabernaemontani	Softstem bulrush	4	X
	Typha spp.	Cattail spp.	1	I
	Zizania sp.	Wild rice Species	8	I
FL	*Nuphar variegata*	Spatterdock	6	X
	Nymphaea odorata	White water lily	6	X
FL/E	*Sparganium fluctuans*	Floating-leaf bur-reed	10	I
	Sparganium eurycarpum	Common bur-reed	5	X
Submergent	*Bidens beckii*	Water marigold	8	X
	Callitriche palustris	Common water starwort	8	X
	Chara spp.	Muskgrasses	7	X
	Ceratophyllum demersum	Coontail	3	X
	Elatine minima	Waterwort	9	X
	Elodea canadensis	Common waterweed	3	X
	Heteranthera dubia	Water stargrass	6	X
	Myriophyllum sibiricum	Northern water milfoil	7	X
	Nitella sp.	Stoneworts	7	X
	Najas flexilis	Slender naiad	6	X
	Potamogeton pusillus	Small pondweed	7	X
	Potamogeton spirillus	Spiral-fruited pondweed	8	X
	Potamogeton vaseyi	Vasey's pondweed	10	X
	Potamogeton richardsonii	Clasping-leaf pondweed	5	X
	Potamogeton crispus	Curly-leaf pondweed	Exotic	X
	Potamogeton strictifolius	Stiff pondweed	8	X
	Potamogeton zosteriformis	Flat-stem pondweed	6	X
	Potamogeton gramineus	Variable pondweed	7	X
	Potamogeton amplifolius	Large-leaf pondweed	7	X
	Potamogeton robbinsii	Fern pondweed	8	X
	Sagitaria sp. (rosette)	Arrowhead rosette	N/A	X
	Utricularia vulgaris	Common bladderwort	7	X
	Vallisneria americana	Wild celery	6	X
SE	*Eleocharis acicularis*	Needle spikerush	5	X
	Sagittaria cuneata	Arum-leaved arrowhead	7	X

FL = Floating Leaf; FL/E = Floating Leaf and Emergent; S/E = Submergent and Emergent; FF = Free Floating
X = Located on rake during point-intercept survey; I = Incidental Species

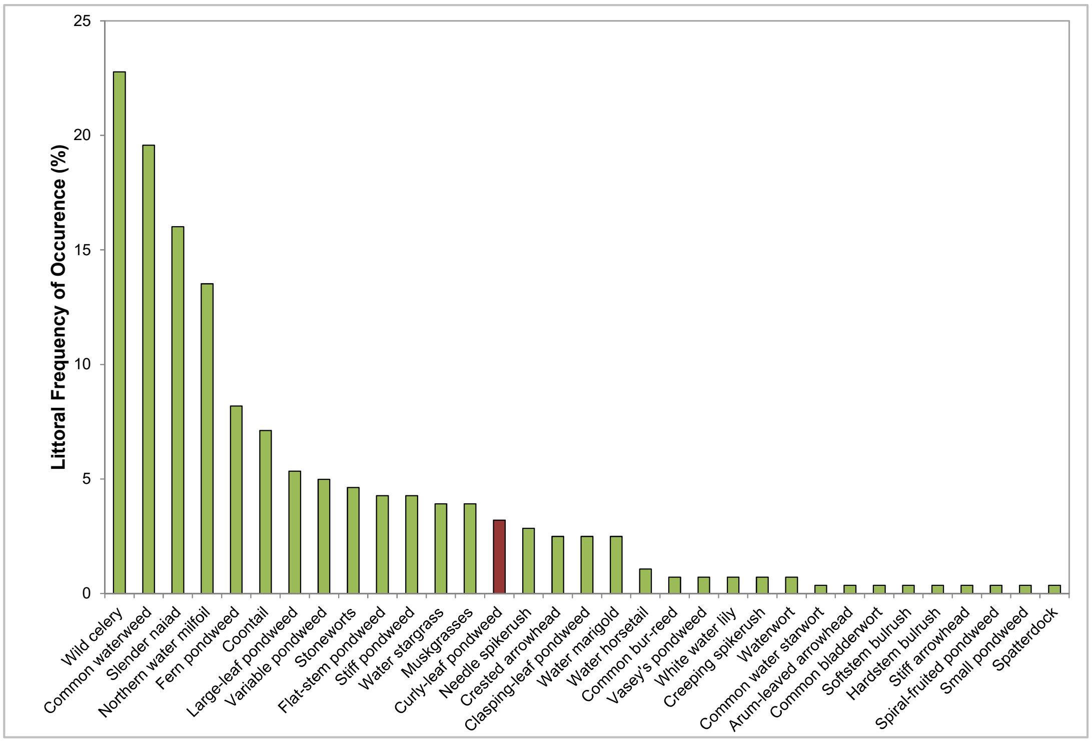

Figure 8.3.4-1. Spider Lake aquatic plant littoral frequency of occurrence analysis. Created using data from a 2012 point-intercept survey. Exotic species indicated in red.

Figure 8.3.4-1 (above) shows that wild celery, common waterweed and slender naiad were the most frequently encountered plants within Spider Lake. Wild celery is a submerged aquatic plant with ribbon-shaped floating leaves that may grow to as long as two meters, depending on water depth. It is a preferred food choice by numerous species of waterfowl and aquatic invertebrates. Common waterweed is an interesting plant in that although it sometimes produces root-like structures that bury themselves into the sediment, it is largely an unrooted plant that can obtain nutrients directly from the water. As a result, this plant's location in a lake can be dependent upon water movement. Naiad species are branching plants that are eaten by waterfowl and provides excellent shelter for aquatic insects and small fish. As its name implies, slender naiad is a slender, low-growing species with narrow, short pale green leaves.

One species discovered during 2011 and 2012 studies, Vasey's pondweed (*Potamogeton vaseyi*), is listed by the Wisconsin Natural Heritage Inventory as a species of special concern in Wisconsin due to uncertainty regarding its distribution and abundance in Wisconsin. Vasey's pondweed is typically found in bays of large soft-water lakes as well as in rivers and ponds.

During aquatic plant inventories, 40 species of native aquatic plants (including incidentals) were found in Spider Lake, along with three non-native plant species. Because of this, one may assume that the system would also have a high diversity. As discussed earlier, how evenly the species are distributed throughout the system also influence the diversity. The diversity index for Spider Lake's plant community (0.92) lies above the Northern Lakes and Forest Lakes ecoregion value (0.86), indicating the lake holds exceptional diversity.

As explained earlier in the Manitowish Waters chain-wide document, the littoral frequency of occurrence analysis allows for an understanding of how often each of the plants is located during the point-intercept survey. Because each sampling location may contain numerous plant species, relative frequency of occurrence is one tool to evaluate how often each plant species is found in relation to all other species found (composition of population). For instance, while wild celery was found at 23% of the sampling locations, its relative frequency of occurrence is 16%. Explained another way, if 100 plants were randomly sampled from Spider Lake, 16 of them would be wild celery. This distribution can be observed in Figure 8.3.4-2, where together 15 native (and one non-native) species account for 89% of the aquatic plant population within Spider Lake, while the other 18 species account for the remaining 10%. Eight additional native and two non-native species were located from the lake but not from of the point-intercept survey, and are indicated in Table 8.3.4-1 as incidentals.

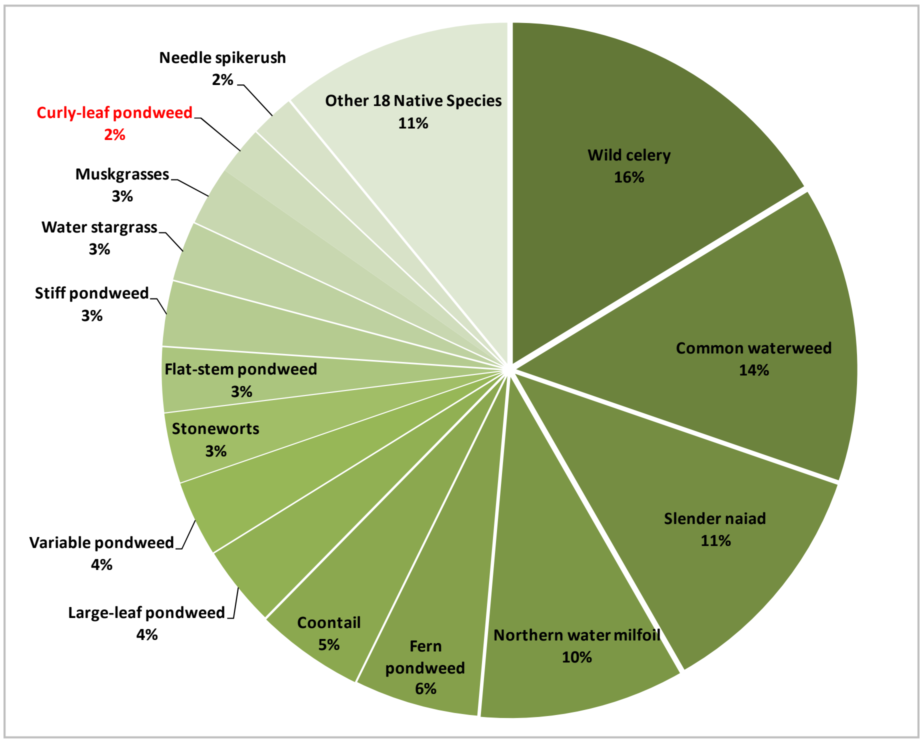

Figure 8.3.4-2 Spider Lake aquatic plant relative frequency of occurrence analysis. Created using data from 2012 point-intercept survey.

Spider Lake's average conservatism value (6.5) is higher than the state (6.0) but slightly under the Northern Lakes and Forests ecoregion (6.7) median. This indicates that the plant community of Spider Lake is indicative of a moderately disturbed system. Combining Spider Lake's species richness and average conservatism values to produce its Floristic Quality Index (FQI) results in a value of 36.9 which is above the median values of the ecoregion and state.

The quality of Spider Lake is also indicated by the high incidence of emergent and floating-leaf plant communities that occur in many areas. The 2012 community map indicates that approximately 2.4 acres of the lake contains these types of plant communities (Spider Lake Map 4, Table 8.3.4-2). Eighteen floating-leaf and emergent species were located on Spider Lake (Table 8.3.4-1), all of which provide valuable wildlife habitat.

Table 8.3.4-2. Spider Lake acres of emergent and floating-leaf plant communities from the 2012 community mapping survey.

Plant Community	Acres
Emergent	1.4
Floating-leaf	-
Mixed Floating-leaf and Emergent	1.0
Total	2.4

The community map represents a 'snapshot' of the emergent and floating-leaf plant communities, replications of this survey through time will provide a valuable understanding of the dynamics of these communities within Spider Lake. This is important, because these communities are often negatively affected by recreational use and shoreland development. Radomski and Goeman (2001) found a 66% reduction in vegetation coverage on developed shorelines when compared to undeveloped shorelines in Minnesota Lakes. Furthermore, they also found a significant reduction in abundance and size of northern pike (*Esox lucius*), bluegill (*Lepomis macrochirus*), and pumpkinseed (*Lepomis gibbosus*) associated with these developed shorelines.

8.3.5 Spider Lake Implementation Plan

The Implementation Plan below is a result of collaborative efforts between Spider Lake stakeholders, the MWLA, the NLDC, the Towns of Manitowish Waters and Boulder Junction, and ecologists/planners from Onterra. This plan provides goals and actions created to protect the quality and integrity of Spider Lake and will serve as reference for keeping stakeholders on track and focused upon these science-driven management activities.

While the Manitowish Waters Chain of Lakes are geographically similar, they are certainly ecologically diverse, as evidenced by the studies described within this report. This diversity leads to the need for individual plans aimed at managing the specific needs of each individual lake. Some of the lakes within the Manitowish Waters Chain have more complicated management needs than others, but in general most lakes' needs center on protecting the current quality of the lake as opposed to performing activities aimed at enhancing or resolving particular issues. The Chain-wide Implementation Plan will serve each of the project lakes well in terms of protecting their current condition as a chain. Spider Lake's Implementation Plan illustrates how Spider Lake stakeholders should proceed in implementing applicable portions of the Chain-wide Implementation Plan for their lake.

Chain-wide Implementation Plan – Specific to Spider Lake

Chain-wide Management Goal 1: Strengthen Association Relationships, Effectiveness and Lake Management Capability

Management Action: **Enhance involvement with other entities that have a hand in managing the Manitowish Waters Chain of Lakes.**

Description: While the MWLA and NLDC are primarily responsible for facilitating partnerships with many defined management units, Spider Lake property owners may participate in this management goal by keeping the lines of communication open with the MWLA and NLDC, as well as members from other Manitowish Waters Chain lakes. This may be done through representation on the MWLA Board of Directors, active participation in the Lake Captain and Deckhand Program, involvement in MWLA and NLDC sponsored events, attending meetings, etc.

Management Action: **Increase the Manitowish Waters Chain of Lakes' volunteer base**

Description: Spider Lake property owners may assist in this management action by simply donating several hours of their time a year towards MWLA and NLDC activities including active participation in the Lake Captain and Deckhand program. While it is beneficial to volunteer on their own lake, the entire chain would benefit by having Spider Lake individuals assist with activities occurring on other lakes within the chain.

Chain-wide Management Goal 2: Maintain Current Water Quality Conditions

<u>Management Action:</u> **Continue and expand monitoring of the Manitowish Waters Chain of Lakes' water quality through the WDNR Citizen Lake Monitoring Network.**

Description: Currently, Spider Lake is enrolled in the CLMN's water clarity monitoring program. This means that Secchi disk clarity data is collected several times during the year on Spider Lake. Although this is a great accomplishment, it must be continued in order to ensure the quality of Spider Lake is protected. Additionally, a better understanding of the lake's water quality would be obtained from volunteers enrolling in the CLMN's advanced water quality monitoring program. In this program, phosphorus and chlorophyll-*a* data is collected from the lake as well.

Volunteers from Spider Lake must also be proactive in recruiting others to participate. This will ensure that the program will continue after the current volunteers have retired their commitments to monitoring the lake's water quality.

<u>Management Action:</u> **Restore highly developed shoreland areas on the Manitowish Waters Chain.**

Description: As a part of this project, the entire Spider Lake shoreline was categorized in terms of its development. According to the results from this survey, 17% of the shoreline is in an urbanized or developed-unnatural state, while another 31% of the shoreline is currently in a semi-natural state. Continuing research indicates that the shoreland zone is a critical part of determining a lake's ecology, through providing both pollutant buffering wildlife habitat. The natural vegetative scenery provides an additional aesthetic benefit.

The TAISP is prepared to provide Spider Lake property owners with the necessary informational resources to restore their developed shoreland, should they be interested. Interested property owners may contact the NLDC and Vilas County Land and Conservation office for more information on shoreland restoration plans, financial assistance, and benefits of implementation.

<u>Management Action:</u> **Protect natural shoreland zones along the Manitowish Waters Chain of Lakes.**

Description: While 17% of the shoreland was found to be highly developed along Spider Lake, about 52% of the shoreland is currently in a very natural or undeveloped state. These areas are extremely important to protect for the environmental and aesthetic benefits they provide.

Spider Lake property owners interested in preserving their shoreland may contact the NLDC and Vilas County Land and Conservation office for information on land trusts, conservation easements, or best management practices. Implementing a number of these options will ensure the integrity of these undeveloped shorelands will remain well into the future.

Management Action: **Investigate algal blooms on the Manitowish Waters Chain.**

Description: While some algae blooms are natural and do not impact a lake ecosystem or human health in a negative manner, some blooms may cause recreational or health impairment. Spider Lake residents who observe algae blooms may contact the NLDC with their concerns. The NLDC can take the appropriate response in contacting WDNR officials about the matter. Residents may be asked to provide a sample of the algae for identification purposes.

Chain-wide Management Goal 3: Expand Awareness and Education of Lake Management and Stewardship Matters

Management Action: **Engage stakeholders on priority education items through participation in educational initiatives and efficient communication.**

Description: Spider Lake stakeholders can assist in the implementation of this action by actively participating in the MWLA and NLDC's educational initiatives. Participation may include attending presentations and trainings of educational topics, volunteering at local and regional events, participating in committees and the Lake Captain and Deckhand program, or simply notifying the MWLA or NLDC of concerns involving Spider Lake and its stakeholders.

Chain-wide Management Goal 4: Control Existing and Prevent Further Aquatic Invasive Species Establishment within the Manitowish Waters Chain of Lakes

Management Action: **Continue control strategy for curly-leaf pondweed on the Manitowish Waters Chain of Lakes.**

Description: Spider Lake residents may participate in curly-leaf pondweed control actions through a variety of passive means, such as keeping themselves up to date on aquatic invasive species matters through trainings, media releases, or participating in local meetings on the issue. Spider Lake residents can also assist by participating in the Lake Captain and Deckhand program, actively monitoring for curly-leaf pondweed. Additionally, lake users may report sightings of aquatic invasive species to the NLDC and remove floating CLP fragments when they are observed.

Management Action: **Maintain connection and open dialogue with management partners on matters pertaining to wild rice growth on the Manitowish Waters Chain.**

Description: As this is an action designed for a designated individual, there is no action necessary for Spider Lake property owners.

Management Action: **Continue control and monitoring efforts on purple loosestrife, Japanese knotweed, phragmites, and pale yellow iris throughout the Manitowish Waters Chain of Lakes.**

Description: Emergent shoreland plants such as purple loosestrife, Japanese knotweed, phragmites, and pale yellow iris can be easily identified and small infestations addressed through simple control methods. Spider Lake property owners may participate in this action through monitoring their shorelands and wetlands and removing plants in accordance with methods determined by the NLDC, MWLA and Vilas County Invasive Species Coordinator.

Management Action: **Continue locally-based aquatic invasive species monitoring and watercraft inspections.**

Description: Prevention of aquatic invasive species introduction remains the most effective way of minimizing the spread of this threat. Spider Lake property owners may participate in this initiative through volunteering for aquatic invasive species monitoring or Clean Boats Clean Waters inspections.

Management Action: **Investigate feasibility of alternative aquatic invasive species control methodologies for applicability to the Manitowish Waters Chain of Lakes.**

Description: As this is an action designed for a designated individual, there is no action necessary for Spider Lake property owners.

Chain-wide Management Goal 5: Enhance the Available Habitat and General Understanding of the Manitowish Waters Chain of Lakes Fishery

Management Action: **Work with WDNR fisheries managers and other stakeholders to enhance and understand the fishery.**

Description: Angling is often one of the most enjoyed recreational activities that takes place on Wisconsin lakes. A complete understanding of a lake's fishery is needed to base decisions off of, both for the fishery manager and the fisherman. Spider Lake residents can help the fishery of the Manitowish Waters Chain of Lakes by attending events aimed at educating the public about the chain's fishery, as well as volunteering for habitat improvement efforts, including shoreland preservation/remediation and coarse woody habitat projects.

Chain-wide Management Goal 6: **Continue to Understand, Protect and Enhance the Ecology of the Manitowish Waters Chain of Lakes Through Stakeholder Stewardship and Science-based Studies**

Management Action: Continue the development of comprehensive management plans for the Manitowish Waters Chain waterbodies.

Description: Though studies have been completed on Spider Lake as part of this chain-wide management planning project, it is up to Spider Lake stakeholders to continue monitoring and protecting the lake through the initiatives set forth by the goals described in this management plan. Additionally, these efforts may be extended to other lakes within the chain as needed.

In addition to current monitoring and protection, Spider Lake may wish to revisit their lake management plan in 5-10 years or as necessary. Comprehensive studies undertaken at that time would be able to point towards trends or changes in the lake with regards to water quality, watershed land use, aquatic plants, etc.