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Stantec

Bonestroo

September 13, 2011

Mr. Drew McNally
Coleman Lake Club
W13203 U.S. Highway 8
Coleman, WI 54112

RE: Coleman Lake Club 2011 Aquatic Macrophyte Survey
Project Number: 007326-11002-0

Dear Mr. McNally:

AQUATIC PLANT SURVEY AND ANALYSIS

The aquatic plant communities within the lakes on the Coleman Lake Club (CLC) property were surveyed on June 20 and July 11-13, 2011 by Bonestroo, Inc. Survey protocols were completed according to the point intercept sampling method described by Madsen (1999) and as outlined in the WDNR draft guidance entitled “Aquatic Plant Management in Wisconsin” (WDNR, 2005).

Sample points were created in each water body the day of the survey and were distributed within the photic zone of all lakes. Geographic coordinates were assigned by and saved into a global positioning system (GPS) receiver. The GPS unit was then used to navigate to intercept points. At each intercept point, plants were collected by tossing a specialized rake on a rope and dragging the rake along the bottom sediments. All collected plants were identified to the lowest practicable taxonomic level (e.g., typically genus or species) and recorded on field data sheets. Visual observations of aquatic plants were also recorded. Water depth and, when detectable, sediment types at each intercept point were also recorded on field data sheets.

The point intercept method was used to evaluate the existing emergent, submergent, floating-leaf, and free-floating aquatic plants. If a species was not collected at a specific point, the space on the datasheet was left blank. Data for each sample point was entered into the WDNR “Worksheets” (i.e., a data-processing spreadsheet) to calculate the following statistics:

- **Taxonomic richness** - total number of taxa detected.
- **Maximum depth of plant growth**
- **Community frequency of occurrence** - number of intercept points where aquatic plants were detected divided by the number of intercept points shallower than the maximum depth of plant growth.
- **Mean intercept point taxonomic richness** - average number of taxa per intercept point.
- **Mean intercept point native taxonomic richness** - average number of native taxa per intercept point.
- **Taxonomic frequency of occurrence within vegetated areas** - number of intercept points where a particular taxon (e.g., genus, species, etc.) was detected divided by the total number of intercept points where vegetation was present.

- **Taxonomic frequency of occurrence at sites within the photic zone** - number of intercept points where a particular taxon (e.g., genus, species, etc.) was detected divided by the total number of intercept points which are equal to or shallower than the maximum depth of plant growth.
- **Relative taxonomic frequency of occurrence** - number of intercept points where a particular taxon (e.g., genus, species, etc.) was detected divided by the sum of all species' occurrences).
- **Mean density** - sum of the density values for a particular species divided by the number of sampling sites.
- **Simpson Diversity Index (SDI)** - an indicator of aquatic plant community diversity. SDI is calculated by taking one minus the sum of the relative frequencies squared for each species present. Based upon the index of community diversity, the closer the SDI is to one, the greater the diversity within the population.
- **Floristic Quality Index (FQI) -** This method uses a predetermined Coefficient of Conservatism (C), which has been assigned to each native plant species in Wisconsin, based on that species' tolerance for disturbance (see below). Non-native plants, such as Eurasian water-milfoil and curly-leaf pondweed, are not assigned conservatism coefficients.

  Coefficient of Conservatism (C)
  0-3: Specie found in a wide variety of plant communities and is very tolerant of disturbance.
  4-6: Specie associated with specific communities and tolerate moderate disturbance.
  7-8: Specie found in narrow range of plant communities and tolerate only minor disturbance.
  9-10: Specie restricted to a very narrow range of conditions and intolerable to disturbance.

  The aggregate conservatism of all the plants inhabiting a site determines its floristic quality. The mean C value for a given lake is the arithmetic mean of the coefficients of all native vascular plant species occurring on the entire site, without regard to dominance or frequency. The FQI value is the mean C times the square root of the total number of native species. This formula combines the conservatism of the species present with a measure of the species richness of the site.

AQUATIC PLANT ECOLOGY

Aquatic plants are vital to the health of a water body. They provide cover and food for a multitude of organisms. Unfortunately, people often develop a negative connotation and refer to rooted aquatic plants as "weeds" and ultimately wish to eradicate them. This type of attitude, and the misconceptions it breeds, must be overcome in order to properly manage a lake ecosystem. Rooted aquatic plants (macrophytes) are extremely important for the well being of a lake community and possess many positive attributes. Despite their importance, aquatic macrophytes sometimes grow to nuisance levels that hamper recreational activities. This is especially prevalent in degraded ecosystems. The introduction of certain aquatic invasive species (AIS), such as EWM, often can exacerbate nuisance conditions, particularly when they compete successfully with native vegetation and occupy large portions of a lake.

When "managing" aquatic plants, it is important to maintain a well-balanced, stable, and diverse aquatic plant community that contains high percentages of desirable native species. To be effective, aquatic plant management in most lakes must maintain a plant community that is robust, species rich, and diverse. Appendix B includes a discussion about aquatic plant ecology, habitat types and relationships with water quality.

AQUATIC INVASIVE SPECIES

Aquatic Invasive Species (AIS) are aquatic plants and animals that have been introduced by human action to a location, area, or region where they did not previously exist. AIS often lack natural control mechanisms they may have had in their native ecosystem and may interfere with the native plant and animal interactions in their new "home". Some AIS have aggressive reproductive potential and contribute to a decline of a lake's ecology and interfere with recreational use of a lake. Common Wisconsin AIS include:

- Eurasian Water-milfoil
- Curly Leaf Pondweed
- Zebra Mussels
- Rusty Crayfish
- Spiny Water Flea
- Purple Loosestrife

The aquatic invasive specie Eurasian water-milfoil was found in Coleman Lake and Chemical Creek. Curly-leaf pondweed was found in Coleman Lake, Chemical Creek, and Trout Lake. No other invasive species were found at any other location within the CLC property

AQUATIC PLANT SURVEYS

Aquatic plant surveys were completed on June 20 and July 11-13, 2011, and included sampling at 803 intercept points across all CLC lakes. The aquatic macrophyte community of the lakes included 49 floating leaved, free-floating, emergent, and submerged aquatic vascular plant species during 2011. Table 1 lists the taxa identified during the 2011 aquatic plant surveys for each lake and Table 2 displays the aquatic plant community data for each lake. A summary of the aquatic plant community surveys is presented below.

Lost Lake

The survey for Lost Lake was completed on June 20, 2011 and included sampling at 21 locations. Vegetation was identified to a maximum depth of 3 feet (photic zone). Aquatic vegetation was detected at 95.2 percent (%) of photic zone intercept points. The Simpson Diversity Index value was 0.79, taxonomic richness was 8 species, and there was an average of 1.71 species identified at points that were within the photic zone and an average of 1.80 species present at points with vegetation present. There were no AIS present in Lost Lake. Table 1 lists all species found and Table 2 summarizes overall aquatic plant community statistics.

The most abundant aquatic plant identified during the aquatic plant survey was chara or muskgrass *(Chara sp.*). It exhibited a 61.9% frequency of occurrence (percent of photic zone intercept points at which the taxa was detected) and was present at 65% of the sites with vegetation.

> *Chara, sp.* (Muskgrass / Chara) looks like a vascular plant; it actually is a multi-celled algae (macroalgae). Muskgrass is usually found in hard waters and prefers muddy or sandy substrate and can often be found in deeper water than other submergent plants. Muskgrass beds provide valuable habitat for small fish and invertebrates. Muskgrass is also a favorite waterfowl food. Its rhizoids slow the movement and suspension of sediments and benefit water quality in the ability to stabilize the lake bottom (Borman, et al., 1997). It can easily be identified by its characteristic "musty" odor.

Filamentous algae (*Algae sp.*) was the second most abundant vascular plant species occurring at 33.3% of the photic zone and was present at 35% of the sites with vegetation.

> *Algae sp.* (Filamentous algae) are single cell algae that form long, visible chains or filaments that can intertwine and for a mat. Filamentous algae begins by growing on lake bottoms, but commonly floats to the surface and is often called "pond scum". Many different species of algae may be present at the same time to form filamentous algae.

Spatterdock or yellow-pond lily (*Nuphar variegata.*) was the third most abundant species occurring at 23.8% of the photic zone and was present at 25% of the sites with vegetation.

> *Nuphar variegata* (Spatterdock) has a flexible stalk and an oval shaped leaf. It grows in water less than 6 feet deep and prefers soft sediment. Yellow flowers occur throughout the summer. Floating leaves provide cover and shade for fish as well as habitat for invertebrates (Borman, et al., 1997).

FQI varies around the state of Wisconsin and ranges from 3.0 to 44.6 with the average FQI of 22.2 and northern region average of 24.3 (WDNR, 2005). The FQI calculated from the 2011 aquatic plant survey data was 17.8 with an average C of 6.71. This FQI value is lower than Wisconsin's northern region mean of 24.3 and was hampered by the overall small size of the lake and low number of sample points. The average C indicates a plant community made up of a variety of plants indicating lower disturbance levels. Filamentous algae does not have an assigned coefficient and was not included in calculation of the FQI. A species of bur-reed was sampled but was not able to be identified down to species level and was not included in calculation of the FQI.

Spring Lake

The survey for Spring Lake was completed on July 11, 2011 and included sampling at 27 locations. Vegetation was identified to a maximum depth of 11 feet. Aquatic vegetation was detected at 79.2% of photic zone intercept points. An average plant community inhabited the lake during 2011. The Simpson Diversity Index value of the community was 0.87, taxonomic richness was 11 species, and there was an average of 2.5 species identified at points that were within the photic zone and an average of 3.16 species present at points with vegetation present. There were no AIS present in Spring Lake. Table 1 lists all species found and Table 2 summarizes overall aquatic plant community statistics.

The most abundant aquatic plant identified during the aquatic plant survey was chara or muskgrass *(Chara sp.*). It exhibited a 54.2% frequency of occurrence and was present at 68.4% of the sites with vegetation.

White water lily (*Nymphaea odorata*) was the second most abundant vascular plant species occurring at 50% of the photic zone and was present at 63.2% of the sites with vegetation.

> *Nymphaea odorata* (White Water Lily) has a flexible stalk with a round floating leaf. White Water Lily can be found growing in a variety of sediment types in less than 6 feet of water. Fragrant white flowers occur throughout the summer. The floating leaves provide shelter and shade for fish as well as habitat for invertebrates (Borman, et al., 1997).

Spatterdock or yellow-pond lily (*Nuphar variegata.*) was the third most abundant species occurring at 29.2% of the photic zone and was present at 36.8% of the sites with vegetation.

The FQI calculated from the 2011 aquatic plant survey data was 23.5 with an average C of 7.09. This FQI value is comparable to Wisconsin's northern region mean of 24.3. The average C indicates a plant community made up of a variety of plants indicating lower disturbance levels. Filamentous algae and water moss do not have an assigned coefficient and were not included in calculation of the FQI.

Harvey Pond

The survey for Harvey Pond was completed on July 11, 2011 and included sampling at 18 locations. Vegetation was identified to a maximum depth of 3 feet. Aquatic vegetation was detected at 72.2% of photic zone intercept points. An average plant community inhabited the lake during 2011. The Simpson Diversity Index value of the community was 0.81, taxonomic richness was 7 species, and there was an average of 0.94 species identified at points that were within the photic zone and an average of 1.31 species present at points with vegetation present. There were no AIS present in Harvey Pond. Table 1 lists all species found and Table 2 summarizes overall aquatic plant community statistics.

The most abundant aquatic plant identified during the aquatic plant survey was filamentous algae. It exhibited a 27.8% frequency of occurrence and was present at 38.5% of the sites with vegetation.

Common water starwort (*Calletriche palustris*) was the second most abundant vascular plant species occurring at 22.2% of the photic zone and was present at 30.8% of the sites with vegetation.

> *Calletriche palustris* (common water-starwort) has slender stems that emerge from a shallow rootstalk. Submersed leaves are pale green. The plants stems are a food source for waterfowl and provide habitat for some fish species (Borman, et al., 1997).

Chara, northern water-milfoil (*Myriophyllum sibiricum*), and variable pondweed (*Potamogeton gramineus*) were the third most abundant species occurring at 11.1% of the photic zone and were present at 15.4% of the sites with vegetation.

> *Myriophyllum sibiricum* (Northern water-milfoil) is usually found growing in soft sediment in fairly clear-water lakes. Leaves are divided like a feather, with five to twelve pairs of thread-like leaflets. Leaves are arranged in whorls. Northern water-milfoil is more desirable than its invasive cousin, Eurasian water-milfoil. Waterfowl eat the foliage and fruit, while beds of this plant provide cover and foraging opportunities for fish and invertebrates (Borman, et al., 1997).

> *Potamogeton gramineus* (Variable Pondweed) is usually found in more firm sediment in water that is about 3 feet deep. Variable pondweed overwinters by hardy rhizomes and winter buds. Flowering usually occurs early in the growing season and fruit is produced during mid summer. The fruits and tubers are grazed by waterfowl and the extensive network of leafy branches offers invertebrate habitat and foraging opportunities for fish (Borman, et al., 1997).

The FQI calculated from the 2011 aquatic plant survey data was 16.3 with an average C of 6.67. This FQI value is lower than Wisconsin's northern region mean of 24.3 and was hampered by the overall small size of the lake and low number of sample points. The average C indicates a plant community made up of a variety of plants indicating lower disturbance levels. Filamentous algae does not have an assigned coefficient and was not included in calculation of the FQI.

Vic Pond

The survey for Vic Pond was completed on July 11, 2011 and included sampling at 57 locations. Vegetation was identified to a maximum depth of 10 feet. Aquatic vegetation was detected at 97.9% of photic zone intercept points. A diverse community inhabited the lake during 2011. The Simpson Diversity Index value of the community was 0.86, taxonomic richness was 17 species, and there was an average of 2.88 species identified at points that were within the photic zone and an average of 2.94 species present at points with vegetation present. There were no AIS present in Vic Pond. Table 1 lists all species found and Table 2 summarizes overall aquatic plant community statistics.

The most abundant aquatic plant identified during the aquatic plant survey was chara or muskgrass. It exhibited a 75.5% frequency of occurrence and was present at 77.1% of the sites with vegetation.

Variable pondweed and floating-leaf pondweed (*Potamogeton natans*) were the second most abundant vascular plant species occurring at 46.9% of the photic zone and were present at 47.9% of sites with vegetation.

> *Potamogeton natans* (Floating-Leaf Pondweed) has stems that emerge from red-spotted rhizomes. Submersed leaves are stalk-like, with no obvious leaf blade. Floating leaves are heart-shaped at their base. Floating-leaf pondweed is usually found in water less than 1.5 meters deep. It provides valuable grazing opportunities for ducks and geese. It may also be consumed by muskrat, beaver and deer (Borman et al. 1997).

Spatterdock or yellow-pond lily was the third most abundant species occurring at 20.4% of the photic zone and was present at 20.8% of the sites with vegetation.

The FQI calculated from the 2011 aquatic plant survey data was 24.7 with an average C of 6.00. This FQI value is comparable to Wisconsin's northern region mean of 24.3 and the average C indicates a plant community made up of a variety of plants indicating lower disturbance levels.

Brock Pond

The survey for Brock Pond was completed on July 11, 2011 and included sampling at 80 locations. Vegetation was identified to a maximum depth of 3 feet. Aquatic vegetation was detected at 84.5%

of photic zone intercept points. An average plant community inhabited the lake during 2011. The Simpson Diversity Index value of the community was 0.87, taxonomic richness was 15 species, and there was an average of 1.48 species identified at points that were within the photic zone and an average of 1.69 species present at points with vegetation present. There were no AIS present in Brock Pond. Table 1 lists all species found and Table 2 summarizes overall aquatic plant community statistics.

The most abundant aquatic plant identified during the aquatic plant survey was common bur-reed *(Sparganium eurycarpum*). It exhibited a 28.8% frequency of occurrence and was present at 32.9% of the sites with vegetation.

> *Sparganium eurycarpum* (Common Bur-reed) has emergent leaves, up to 1.5 meters tall, that are rather spongy and look triangle in cross section. Common bur-reed can be distinguished from other bur-reeds by its two stigmas on each female flower and wide, flat-topped fruit. It can be found in marshes and along lake, pond, and river margins. Colonies of bur-reed help anchor sediment and provide nesting sites for birds and waterfowl. (Borman, et al., 1997).

Filamentous algae was the second most abundant species occurring at 27.5% of the photic zone and was present at 31.4% of the sites with vegetation. Floating-leaf pondweed was the third most abundant species occurring at 21.3% of the photic zone and was present at 24.3% of the sites with vegetation.

The FQI calculated from the 2011 aquatic plant survey data was 20.5 with an average C of 5.92. This FQI value, though slightly lower than, is comparable to Wisconsin's northern region mean of 24.3. The average C indicates a plant community made up of a variety of plants indicating lower disturbance levels. Filamentous algae do not have an assigned coefficient and were not included in calculation of the FQI. A species of arrowhead was present during the survey, but was not able to be identified down to species level and was not included in calculation of the FQI.

Coleman Lake

The survey for Coleman Lake was completed on July 12, 2011 and included sampling at 263 locations. Vegetation was identified to a maximum depth of 22 feet. Aquatic vegetation was detected at 95% of photic zone intercept points. An extremely diverse plant community inhabited the lake during 2011. The Simpson Diversity Index value of the community was 0.96, taxonomic richness was 24 species, and there was an average of 2.12 species identified at points that were within the photic zone and an average of 2.24 species present at points with vegetation present. There were 2 AIS present in Coleman Lake. Table 1 lists all species found and Table 2 summarizes overall aquatic plant community statistics.

The most abundant aquatic plant identified during the aquatic plant survey was the AIS Eurasian water-milfoil *(Myriophyllum spicatum* - EWM). It exhibited an 82.2% frequency of occurrence and was present at 86.5% of the sites with vegetation. Eurasian water-milfoil infestation occupies approximately 76.45 acres on the lake (Figure 1). In most locations, EWM was extremely dense with an average density rating of 2 and formed large, monotypic colonies. It is not know how EWM was introduced into Coleman Lake and has likely been present for over five years to be present at its current expanse. Though no EWM was found downstream from Coleman Lake, it should be

considered a source of infestation for other lakes within the Club property and control options for this plant should be looked into.

> *Myriophyllum spicatum* (Eurasian water-milfoil or EWM) is a submersed aquatic plant native to Europe, Asia and northern Africa. It was introduced to the United States by early European settlers. EWM was first detected in Wisconsin lakes during the 1960's. In the past three decades, this AIS has significantly expanded its range to about 61 of Wisconsin's 72 counties and continues to infest new water bodies every year. Because of its potential for explosive growth and its incredible ability to regenerate, EWM can successfully out-compete most native aquatic plants, especially in disturbed areas.
>
> Eurasian water-milfoil shows no substrate preference in most instances and can grow in water depths greater than 4 meters (Nichols, 1999). Dense beds of EWM are usually identified in soft/organic rich sediments in many lakes. Eurasian water-milfoil can reproduce by seeds, but its main form of reproduction is vegetatively by fragmentation, allowing it to disperse over long distances. The plant produces fragments after fruiting once or twice during the summer. These shoots may then be carried by water currents or inadvertently picked up by boaters. EWM is readily dispersed by boats, motors, trailers, bilges, live wells, or bait buckets, and can stay alive for weeks if kept moist. Once established in an aquatic community, EWM reproduces from shoot fragments and stolons (runners that creep along the substrate).
>
> EWM is an opportunistic species and is adapted for rapid growth early in spring which can form a dense leaf canopy that shades out native aquatic plants. Its ability to spread rapidly by fragmentation and effectively block out sunlight needed for native plant growth often results in monotypic stands. Monotypic stands of EWM provide only a single habitat, and threaten the integrity of aquatic communities in a number of ways. For example, dense stands disrupt predator-prey relationships by fencing out larger fish, and reducing the number of nutrient-rich native plants available for waterfowl (DNR, 2002).

White water lily was the second most abundant species occurring at 22.1% of the photic zone and was present at 23.3% of the sites with vegetation. Chara or muskgrass was the third most abundant species occurring at 18.2% of the photic zone and was present at 19.2% of the sites with vegetation.

Another AIS, curly-leaf pondweed (*Potamogeton crispus*) was also present within Coleman Lake. Curly-leaf pondweed occurred at 9.3% of photic zone sites and 9.8% of sites with vegetation. Though this plant is AIS, it was not present within the lake in dense colonies and appears to have become a part of the community and control of this species is not recommended at this time though it should be monitored.

> *Potamogeton crispus* (Curly-leaf pondweed) spreads through burr-like winter buds (turions), which are moved among waterways. These plants can also reproduce by seed, but this plays a relatively small role compared to the vegetative reproduction through turions. New plants form under the ice in winter, making CLP one of the first nuisance aquatic plants to emerge in the spring. The leaves of curly-leaf pondweed are reddish-green, oblong, and about 3 inches long, with distinct wavy edges that are finely toothed. The stem of the plant is

> flat, reddish-brown and grows from 1 to 3 feet long. The plant usually drops to the lake bottom by early July.
>
> CLP becomes invasive in some areas because of its tolerance for low light and low water temperatures. These tolerances allow it to get a head start on and out-compete native plants in the spring. CLP forms surface mats that interfere with aquatic recreation in mid-summer, when most aquatic plants are growing, CLP plants are dying off. Plant die-offs may result in a critical loss of dissolved oxygen. Furthermore, the decaying plants can increase nutrients which contribute to algal blooms, as well as create unpleasant stinking messes on beaches (WDNR website, 2006).

The FQI calculated from the 2011 aquatic plant survey data was 27.3 with an average C of 5.95. This FQI value, though slightly higher than, is comparable to Wisconsin's northern region mean of 24.3. The average C indicates a plant community made up of a variety of plants indicating lower disturbance levels. Filamentous algae, EWM, and CLP do not have an assigned coefficient and were not included in calculation of the FQI.

Chemical Creek

The survey for Chemical Creek was completed on July 12, 2011 and included sampling at 38 locations between Trout Lake and Coleman Lake. Vegetation was identified to a maximum depth of 3 feet. Aquatic vegetation was detected at 100% of photic zone intercept points. A diverse plant community inhabited the creek during 2011. The Simpson Diversity Index value of the community was 0.91, taxonomic richness was 16 species, and there was an average of 6.47 species identified at points that were within the photic zone. There were two AIS present in Chemical Creek. Table 1 lists all species found and Table 2 summarizes overall aquatic plant community statistics.

The most abundant aquatic plant identified during the aquatic plant survey was sago pondweed *(Stuckenia pectinata*). It exhibited a 92.1% frequency of occurrence and was present at 92.1% of the sites with vegetation.

> *Stuckenia pectinata* (Sago Pondweed) resembles two other pondweeds with needle-like leaves, but sago pondweed tends to be much more common. The fruit and tubers of sago pondweed are very important food sources for waterfowl, while leaves and stems provide shelter for small fish and invertebrates (Borman, et al., 1997).

The second most abundant aquatic plant identified during the aquatic plant survey was curly-leaf pondweed, an AIS. It exhibited an 84.2% frequency of occurrence and was present at 84.2% of the sites with vegetation. Though this plant is considered invasive, it does not create a problem by itself within the Creek. The entire creek has abundant vegetation and a tremendous diversity and control options would cause undue harm to the surrounding community. Also, continual water flow would negate any herbicide application by causing it to drift down stream and be ineffective. Eurasian water-milfoil was also present in Chemical Creek near its confluence with Coleman Lake

Coontail (*Ceratophyllum demersum*) was the third most abundant species occurring at 71.1% of the photic zone and was present at 81.1% of the sites with vegetation.

Ceratophyllum demersum (Coontail) is one of the most widely distributed aquatic plants within Wisconsin. The plant lacks true roots and can be found in water up to 16 feet deep. The leaves are arranged in a whorled fashion and are stiff and located closer together at the tip of the plant, giving it the appearance of a raccoon tail. Coontail is excellent habitat for invertebrates, especially in the winter when most other plants have died. The plant itself is food for waterfowl and provides shelter and foraging opportunities for fish (Borman, et al., 1997). Coontail may be mistaken for EWM.

The FQI calculated from the 2011 aquatic plant survey data was 21.4 with an average C of 5.71. This FQI value, though slightly lower than, is comparable to Wisconsin's northern region mean of 24.3. The average C indicates a plant community made up of a variety of plants indicating lower disturbance levels. Curly-leaf pondweed and Eurasian water-milfoil do not have an assigned coefficient and were not included in calculation of the FQI.

Trout Lake

The survey for Trout Lake was completed on July 12, 2011 and included sampling at 17 locations. Vegetation was identified to a maximum depth of 15 feet. Aquatic vegetation was detected at 94.1% of photic zone intercept points. An average plant community inhabited the lake during 2011. The Simpson Diversity Index value of the community was 0.87, taxonomic richness was 11 species, and there was an average of 2.88 species identified at points that were within the photic zone and an average of 3.06 species present at points with vegetation present. Table 1 lists all species found and Table 2 summarizes overall aquatic plant community statistics.

The most abundant aquatic plant identified during the aquatic plant survey was coontail. It exhibited a 64.7% frequency of occurrence and was present at 68.8% of the sites with vegetation.

Sago pondweed and curly-leaf pondweed were the second most abundant species occurring at 41.2% of the photic zone and was present at 43.8% of the sites with vegetation. Similar to the other Club water bodies infested with CLP, control of this species does not need to be a concern on Trout Lake. Northern water-milfoil was the third most abundant species occurring at 35.5% of the photic zone and was present at 37.5% of the sites with vegetation.

The FQI calculated from the 2011 aquatic plant survey data was 20.5 with an average C of 5.92. This FQI value, though slightly lower than, is comparable to Wisconsin's northern region mean of 24.3. The average C indicates a plant community made up of a variety of plants indicating lower disturbance levels. Filamentous algae do not have an assigned coefficient and were not included in calculation of the FQI. A species of arrowhead was present during the survey, but was not able to be identified down to species level and was not included in calculation of the FQI.

Moon Lake

The survey for Moon Lake was completed on July 13, 2011 and included sampling at 131 locations. Vegetation was identified to a maximum depth of 27 feet. Aquatic vegetation was detected at 80.9% of photic zone intercept points. A diverse plant community inhabited the lake during 2011. The Simpson Diversity Index value of the community was 0.80, taxonomic richness was 20 species, and there was an average of 1.68 species identified at points that were within the photic zone and an average of 2.08 species present at points with vegetation present. There were no AIS present in

Moon Lake. Table 1 lists all species found and Table 2 summarizes overall aquatic plant community statistics.

The most abundant aquatic plant identified during the aquatic plant survey was chara or muskgrass. It exhibited a 61.7% frequency of occurrence and was present at 76.3% of the sites with vegetation.

Wild celery (*Vallisneria americana*) was the second most abundant species occurring at 28.7% of the photic zone and was present at 35.5% of the sites with vegetation. Illinois pondweed (Potamogeton illinoensis) was the third most abundant species occurring at 17.4% of the photic zone and was present at 21.5% of the sites with vegetation.

> *Vallisneria americana* (Wild Celery) also known as eel-grass or tape-grass, and has ribbon-like leaves that tend to grow until they emerge in clusters along the waters surface. Wild celery is a premiere source of food for waterfowl. All portions of the plant are consumed. Beds of wild celery are also considered good fish habitat providing shade, shelter and feeding opportunities (Borman, et al., 1997).
>
> *Potamogeton illinoensis* (Illinois Pondweed) has stout stems that emerge from thick rhizomes. Most of the submersed leaves are lance-shaped to oval and either attach directly to the stem or have a short stalk. The leaves often have a sharp, needle like tip. Floating leaves which have a thick stalk and ellipse shaped blade are sometimes produced. Illinois pondweed is usually found in water with moderate to high pH and fairly good water clarity. The fruit produced by Illinois pondweed can be locally important to ducks and geese. The plant may also be grazed by muskrat, deer and beaver. This pondweed also offers excellent shade and cover for fish and good surface area for invertebrates.

The FQI calculated from the 2011 aquatic plant survey data was 27.6 with an average C of 6.05. This FQI value is higher than Wisconsin's northern region mean of 24.3. The average C indicates a plant community made up of a variety of plants indicating lower disturbance levels.

Railroad Pond

The survey for Railroad Pond was completed on July 13, 2011 and included sampling at 72 locations. Vegetation was identified to a maximum depth of 8 feet. Aquatic vegetation was detected at 94.4% of photic zone intercept points. An average plant community inhabited the lake during 2011. The Simpson Diversity Index value of the community was 0.60, taxonomic richness was 9 species, and there was an average of 1.49 species identified at points that were within the photic zone and an average of 1.60 species present at points with vegetation present. There were no AIS present in Railroad Pond. Table 1 lists all species found and Table 2 summarizes overall aquatic plant community statistics.

The most abundant aquatic plant identified during the aquatic plant survey was chara or muskgrass. It exhibited an 88.9% frequency of occurrence and was present at 94.1% of the sites with vegetation.

Floating-leaf pondweed was the second most abundant species occurring at 29.2% of the photic zone and was present at 30.9% of the sites with vegetation. Small pondweed (Potamogeton

pusillus) was the third most abundant species occurring at 16.7% of the photic zone and was present at 17.7% of the sites with vegetation.

> *Potamogeton pusillus* (Small Pondweed) has small slender stems, and branches repeatedly near its ends. There is some limited reproduction by seed. Small pondweed can be locally important as a food source for a variety of wildlife. Waterfowl feed on small pondweed as well as deer, muskrat, and some small fish (Borman, et al., 1997).

The FQI calculated from the 2011 aquatic plant survey data was 19 with an average C of 6.33. This FQI value is lower than Wisconsin's northern region mean of 24.3 and was hampered by the overall small size of the lake and low number of sample points. The average C indicates a plant community made up of a variety of plants indicating lower disturbance levels.

North Pond

The survey for North Pond was completed on July 13, 2011 and included sampling at 79 locations. Vegetation was identified to a maximum depth of 5 feet. Aquatic vegetation was detected at 54.4% of photic zone intercept points. An average plant community inhabited the lake during 2011. The Simpson Diversity Index value of the community was 0.87, taxonomic richness was 11 species, and there was an average of 0.84 species identified at points that were within the photic zone and an average of 1.53 species present at points with vegetation present. There were no AIS present in North Pond. Table 1 lists all species found and Table 2 summarizes overall aquatic plant community statistics.

The most abundant aquatic plant identified during the aquatic plant survey was elodea or common waterweed (*Elodea canadensis*). It exhibited a 20.3% frequency of occurrence and was present at 37.2% of the sites with vegetation.

> *Elodea canadensis* (Elodea or common waterweed) is an abundant native plant species that is distributed statewide. It prefers soft substrate and water depths to 15 feet (Nichols, 1999). Elodea reproduces by seed and sprigs (USDA, 2002). The stems of elodea offer shelter and grazing to fish, but very dense elodea can interfere with fish movement. Elodea can be considered invasive at times and out-competes other more desirable plants.

Floating-leaf pondweed was the second most abundant species occurring at 11.4% of the photic zone and was present at 20.9% of the sites with vegetation. Northern water-milfoil and chara were the third most abundant species occurring at 10.1% of the photic zone and were present at 18.6% of the sites with vegetation.

The FQI calculated from the 2011 aquatic plant survey data was 19.3 with an average C of 5.82. This FQI value is lower than Wisconsin's northern region mean of 24.3 and was hampered by the overall small size of the lake and low number of sample points. The average C indicates a plant community made up of a variety of plants indicating lower disturbance levels.

Reference: Coleman Lake Club 2011 Aquatic Macrophyte Survey

CONCLUSIONS AND RECOMMENDATIONS

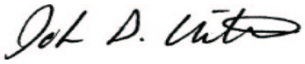
In summary, the aquatic macrophyte communities within the lakes on the Coleman Lake Club property are in an outstanding, natural condition. A total of 49 species were found across all water bodies within CLC property. Several rare and uncommon species were found within the water bodies on the property. The highest number of species (24) was surveyed on Coleman Lake and an astounding 6.47 species per sample point were surveyed within Chemical Creek. Current management practices and boating restrictions likely contribute to the maintenance of this diverse macrophyte community. Even with this management, Eurasian water milfoil (EWM) and Curly Leaf Pondweed (CLP) were present within Coleman Lake and Chemical Creek and CLP was present in Trout Lake.

Both CLP and EWM are considered invasive species, not native to Wisconsin, and should be cause for special management concerns. Curly-leaf pondweed's life cycle is unique in that it dies off in mid-summer. Because of this and the timing of the aquatic plant surveys, the true extent of its infestation may not have been accurately gauged since some plants may have begun dying back. However, even at its current state, the CLP infestation is not significant enough to warrant concern and has simply become part of the ecosystem where present. Yearly monitoring of this AIS should continue in order to determine if it is becoming more prevalent and is spreading. An early season survey will more accurately track and identify CLP locations before the plant dies back. If the spread of CLP increases by more than 25% between years, the Club should look into control options. Be advised control options on Chemical Creek are limited because of continual water flow which would wash herbicide down-stream.

Eurasian water-milfoil, however, has become the most prevalent plant within Coleman Lake and has created many large, monotypic stands. Besides causing difficulties with navigation with its dense growth, these monotypic stands offer poor habitat for fish and wildlife. Management of this species through a large-scale, whole lake based herbicide treatment is recommended as it occupies nearly the entire photic zone on Coleman Lake. Treatment of this AIS has already been proposed by Bonestroo (now Stantec) and the CLC currently has a proposal and cost estimate to complete this work. This proposal included the development of an aquatic plant management plan for all CLC waters, an AIS treatment plan scheduled to be implemented in spring 2012 and submittal of all necessary permitting to the Wisconsin DNR for approval. Once treated, we believe that EWM will be almost totally eliminated from Coleman Lake.

Respectfully,

STANTEC CONSULTING SERVICES INC.



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Reference: Coleman Lake Club 2011 Aquatic Macrophyte Survey

Attachments:

c. Brad Coursen, Coleman Lake Club
Douglas Seaman, Coleman Lake Club
Mark Kordus, Bonestroo, Inc. - Stantec, Inc.
James Scharl, Bonestroo, Inc. - Stantec, Inc.

As you may be aware, Bonestroo has completed the final phase of our merger with Stantec Consulting Services, Inc. (Stantec). Effective September 3, 2011, Stantec has assumed Bonestroo contracts and associated billing rate structures with no interruption in our client service or operations. Please be assured that the original contractual agreement, single point of contact, the continuity of your current Project(s) and the quality of our services will be unaffected.

ATTACHMENT A

TABLE 1
Coleman Lake Club
2011 Aquatic Macrophyte Sampling Summary

	Specie	Lost Lake	Spring Lake	Harvey Pond	Vic Pond	Brock Pond	Coleman Lake	Chemical Creek	Trout Lake	Moon Lake	Railroad Pond	North Pond
AIS	**Curly-leaf pondweed**						**x**	**x**	**x**			
	Eurasian water-milfoil						**x**	**x**				
Submergent	bushy pondweed		x		x	x				x	x	
	chara	x	x	x	x	x	x			x	x	x
	clasping-leaf pondweed					x						
	common bladderwort		x		x		x	x				
	common water starwort			x								
	common waterweed				x		x	x	x	x		x
	coontail						x	x	x			
	creeping bladderwort		x									
	Filamentous algae	x	x	x		x	x					
	flat-leaf bladderwort		x				x					x
	flat-stem pondweed		x		x		x		x	x	x	x
	floating-leaf pondweed	x		x	x	x	x	x	x	x	x	
	horned pondweed	x		x								
	Illinois pondweed									x		
	large-leaf pondweed						x			x		x
	northern water-milfoil		x	x	x		x	x	x	x	x	x
	pipewort									x		
	ribbon-leaf pondweed				x			x				
	sago pondweed				x		x	x	x	x		
	small pondweed				x	x	x				x	
	stiff water crowfoot	x				x	x	x	x			
	variable pondweed		x	x	x		x		x	x	x	
	various-leaved water-milfoil											x
	water bulrush									x		
	water marigold							x		x		
	water moss		x			x						
	water stargrass						x	x		x		
	white-stem pondweed						x			x		
	wild celery						x			x		
Emergent	3-way sedge				x							
	arrowhead sp.					x						
	Bur-reed sp.	x										
	cattail					x				x		x
	common bur-reed					x						
	creeping spikerush				x						x	
	hard-stem bulrush						x			x		
	narrow-leaved bur-reed		x									
	rigid arrowhead					x						
	soft-stem bulrush				x		x					
	sweet flag	x										
	water horsetail	x				x					x	x
Floating-leaf	spatterdock	x	x		x	x	x	x	x	x		x
	water smartweed											x
	watershield				x							
	white water lily		x		x	x	x	x		x		
Free-floating	Forked duckweed							x				
	Large duckweed						x	x	x			

TABLE 2

Coleman Lake Club

2011 Aquatic Macrophyte Sampling Statistical Summary

	Lost Lake	Spring Lake	Harvey Pond	Vic Pond	Brock Pond	Coleman Lake	Chemical Creek	Trout Lake	Moon Lake	Railroad Pond	North Pond	TOTALS
Date Sampled	6/20/2011	7/11/2011	7/11/2011	7/11/2011	7/11/2011	7/12/2011	7/12/2011	7/12/2011	7/13/2011	7/13/2011	7/13/2011	---
Points Sampled	21	27	18	57	80	263	38	17	131	72	79	803
Points with vegetation	20	19	13	48	70	245	38	16	93	68	43	673
Points shallower than maxium depth of plants	21	24	18	49	80	258	38	17	115	72	79	771
Frequency of occurrence	95.24%	79.17%	72.20%	97.96%	84.50%	94.96%	100.00%	94.12%	80.87%	94.40%	54.43%	87.29%
Simpson Diversity Index	0.79	0.87	0.81	0.86	0.87	0.96	0.91	0.87	0.8	0.6	0.87	---
Maxiumum depth of plants (ft)	3	11	3	10	3	22	3	15	27	8	5	27
Average number of species per site (shallower than max depth)	1.71	2.5	0.94	2.88	1.48	2.12	6.47	2.88	1.68	1.49	0.84	---
Average number of native species per site (shallower than max depth)	1.71	2.5	0.94	2.88	1.48	1.19	5.45	2.47	1.68	1.49	0.84	---
Species Richness	8	13	7	17	15	24	16	11	20	9	11	49
Mean Coeffecient of Conservatism	6.71	7.09	6.67	6.00	5.92	5.95	5.71	5.20	6.05	6.33	5.82	---
FQI	17.76	23.52	16.33	24.74	20.50	27.28	21.38	16.44	27.06	19.00	19.30	---

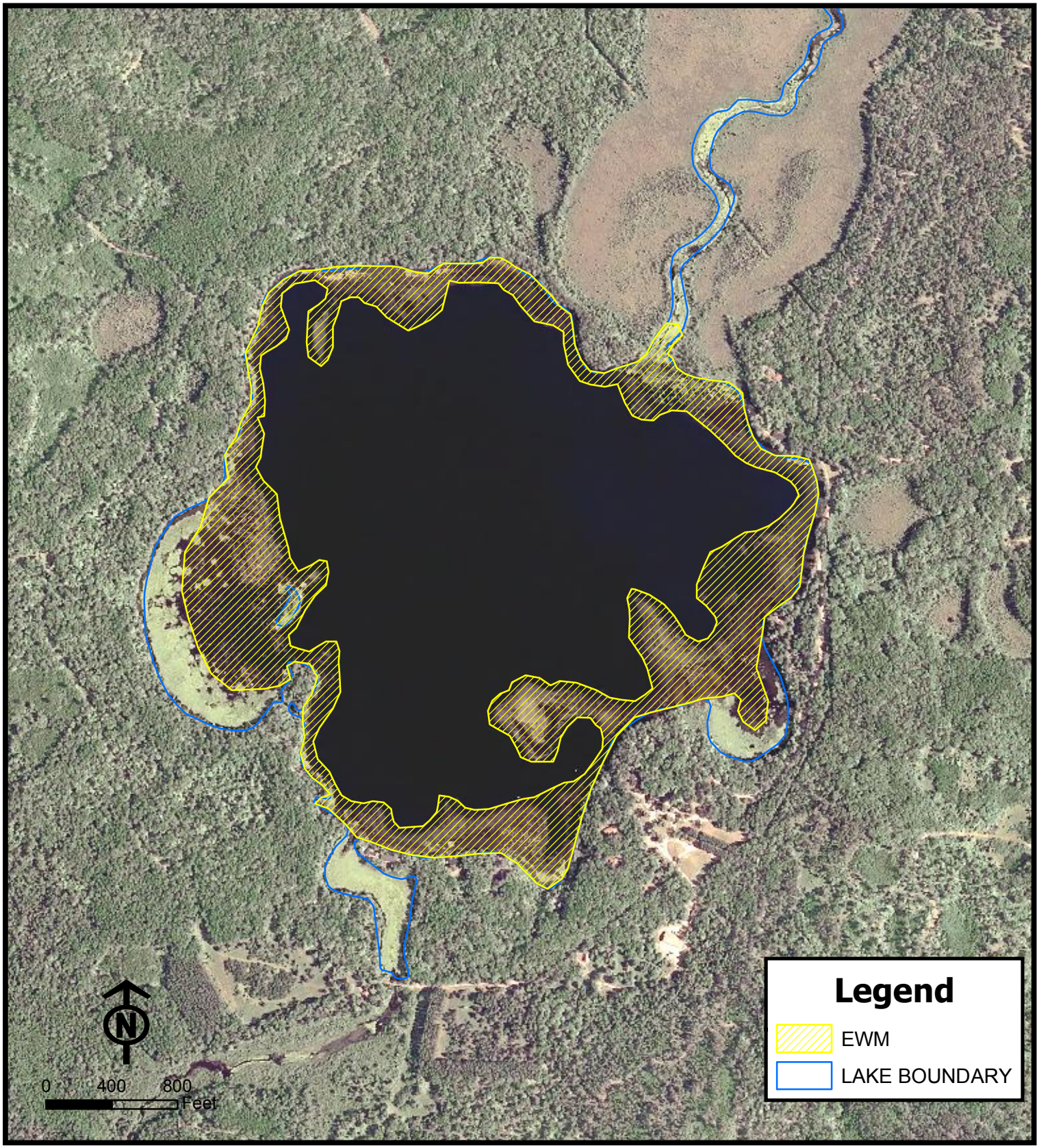
TABLE 3
Coleman Lake Club
2011 Floristic Quality Assessment Summary

	Specie	Lost Lake	Spring Lake	Harvey Pond	Vic Pond	Brock Pond	Coleman Lake	Chemical Creek	Trout Lake	Moon Lake	Railroad Pond	North Pond
AIS	**Curly-leaf pondweed**											
	Eurasian water-milfoil											
Submergent	bushy pondweed		6		6	6				6	6	
	chara	7	7	7	7	7	7			7	7	7
	clasping-leaf pondweed					5						
	common bladderwort		7		7		7	7				
	common water starwort			8								
	common waterweed				3		3	3	3	3		3
	coontail						3	3	3			
	creeping bladderwort		9									
	Filamentous algae											
	flat-leaf bladderwort		9				9					9
	flat-stem pondweed		6		6		6		6	6	6	6
	floating-leaf pondweed	5		5	5	5	5	5	5	5	5	
	horned pondweed	7		7								
	Illinois pondweed									6		
	large-leaf pondweed						7			7		7
	northern water-milfoil		6	6	6		6	6	6	6	6	6
	pipewort									9		
	ribbon-leaf pondweed				8			8				
	sago pondweed				3		3	3	3	3		
	small pondweed				7	7	7				7	
	stiff water crowfoot	8				8	8	8	8			
	variable pondweed		7	7	7		7		7	7	7	
	various-leaved water-milfoil											7
	water bulrush									9		
	water marigold							8		8		
	water moss											
	water stargrass						6	6		6		
	white-stem pondweed						8			8		
	wild celery						6			6		
Emergent	3-way sedge				9							
	arrowhead sp.											
	Bur-reed sp.											
	cattail					1				1		1
	common bur-reed					5						
	creeping spikerush				6						6	
	hard-stem bulrush						6			6		
	narrow-leaved bur-reed		9									
	rigid arrowhead					8						
	soft-stem bulrush				4		4					
	sweet flag	7										
	water horsetail	7				7					7	7
Floating-leaf	spatterdock	6	6		6	6	6	6	6	6		6
	water smartweed											5
	watershield				6							
	white water lily		6		6	6	6	6		6		
Free-floating	Forked duckweed							6				
	Large duckweed						5	5	5			

Total species	7	11	6	17	12	21	14	10	20	9	11
Mean C	6.71	7.09	6.67	6.00	5.92	5.95	5.71	5.20	6.05	6.33	5.82
FQI	17.76	23.52	16.33	24.74	20.50	27.28	21.38	16.44	27.06	19.00	19.30

ATTACHMENT B

2011 Coleman Lake Eurasian Water Milfoil Infestation Map



7326-11002-0

2011 MACRAPHYTE SURVEY
Eurasian water milfoil (Approx. 76.45 Acres)
COLEMAN LAKE (Total Lake Volume 5,535 acre/feet)
MARINETTE COUNTY, WISCONSIN

Bonestroo
Engineering Planning Science