Please note that study methods and explanations of analyses for Lake Content can be found within the Town of St. Germain Town-wide Management Plan document.

8.3 Lake Content

An Introduction to Lake Content

Lake Content, Vilas County, is a 242-acre, eutrophic, shallow headwater drainage lake with a maximum depth of 14 feet and a mean depth of 7 feet (Lake Content – Map 1). The lake's watershed encompasses 672 acres and is mainly comprised of upland forests. Lake Content does not possess a tributary inlet but does possess a channelized outlet to Big Saint Germain Lake. This channel was apparently a manmade modification of an existing natural outlet which occurred in the 1950s. In 2019, 41 native aquatic plant species were located in the lake, of which fern-leaf pondweed (*Potamogeton robbinsii*) was the most common. One non-native plant, narrow-leaved cattail (*Typha angustifolia)*, was found during the 2019 surveys.

Lake at a Glance - Lake Content

Morphology	
LakeType	Shallow Headwater Drainage Lake
Surface Area (Acres)	242
Max Depth (feet)	14
Mean Depth (feet)	7.0
Perimeter (Miles)	3.1
Shoreline Complexity	2.0
Watershed Area (Acres)	672
Watershed to Lake Area Ratio	2:1
Water Quality	
Trophic State	Eutrophic
Limiting Nutrient	Phosphorus
Avg Summer P (μg/L)	35.5
Avg Summer Chl-α (μg/L)	13.7
Avg Summer Secchi Depth (ft)	7.4
Summer pH	7.9
Alkalinity (mg/L as $CaCO_3$)	32.8
Vegetation (2019)	
Number of Native Species	41
NHI-Listed Species	None
Exotic Species	Narrow-leaved cattail (*Typha angustifolia*)
Average Conservatism	6.7
Floristic Quality	37.3
Simpson's Diversity (1-D)	0.86

Descriptions of these parameters can be found within the town-wide portion of themanagement plan

8.3.1 Lake Content Water Quality

It is often difficult to determine the status of a lake's water quality purely through observation. Anecdotal accounts of a lake "getting better" or "getting worse" can be difficult to judge because a) a lake's water quality may fluctuate from year to year based upon environmental conditions such as precipitation, and b) differences in observation and perception of water quality can differ greatly from person to person. It is best to analyze the water quality of a lake through scientific data as this gives a concrete indication as to the health of the lake, and whether its health has deteriorated or improved. Further, by looking at data for similar lakes regionally and statewide, the status of a lake's water quality can be made by comparison.

Water quality data were collected from Lake Content on three occasions in 2019. Data were collected by Onterra staff and citizen lake volunteers. The lake was sampled for a variety of water quality parameters including total phosphorus, chlorophyll-*a*, Secchi disk depth, temperature, and dissolved oxygen. Please note that the data in these graphs represent concentrations and depths taken during the growing season (April-October) and summer months (June-August) 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 2019, any historical data was researched and are included within this report as available.

Near-surface total phosphorus data from Lake Content are limited, and are available from 2000-2004, 2010, and 2019 (Figure 8.3.1-1). Average summer total phosphorus concentrations ranged from 23.0 µg/L in 2004 to 48.3 µg/L in 2000. Please note that the 2004 value only represents one sampling event and may not accurately represent the summer mean that year. The weighted summer average total phosphorus concentration is 35.5 µg/L and falls into the *good* category for shallow headwater drainage lakes in Wisconsin. Lake Content's summer average total phosphorus concentrations are higher than the median values for shallow headwater drainage lakes in Wisconsin and all lake types within the Northern Lakes and Forests (NLF) ecoregion. While the data indicate annual phosphorus concentrations in Lake Content are variable, given the limited dataset, it cannot be determined if any trends in phosphorus concentration are occurring over time.

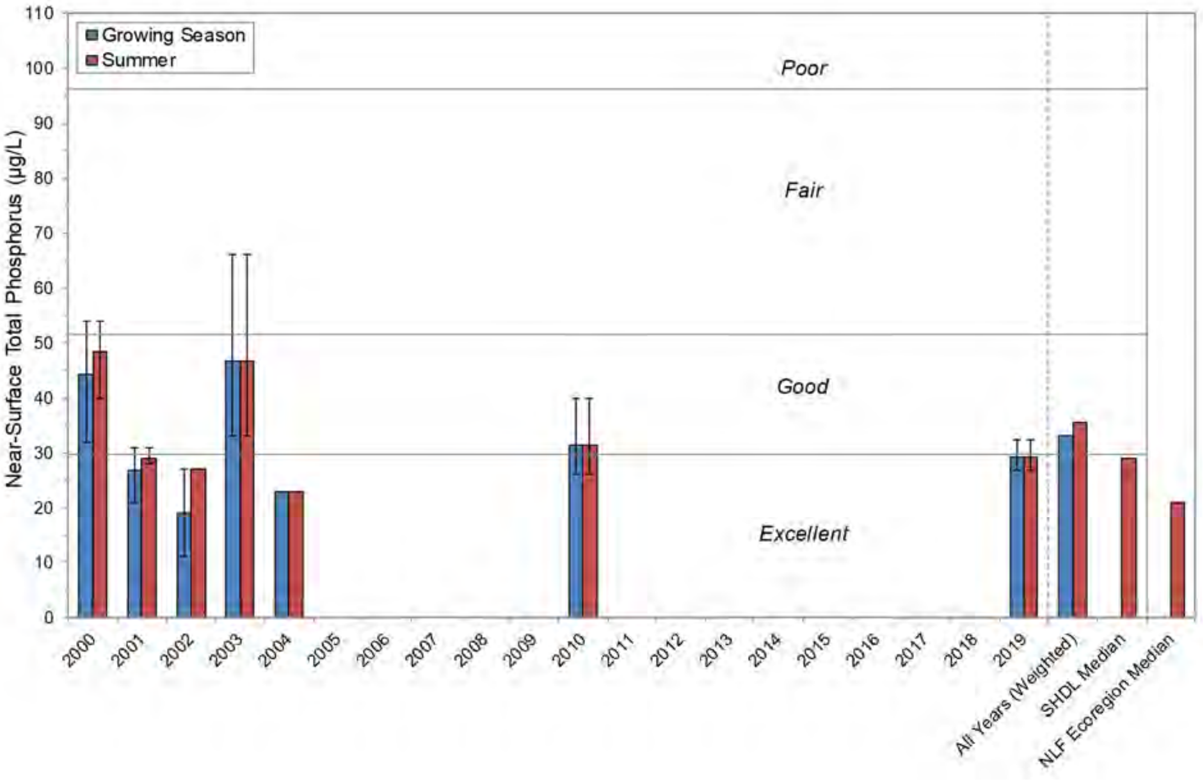


Figure 8.3.1-1. Lake Content average annual near-surface total phosphorus concentrations and median near-surface total phosphorus concentrations for state-wide shallow headwater drainage lakes (SHDL) and Northern Lakes and Forests (NLF) ecoregion lakes. Water Quality Index values adapted from WDNR PUB WT-913. Error bars represent maximum and minimum values.

As is discussed in the subsequent Lake Content Watershed Assessment Section (Section 8.3.2), measured phosphorus concentrations in Lake Content are approximately 40% higher than predicted by Wisconsin Lakes Modeling Suite (WiLMS) watershed modeling. This discrepancy between measured and predicted concentrations indicates that phosphorus is originating from a source(s) that was not accounted for in the model. It is believed that this additional phosphorus is likely originating from internal phosphorus loading within Lake Content as well as possible periodic inflow of a higher nutrient water from Big Saint Germain Lake.

Internal nutrient loading involves the release of phosphorus (and other nutrients) from lake bottom sediments into the overlying water. In general, lakes tend to act as phosphorus sinks, meaning they accumulate phosphorus over time within lake sediments. In most lakes, there is a net movement of phosphorus from the water to bottom sediments where it accumulates. The retention of this phosphorus within bottom sediments depends on a number of physical, chemical, and biological factors (Wetzel 2001). If this phosphorus remains bound within bottom sediments, it is largely unavailable for biological use. However, under certain conditions, this phosphorus can be released from bottom sediments into the overlying water where it may become biologically available.

While the internal loading of phosphorus in Big Saint Germain Lake is the result of thermal stratification and onset of anoxia in the hypolimnion, Lake Content is shallow and does not experience strong thermal stratification. (Frodge, Thomas and Pauley 1991) found that dense growth of aquatic plants can create anoxia at the sediment-water interface, creating conditions where phosphorus can be released from bottom sediments into the overlying water. The anoxic conditions are created because the density of aquatic plant growth inhibits water exchange and mixing. In July 2019, anoxic conditions were present near the bottom and near-bottom phosphorus concentrations in Lake Content were 61 µg/L, over twice the concentration at the surface. This indicates that internal nutrient loading likely occurs during the summer in Lake Content.

Examination of average phosphorus concentrations by month in Lake Content shows that concentrations tend to increase over the course of the summer, an indication that phosphorus is being mobilized from bottom waters to the surface. Rather than being mobilized through entrainment like on Big Saint Germain Lake, sediment-released phosphorus in Lake Content is likely mobilized through passive diffusion given that water temperature and density is similar throughout the water column. Near-surface phosphorus concentrations in Lake Content decline in the fall, in contrast to stratified lakes which tend to see increases in fall phosphorus concentrations as sediment-released phosphorus is mixed throughout the water column during fall turnover. In Lake Content, the natural die-back of plants in fall likely allows for mixing and reoxygenation of bottom waters, reducing internal nutrient loading. Calculation in the change of mass of phosphorus between May and August in Lake Content indicates that on average approximately 90 pounds of phosphorus are loaded to the lake from internal nutrient loading during the summer.

While the internal loading of phosphorus elevates surface concentrations in Lake Content during the summer, this is a natural process given the dense aquatic plant growth. Presently, internal loading does not elevate phosphorus concentrations to levels (40 µg/L) that would place Lake Content on the list of impaired waterbodies. However, water quality monitoring should continue to determine if phosphorus concentrations increase over time.

Chlorophyll-*a* data from Lake Content are available from 2000-2004, 2010, and 2019 (Figure 8.3.1-2). Average summer chlorophyll-*a* concentrations ranged from 5.8 µg/L in 2002 to 23.3 µg/L in 2000. Lake Content's summer average chlorophyll-*a* concentration is 13.7 µg/L and falls in the *good* category for shallow headwater drainage lakes in Wisconsin. Lake Content's average summer chlorophyll-*a* concentration is approximately two times higher than the median concentration for Wisconsin's shallow headwater drainage lakes and all lake types within the NLF ecoregion. As discussed previously, Lake Content's phosphorus concentrations are higher than predicted likely due to internal nutrient loading, and these higher nutrient concentrations fuel higher levels of algal growth. Chlorophyll-*a* concentrations in Lake Content periodically exceed 20 µg/L, the level at which nuisance algal blooms often occur.

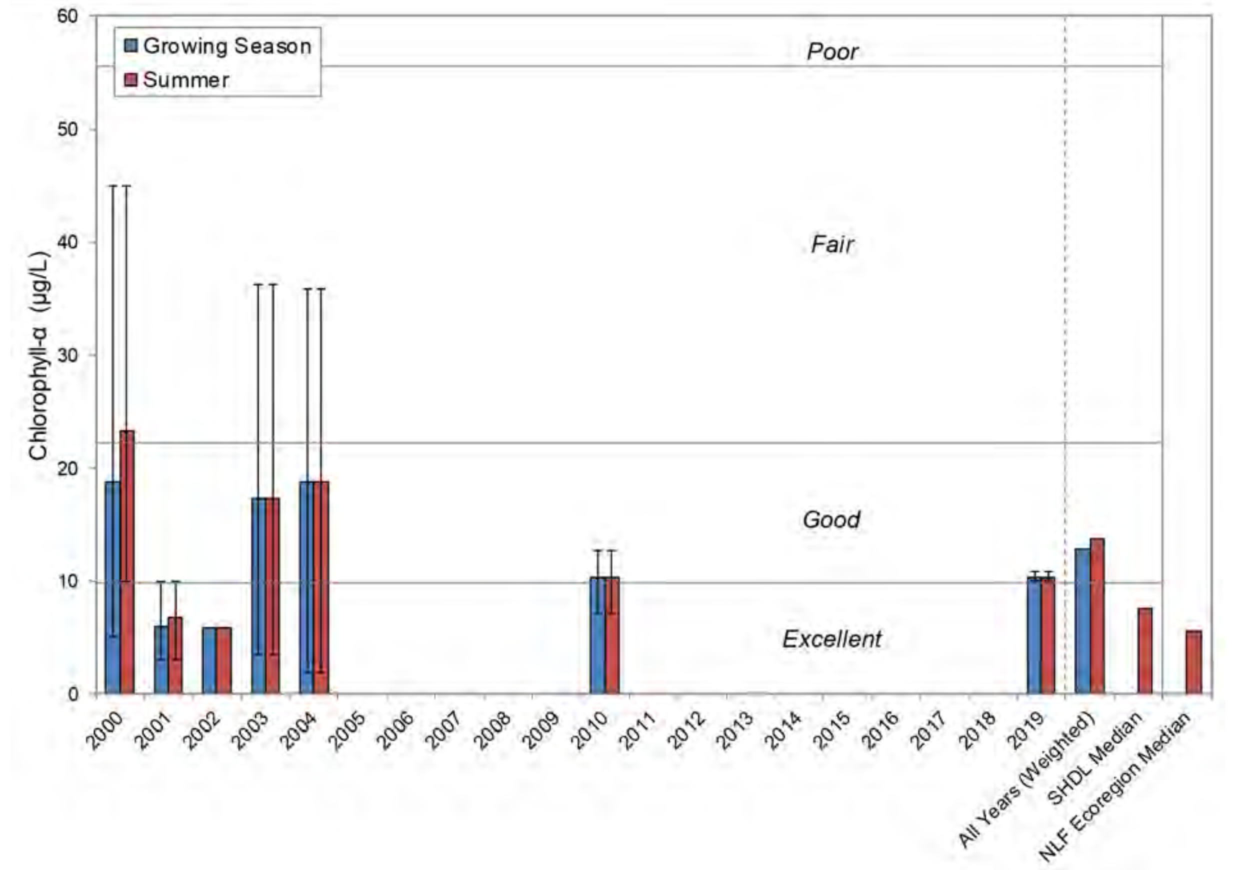


Figure 8.3.1-2. Lake Content average annual chlorophyll-α concentrations and median chlorophyll-α concentrations for state-wide shallow headwater drainage lakes (SHDL) and Northern Lakes and Forests (NLF) ecoregion lakes. Water Quality Index values adapted from WDNR PUB WT-913. Error bars represent maximum and minimum values.

Secchi disk depth data are available from Lake Content from 1995-2003, 2010, and 2019 (Figure 8.3.1-3). Average summer Secchi disk depths ranged from 4.6 feet in 2000 to 13.0 feet in 2002, corresponding with the same years which had the lowest and highest concentrations of total phosphorus and chlorophyll-*a*, respectively. The weighted summer average Secchi disk depth is 7.4 feet and falls into the *excellent* category for shallow headwater drainage lakes in Wisconsin. Lake Content's summer average Secchi disk depth is nearly 2.0 feet higher than the median depth for Wisconsin's shallow headwater drainage lakes and approximately 1.5 feet lower than the median depth for all lake types within the NLF ecoregion. Like what was observed in Big Saint Germain Lake, water clarity in Lake Content is higher than expected based on the measured concentrations of chlorophyll-*a*. It is not clear why this is occurring, but it may indicate that Lake Content's algal community is dominated by large particulates, such as *Aphanizomenon* and/or

Gloeotrichia. While annual water clarity is variable in Lake Content, there are no discernable trends over time within the available dataset.

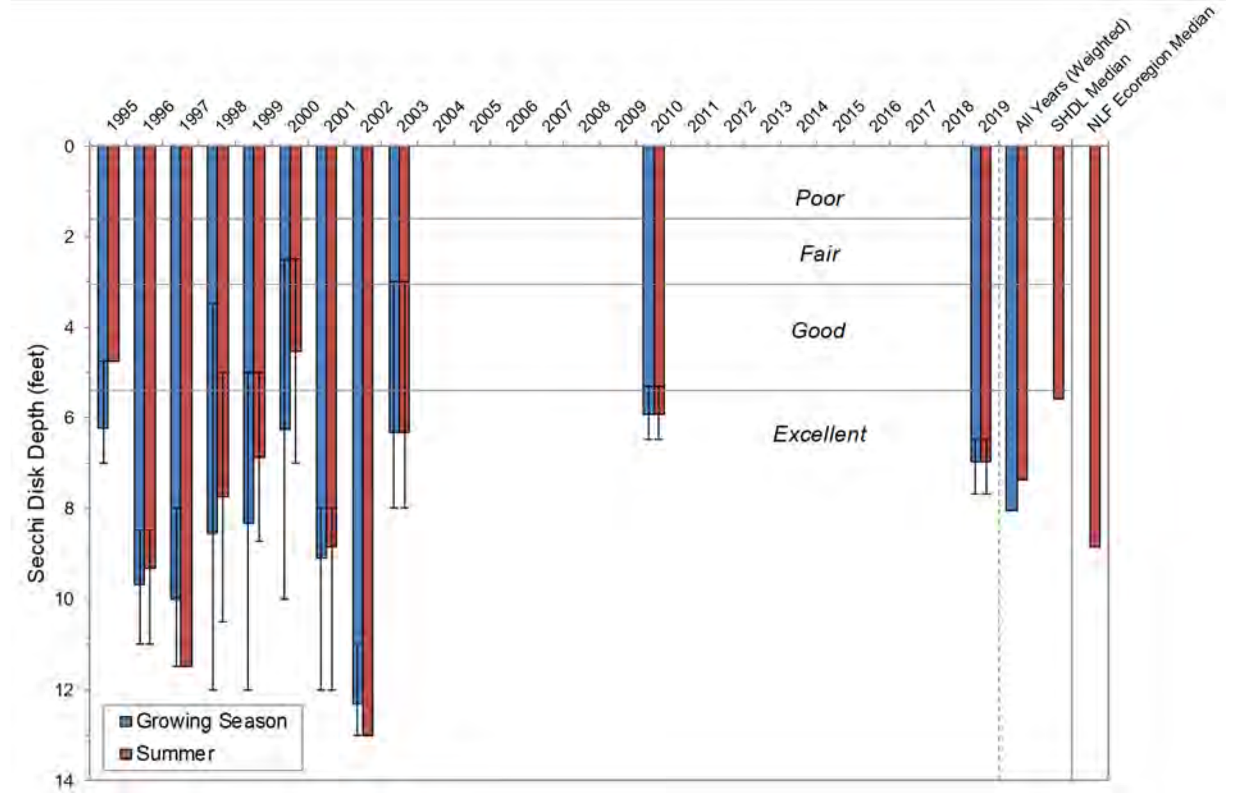


Figure 8.3.1-3. Lake Content average annual Secchi disk depth and median Secchi disk depths for state-wide shallow headwater drainage lakes (SHDL) and Northern Lakes and Forests (NLF) ecoregion lakes. Water Quality Index values adapted from WDNR PUB WT-913. Error bars represent maximum and minimum values.

A measure of water clarity once all of the suspended material (i.e., phytoplankton and sediments) have been removed, is termed *true color*, and measures how the clarity of the water is influenced by dissolved components. True color was measured in Lake Content in 2019 at 5 SU (standard units), indicating the lake's water is clear and contains low concentrations of these dissolved organic compounds. This indicates that Lake Content's water clarity is primarily influenced by free-floating algae.

Limiting Plant Nutrient of Lake Content

Using midsummer nitrogen and phosphorus concentrations from Lake Content, a nitrogen:phosphorus ratio of 21:1 was calculated. This finding indicates that Lake Content is indeed phosphorus limited as are the vast majority of Wisconsin lakes. In general, this means that phosphorus is the primary nutrient regulating algal production.

Lake Content Trophic State

Figure 8.3.1-4 contains the Trophic State Index (TSI) values for Lake Content. These TSI values are calculated using summer near-surface total phosphorus, chlorophyll-*a*, and Secchi disk depth data collected as part of this project along with available historical data. In general, the best values to use in assessing a lake's trophic state are chlorophyll-*a* and total phosphorus, as water clarity can be influenced by other factors other than phytoplankton such as dissolved organic compounds. The closer the calculated TSI values are for these three parameters are to one another indicates a higher degree of correlation.

The weighted TSI values for total phosphorus and chlorophyll-*a* in Lake Content indicate the lake is at present in a eutrophic state. Based upon just the Secchi disk depth, the lake would be classified as meso-eutrophic. As mentioned above, the water clarity in this lake is higher than would be expected given the phosphorus and chlorophyll-*a* concentrations. Phosphorus and chlorophyll-*a* are the best parameters to measure a lake's trophic status as these are the parameters used by the DNR to determine if a lake is impaired. Lake Content's productivity based upon phosphorus and chlorophyll-*a* is higher than other shallow headwater drainage lakes in Wisconsin and all lake types within the NLF ecoregion.

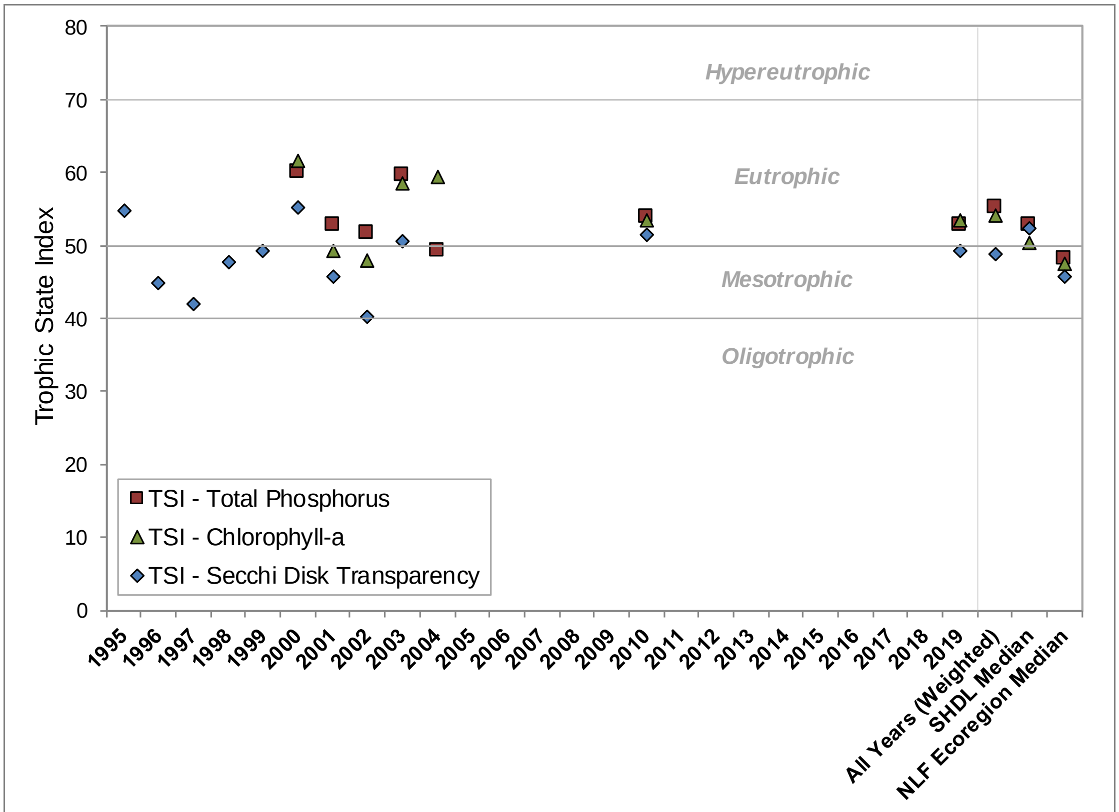


Figure 8.3.1-4. Lake Content, statewide shallow headwater drainage lakes, and regional Trophic State Index values. Values calculated with summer month surface sample data using WDNR PUB-WT-193.

Dissolved Oxygen and Temperature in Lake Content

Dissolved oxygen and temperature were measured in Lake Content on four occasions by Onterra staff in 2019. Profiles depicting these data are displayed in Figure 8.3.1-5. Lake Content is *polymictic*, meaning the lake does not develop strong thermal stratification during the summer, and maintains relatively uniform temperature and dissolved oxygen concentrations throughout the water column. The temperature and dissolved oxygen profiles collected in 2019 show that water temperature is relatively uniform from the surface to the deepest point in Lake Content. However, dissolved oxygen declines rapidly immediately near the bottom. As discussed earlier, this small area of anoxia directly above the bottom is believed to be due to the dense growth of aquatic plants which inhibit water exchange in this area.

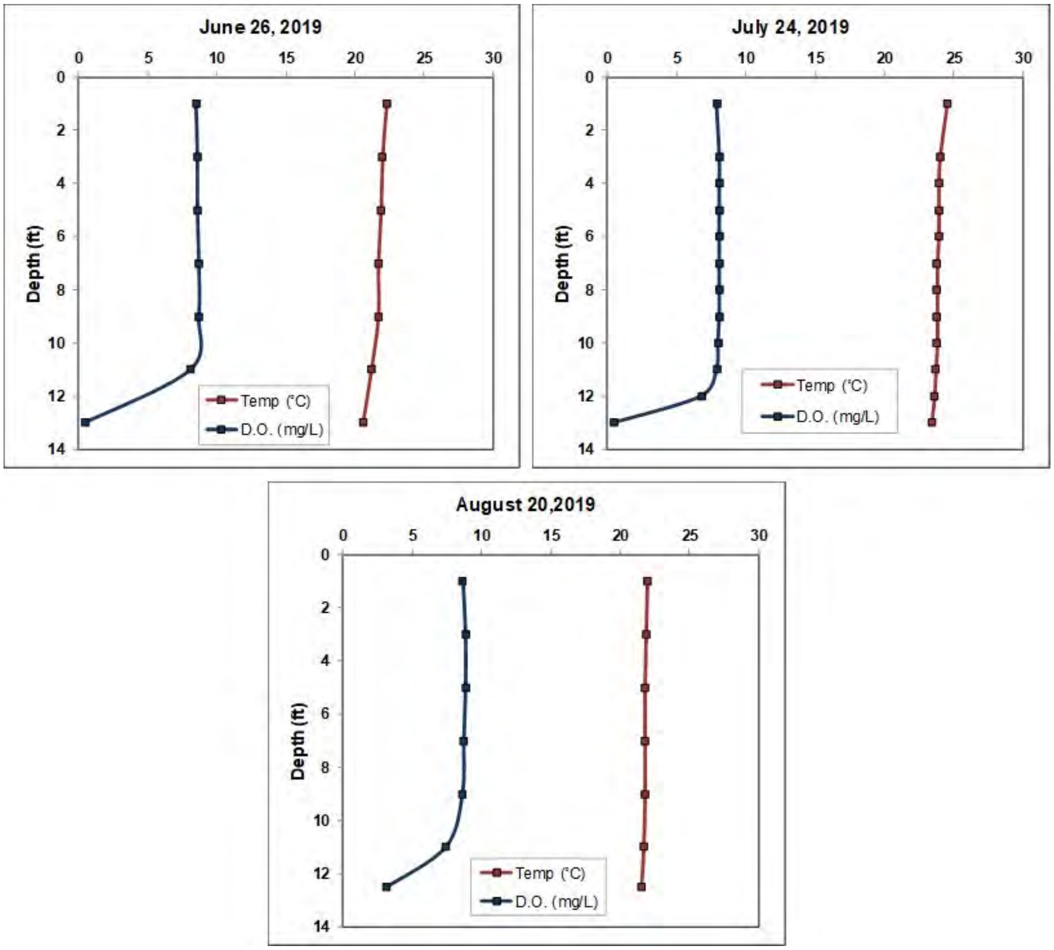


Figure 8.3.1-5. Lake Content 2019 dissolved oxygen and temperature profiles.

Additional Water Quality Data Collected at Lake Content

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 Lake Content'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.

The pH scale ranges from 0 to 14 and indicates the concentration of hydrogen ions (H^+) within the lake's water and is an index of the lake's acidity. Water with a pH value of 7 has equal amounts of hydrogen ions and hydroxide ions (OH^-) and is considered to be neutral. Water with a pH of less than 7 has higher concentrations of hydrogen ions and is considered to be acidic, while values greater than 7 have lower hydrogen ion concentrations and are considered basic or alkaline. The pH scale is logarithmic; meaning that for every 1.0 pH unit the hydrogen ion concentration changes tenfold. The normal range for lake water pH in Wisconsin is about 5.2 to 8.3, though values lower than 5.2 can be observed in some acid bog lakes and higher than 8.3 in some marl lakes. In lakes with a pH of 6.5 and lower, the spawning of certain fish species such as walleye becomes inhibited (Shaw and Nimphius 1985). The mid-summer pH of the water in Lake Content was found to be slightly alkaline with a value of 7.9 and falls within the normal range for Wisconsin Lakes.

Alkalinity is a lake's capacity to resist fluctuations in pH by neutralizing or buffering against inputs such as acid rain. The main compounds that contribute to a lake's alkalinity in Wisconsin are bicarbonate (HCO_3^-) and carbonate (CO_3^-), which neutralize hydrogen ions from acidic inputs. These compounds are present in a lake if the groundwater entering it comes into contact with minerals such as calcite ($CaCO_3$) and/or dolomite ($CaMgCO_3$). A lake's pH is primarily determined by the amount of alkalinity. Rainwater in northern Wisconsin is slightly acidic naturally due to dissolved carbon dioxide from the atmosphere with a pH of around 5.0. Consequently, lakes with low alkalinity have lower pH due to their inability to buffer against acid inputs. The alkalinity in Lake Content was 32.8 mg/L (mg/L as $CaCO_3$), indicating that the lake is not sensitive to lower pH values from acid rain.

Like associated pH and alkalinity, the concentration of calcium within a lake's water depends on the geology of the lake's watershed. Recently, the combination of calcium concentration and pH has been used to determine what lakes can support zebra mussel populations if they are introduced. The commonly accepted pH range for zebra mussels is 7.0 to 9.0, so Lake Content's pH of 7.9 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 Lake Content was found to be 11.6 mg/L, meaning it is unlikely to support the growth of zebra mussels.

8.3.2 Lake Content Watershed Assessment

Two aspects of a lake's watershed are the key factors in determining the amount of phosphorus the watershed exports to the lake: 1) the land cover (land use) within the watershed and 2) the size of the watershed. The type of land cover and the amount of that land cover that exists in the watershed is largely going to determine the amount of phosphorus (and sediment) that runs off the land and eventually makes its way to the lake. The actual amount of pollutants (nutrients, sediment, toxins, etc.) depends greatly on how the land within the watershed is used. Areas within a lake's watershed that are naturally vegetated (e.g., forests, grasslands, and wetlands) strongly influence the way water behaves on the land surface after it falls as precipitation or is released by the melting of snow (Silk and Ciruna 2005).

Runoff is slowed down in areas with denser vegetation and increases the time it takes for precipitation from a storm event to reach the lake. This allows more water to soak into the soil and reduces the potential for flooding. Intact wetlands within a lake's watershed have been likened to the "kidneys of the landscape" as they filter out nutrients, sediments, and other pollutants from water which passes through them (Silk and Ciruna 2005). The water quality within a lake is largely a reflection of the health of its watershed, and maintaining natural land cover within a lake's watershed is essential for maintaining good water quality.

Among the largest threats to a lake's water quality is the conversion of natural areas to agriculture and urban development. Conversion of natural areas to agriculture disrupts the hydrologic regime and increases surface runoff due to increased soil compaction and reduced water infiltration. Wetlands which were drained and converted to farmland were shown to increase runoff by 200-400% (Silk and Ciruna 2005). Agriculture accounts for 60% of the pollutants in lakes and rivers in the United States due to increased runoff in combination with the application of fertilizers, pesticides, and manure.

Similar to agriculture, urban development can significantly alter the hydrologic regime within a watershed, primarily through the installation of impervious surfaces (e.g., roads, driveways, roof-tops) which decrease water infiltration and increase runoff. As impervious surface cover increases, the time it takes water from a storm event to reach the lake decreases. With the increase in water velocity and volume entering the water body, nutrient and sediment input also increase, degrading water quality. Nutrient input can also increase from urban areas as the result of fertilizer application, wastewater treatment facilities, and other industrial activities.

As is discussed further in this section, Lake Content's watershed is largely comprised of intact upland forests and wetlands with some smaller areas of rural and urban development. In the forested watersheds of northern Wisconsin where soils and climate are not as conducive for farming, apart from shoreland development (discussed in the next section) forestry or timber harvest likely represents the largest man-made disturbance occurring in these watersheds. While timber harvest has the potential to increase sediment erosion through the removal of vegetation and construction of access roads and bridges, the impacts of timber harvest to a lake's water quality are going to be highly dependent upon harvest rates and methods, vegetation management, and the location and size of these activities within the watershed (Silk and Ciruna 2005).

Wisconsin is required by federal law to develop and implement a program of best management practices (BMPs) to reduce nonpoint source pollution, including from timber harvesting activities

(WDNR PUB FR-093 2010). In summary, any forestry activities that occur within Lake Content's watershed must be implemented under this framework and should not impart significant impacts to the lake's water quality.

In addition to land cover within the watershed, the size of the watershed relative to the water volume within the lake also influences water quality. The watershed to lake area ratio (WS:LA) defines how many acres of watershed drain to each surface-acre of the lake. Larger ratios result in the watershed having a greater role in the lake's annual water budget and phosphorus load. In systems with lower WS:LA ratios, land cover type plays a very important role in how much phosphorus is loaded to the lake from the watershed. In these systems, the occurrence of agriculture or urban development in even a small percentage of the watershed (less than 10%) can unnaturally elevate phosphorus inputs to the lake. If these land cover types are converted to a cover that does not export as much phosphorus, such as converting row crop areas to grasslands or forested areas, the phosphorus load and its impacts to the lake may be decreased. In fact, if the phosphorus load is reduced greatly, changes in lake water quality may be noticeable, (e.g., reduced algal abundance and better water clarity) and may even be enough to cause a shift in the lake's trophic state.

In systems with high WS:LA ratios, like those 10-15:1 or higher, the impact of land cover may be tempered by the sheer amount of land draining to the lake. Situations actually occur where lakes with completely forested watersheds have sufficient phosphorus loads to support high rates of primary production. In other systems with high ratios, the conversion of vast areas of row crops to vegetated areas (grasslands, meadows, forests, etc.) may not reduce phosphorus loads sufficiently to see measurable changes in primary production. Both of these situations occur frequently in impoundments.

Regardless of the size of the watershed or the makeup of its land cover, it must be remembered that every lake is different and other factors, such as flushing rate, lake volume, sediment type, and many others, also influence how the lake will react to what is flowing into it. For instance, a deeper lake with a greater volume can dilute more phosphorus within its waters than a less voluminous lake and as a result, the production of a lake is kept low. However, in that same lake, because of its low flushing rate (a residence time of years), there may be a buildup of phosphorus in the sediments that may reach sufficient levels over time and lead to a problem such as internal nutrient loading. On the contrary, a lake with a higher flushing rate (low residence time of days or weeks) may be more productive early on, but the constant flushing of its waters may prevent a buildup of phosphorus and internal nutrient loading may never reach significant levels.

Watershed Modeling

A reliable and cost-efficient method of creating a general picture of a watershed's effect on a lake can be obtained through modeling. The WDNR created a useful suite of modeling tools called the Wisconsin Lake Modeling Suite (WiLMS). Certain morphological attributes of a lake and its watershed are entered into WiLMS along with the acreages of different types of land cover within the watershed to produce useful information about the lake ecosystem. This information includes an estimate of annual phosphorus load and the partitioning of those loads between the watershed's different land cover types and atmospheric fallout entering through the lake's water surface.

A lake's **flushing rate** is simply a determination of the time required for the lake's water volume to be completely exchanged. **Residence time** describes how long a volume of water remains in the lake and is expressed in days, months, or years. The parameters are related and both determined by the volume of the lake and the amount of water entering the lake from its watershed. Greater flushing rates equal shorter residence times.

WiLMS also calculates the lake's flushing rate and residence times using county-specific average precipitation/evaporation values or values entered by the user. Predictive models are also included within WiLMS that are valuable in validating modeled phosphorus loads to the lake in question and modeling alternate land cover scenarios within the watershed. Finally, if specific information is available, WiLMS will also estimate the significance of internal nutrient loading within a lake and the impact of shoreland septic systems.

Lake Content Watershed Assessment

Lake Content's watershed encompasses approximately 672 acres, yielding a watershed to lake area ratio of 2:1 (Figure 8.3.2-1 and Lake Content – Map 2). In other words, approximately 2.0 acres of land drain to every one acre of Lake Content's surface area. WiLMS modeling estimates that Lake Content's water residence time is approximately 0.34 years, meaning the water within the lake is completely replaced (flushing rate) on average once nearly every three years. However, given the presence of a naturally-existing outlet to Big Saint Germain Lake and no tributary inlets indicates that Lake Content receives significant groundwater input. WiLMS does not account for groundwater input, and Lake Content's flushing rate is likely higher.

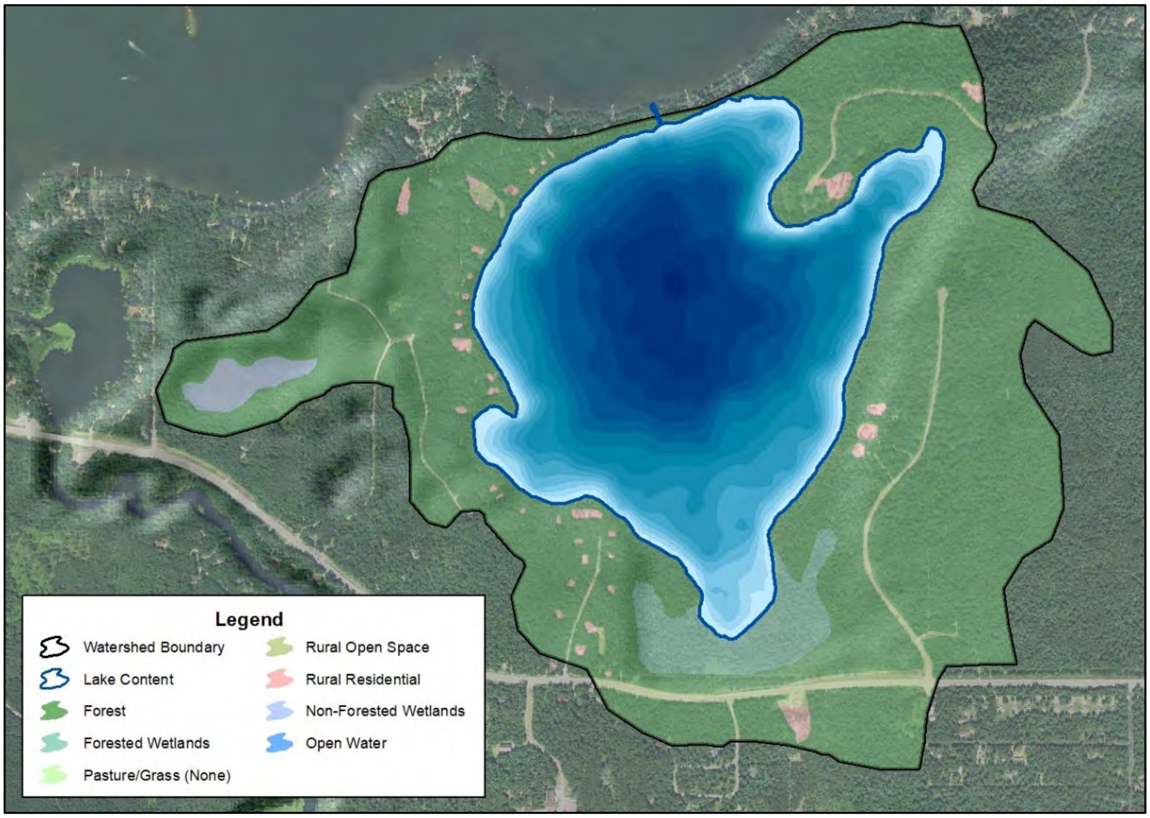


Figure 8.3.2-1. Lake Content watershed boundaries and land cover types.

Approximately 56% (375 acres) of Lake Content's watershed is comprised of upland forests, 36% (242 acres) is comprised of the lake's surface, 5% (32 acres) is comprised of wetlands, 2% (15 acres) is comprised of rural open space, and 1% (7 acres) is comprised of rural residential areas (Figure 8.3.2-2).

Using the land cover types and their acreages within Lake Content's watershed, WiLMS was utilized to estimate the annual potential phosphorus load delivered to the lake. In addition, data obtained from a stakeholder survey sent to Lake Content riparian property owners in 2019 was also used to estimate the potential phosphorus loading to the lake from riparian septic systems. The model estimated that approximately 80 pounds of phosphorus are loaded to Lake Content from its watershed on an annual basis (Figure 8.3.2-2).

Of the estimated 80 pounds of phosphorus that are loaded to Lake Content annually, approximately 38 pounds originate from direct atmospheric deposition onto the lake's surface, 31 pounds from upland forests, 4 pounds from rural open space, 3 pounds from developed shoreland properties, 2 pounds from wetlands, and 2 pounds from riparian septic systems (Figure 8.3.2-2).

Using the estimated annual potential phosphorus load of 80 pounds, WiLMS predicted an in-lake growing season average total phosphorus concentration of 22 µg/L, which is approximately 44% lower than the measured growing season mean concentration of 33 µg/L. This is an indication that there is a source of phosphorus being delivered to Lake Content that was not accounted for in the model. As discussed in the previous Lake Content Water Quality Section (Section 8.3.1), this additional phosphorus is believed to be from the internal loading of phosphorus from bottom sediments. WiLMS estimated that an additional 70 pounds, or a total of 150 pounds of phosphorus needs to be loaded to Lake Content on annual basis to achieve the measured growing season concentration of 33 µg/L. The WiLMS estimate of internal loading is similar to the estimate calculated using changes between spring and late-summer phosphorus concentrations of 90 lbs.

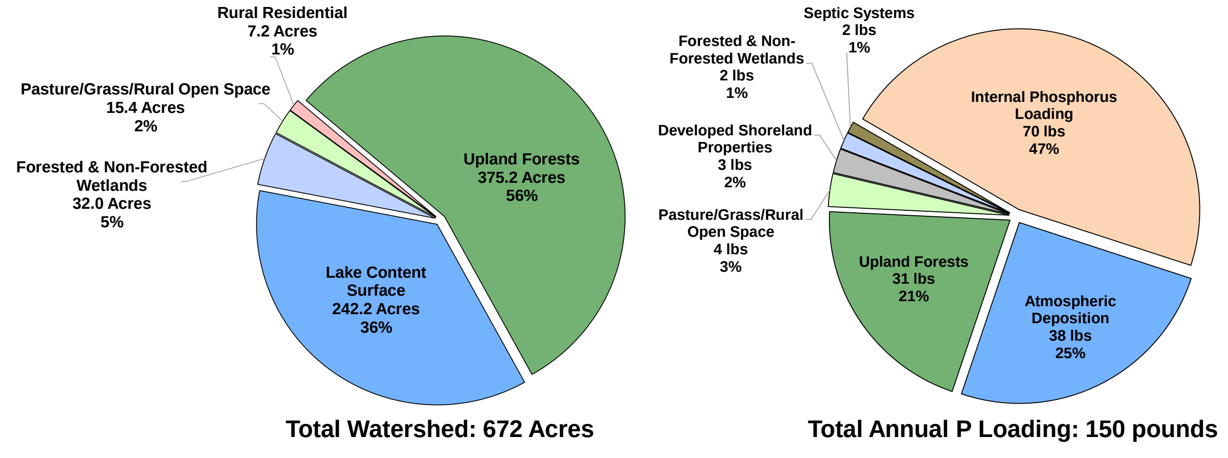


Figure 8.3.2-2. Lake Content watershed land cover types (left) and estimated annual watershed phosphorus loading (right). Based upon National Land Cover Database (NLCD) (Fry et al. 2011).

8.3.3 Lake Content Shoreland Condition

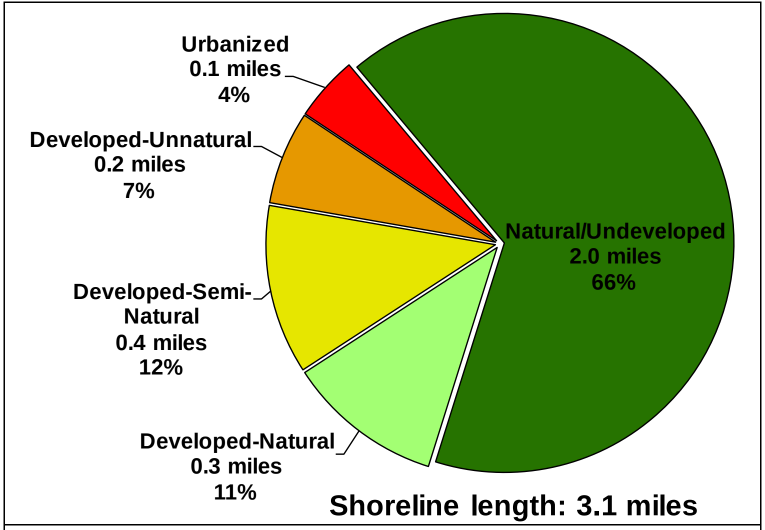


Figure 8.3.3-1. Lake Content shoreland categories and total lengths. Based upon a fall 2019 survey. Locations of these categorized shorelands can be found on Lake Content Map – 3.

As mentioned previously in the Town-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 fall of 2019, Lake Content's immediate shoreline was assessed in terms of its level of development.

Lake Content has stretches of shoreland that fit all of the five shoreland assessment categories (Figure 8.3.3-1). Approximately 77% (2.3 miles) of the lake's shoreline contains little to no development, categorized as natural/undeveloped or developed-natural. 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, 11% (0.3 miles) of shoreline with a higher degree of development was observed, categorized as either urbanized or developed-unnatural. If restoration of the Lake Content 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.

Coarse Woody Habitat

As part of the shoreland condition assessment, Lake Content was also surveyed to determine the extent of its coarse woody habitat. Coarse woody habitat was identified, and classified in three size categories (cluster of pieces, 2-8 inches in diameter, and 8+ inches in diameter) as well as four branching categories: no branches, minimal branches, moderate branches, and full canopy. Pictures descriptions of these categories can be found in the Town-Wide Section 3.4. As discussed earlier, 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 (Newbrey et al. 2005).

During this survey, 35 total pieces of coarse woody habitat were observed along 3.1 miles of shoreline (Lake Content Map – 4), which yields a coarse woody habitat to shoreline mile ratio of 11:1 (Figure 8.3.3-2). Only instances where emergent coarse woody habitat extended from shore into the water were recorded during the survey. Seventeen pieces of 2-8 inches in diameter pieces of coarse woody habitat were found, 18 pieces of 8+ inches in diameter pieces of coarse woody habitat were found, and zero instances of clusters of coarse woody habitat were found.

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). Please note the methodologies between the surveys done on Lake Content and those cited in this literature comparison are much different, but still provide a valuable insight into what undisturbed shorelines may have in terms of coarse woody habitat. Onterra has completed coarse woody habitat surveys on 111 lakes throughout Wisconsin since 2012, with the majority occurring in the NLF ecoregion on lakes with public access. The number of coarse woody habitat pieces per shoreline mile in Lake Content falls in the 13th percentile of these 111 lakes.

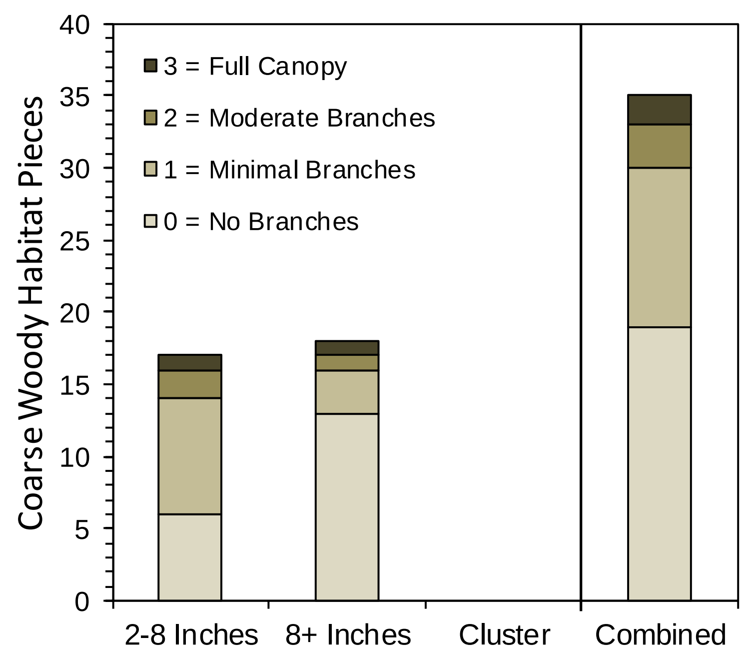


Figure 8.3.3-2. Lake Content coarse woody habitat survey results. Based upon a Fall of 2019 survey. Locations of the Lake Content coarse woody habitat can be found on Lake Content – Map 4.

8.3.4 Lake Content Aquatic Vegetation

An Early-Season Aquatic Invasive Species (ESAIS) Survey was conducted by Onterra ecologists on Lake Content on June 24, 2019. While the intent of this survey is to locate any potential non-native species within the lake, the primary focus is to locate occurrences of the non-native curly-leaf pondweed, which should be at or near its peak growth at this time. No curly-leaf pondweed was located during this survey; however, the non-native narrow-leaved cattail was located later in the summer during the emergent and floating-leaf aquatic plant community mapping survey.

The whole-lake aquatic plant point-intercept survey was conducted on Lake Content by Onterra ecologists on August 1, 2019 and the emergent and floating-leaf aquatic plant community mapping survey was conducted on August 15, 2019. During these surveys, a total of 42 native aquatic plant species were located (Table 8.3.4-1). Onterra also completed a whole-lake point-intercept survey on Lake Content in 2010, and the species located during that survey are also included in Table 8.3.4-1.

Lakes in Wisconsin vary in their morphometry, water chemistry, water clarity, substrate composition, management, and recreational use, all factors which influence aquatic plant community composition. Like terrestrial plants, different aquatic plant species are adapted to grow in certain substrate types; some species are only found growing in soft substrates, others only in sandy/rocky areas, and some can be found growing in either. The combination of both soft sediments and areas of harder substrates creates different habitat types for aquatic plants, and generally leads to a higher number of aquatic plant species within the lake.

During the 2019 point-intercept survey, information regarding substrate type was collected at locations sampled with a pole-mounted rake (less than 15 feet). Given the maximum depth of Lake Content is 14 feet, all of the locations were able to be sampled. These data indicate that 90% of the point-intercept locations contained soft organic sediments, 9% contained sand, and 1% contained rock (Figure 8.3.4-1). As is discussed in the Lake Content Water Quality Section (8.3.1), the lake is a eutrophic system with good water clarity. The combination of higher nutrients, clear water, and organic substrates creates ideal conditions for abundant aquatic plant growth.

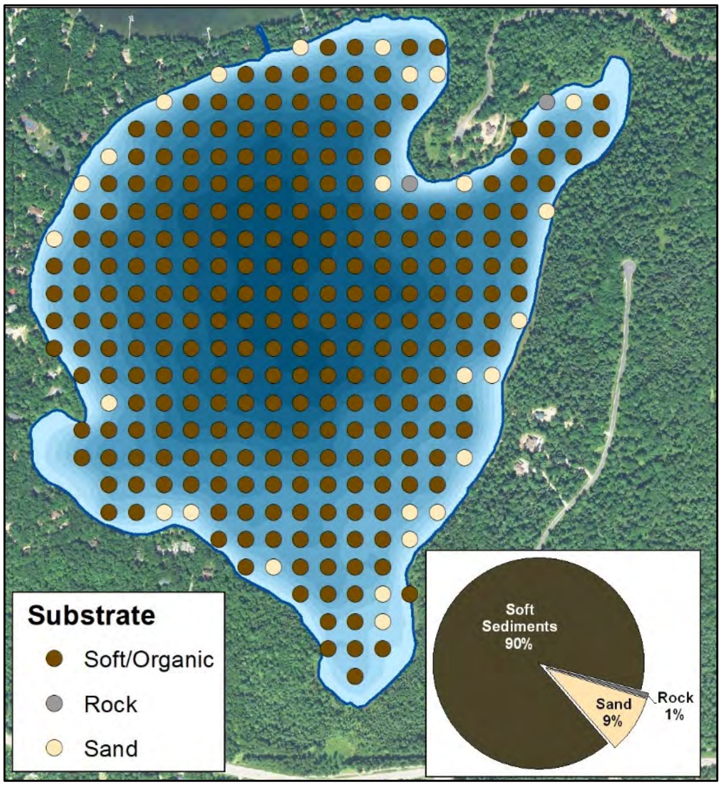


Figure 8.3.4-1. Lake Content substrate types as determined from the 2019 point-intercept survey.

Table 8.3.4-1. Aquatic plant species located in Lake Content during 2010 and 2019 aquatic plant surveys.

Growth Form	Scientific Name	Common Name	Status in Wisconsin	Coefficient of Conservatism	2010	2019
Emergent	*Calla palustris*	Water arum	Native	9	I	I
	Carex comosa	Bristly sedge	Native	5	I	I
	Carex utriculata	Common yellow lake sedge	Native	7		X
	Dulichium arundinaceum	Three-way sedge	Native	9		I
	Eleocharis palustris	Creeping spikerush	Native	6	I	I
	Pontederia cordata	Pickerelweed	Native	9	I	X
	Sagittaria latifolia	Common arrowhead	Native	3	I	
	Sagittaria rigida	Stiff arrowhead	Native	8		I
	Schoenoplectus acutus	Hardstem bulrush	Native	5	I	I
	Scirpus cyperinus	Wool grass	Native	4		I
	Sparganium americanum	American bur-reed	Native	8		I
	Sparganium eurycarpum	Common bur-reed	Native	5	X	X
	Typha angustifolia	Narrow-leaved cattail	Non-Native - Invasive	N/A		I
	Typha latifolia	Broad-leaved cattail	Native	1	I	I
FL	*Brasenia schreberi*	Watershield	Native	7	X	X
	Nuphar variegata	Spatterdock	Native	6	X	X
	Nymphaea odorata	White water lily	Native	6	X	X
	Sparganium angustifolium	Narrow-leaf bur-reed	Native	9	X	I
Submergent	*Ceratophyllum demersum*	Coontail	Native	3	X	X
	Chara spp.	Muskgrasses	Native	7	X	X
	Elatine minima	Waterwort	Native	9	X	I
	Elodea canadensis	Common waterweed	Native	3	X	X
	Eriocaulon aquaticum	Pipewort	Native	9	I	X
	Heteranthera dubia	Water stargrass	Native	6	X	X
	Isoetes spp.	Quillwort spp.	Native	8	X	X
	Lobelia dortmanna	Water lobelia	Native	10	X	X
	Myriophyllum sibiricum	Northern watermilfoil	Native	7	X	X
	Myriophyllum tenellum	Dwarf watermilfoil	Native	10	X	X
	Najas flexilis	Slender naiad	Native	6	X	X
	Nitella spp.	Stoneworts	Native	7	X	
	Potamogeton amplifolius	Large-leaf pondweed	Native	7	X	X
	Potamogeton amplifolius x *P. praelongus*	Large-leaf x White-stem pondweed hybrid	Native	N/A	X	
	Potamogeton friesii	Fries' pondweed	Native	8	X	
	Potamogeton gramineus	Variable-leaf pondweed	Native	7		X
	Potamogeton illinoensis	Illinois pondweed	Native	6	X	
	Potamogeton praelongus	White-stem pondweed	Native	8	X	X
	Potamogeton pusillus	Small pondweed	Native	7	X	X
	Potamogeton richardsonii	Clasping-leaf pondweed	Native	5	X	X
	Potamogeton robbinsii	Fern-leaf pondweed	Native	8	X	X
	Potamogeton zosteriformis	Flat-stem pondweed	Native	6	X	X
	Ranunculus aquatilis	White water crowfoot	Native	8	X	
	Vallisneria americana	Wild celery	Native	6	X	X
SE	*Eleocharis acicularis*	Needle spikerush	Native	5	X	X
	Juncus pelocarpus	Brown-fruited rush	Native	8	X	X
	Sagittaria cristata	Crested arrowhead	Native	9	X	X
	Sagittaria graminea	Grass-leaved arrowhead	Native	9	X	
FF	*Lemna minor*	Lesser duckweed	Native	5		X
	Lemna trisulca	Forked duckweed	Native	6	X	X
	Lemna turionifera	Turion duckweed	Native	2	X	
	Spirodela polyrhiza	Greater duckweed	Native	5		X

X = Located on rake during point-intercept survey; I = Incidentally located; not located on rake during point-intercept survey
FL = Floating-leaf; SE = Submergent and/or Emergent; FF = Free-floating

The maximum depth of plant growth is largely going to be determined by water clarity. In general, aquatic plants grow to a depth of two to three times the average Secchi disk depth. Lake Content's mean Secchi disk depth in 2019 was 7.0 feet, and aquatic plants were recorded growing to the maximum depth of the lake at 14 feet. Lake Content's high water clarity allows for sufficient light availability at the maximum depths to support aquatic plant growth lake-wide. Given Lake Content's shallower depth, the entire lake is comprised of littoral area.

The littoral frequency of occurrence of vegetation in Lake Content declined slightly from an occurrence of 99% in 2010 to an occurrence of 92% in 2019, representing a statistically valid reduction of 7% (Figure 8.3.4-2). Total rake fullness (TRF) ratings recorded in 2010 and 2019 indicated overall biomass of aquatic plants in Lake Content is high. The TRF ratings indicate that the biomass of plants in 2019 was lower when compared to 2010, with 67% of sampling locations in 2010 having TRF ratings of 2 or 3 compared to 53% in 2019.

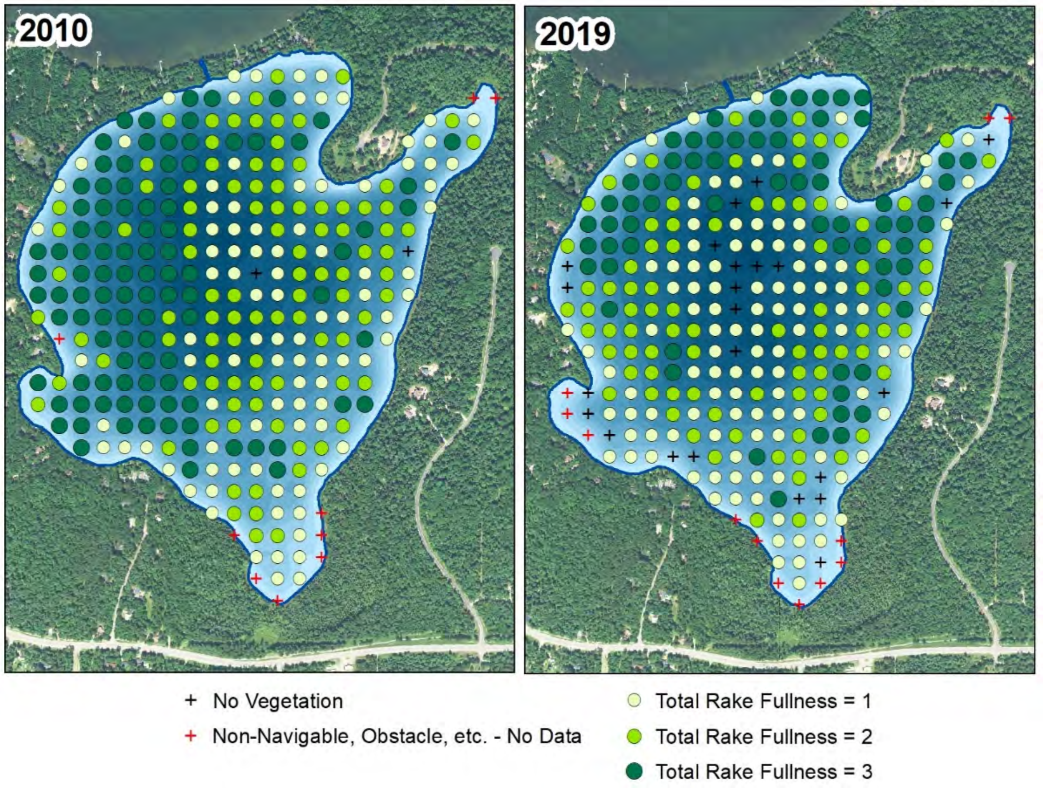


Figure 8.3.4-2. Distribution of aquatic vegetation in Lake Content in 2010 and 2019 illustrating the same distribution in vegetation occurrence. Littoral frequency of occurrence of vegetation in 2010 was 99% (n = 295) and 92% in 2019 (n = 292). Created using data from Onterra 2010 and 2019 point-intercept surveys.

Unlike some of the other Town of Saint Germain project lakes which have seen significant declines in the occurrence of vegetation between 2010 and 2019 due to either changes in water levels or reductions in water clarity, the occurrence of vegetation in Lake Content has remained relatively stable. In fact, the average depth of littoral sampling locations was 7.4 feet in 2010 and 8.0 feet in 2019, indicating water levels were similar during both survey years. In contrast, the seepage lakes of Alma and Moon lakes saw water levels increase by over 3.0 feet between 2010 and 2019, causing a significant reduction in overall aquatic plant occurrence.

While Figure 8.3.4-2 illustrates that the distribution of aquatic vegetation in Lake Content remained similar between 2010 and 2019, some individual species within Lake Content's aquatic plant community saw large changes in abundance between these two surveys. The data from the two point-intercept surveys completed on Lake Content can be used to compare how the occurrence of individual species have changed between the 2010 and 2019 surveys. The littoral frequencies of occurrence of aquatic plant species which had a littoral occurrence of at least 5% in one of the two point-intercept surveys are displayed in Figure 8.3.4-3.

Five species in Lake Content exhibited statistically valid reductions in their occurrence between 2010 and 2019 and include: coontail (23% decline), flat-stem pondweed (37% decline), white-stem pondweed (74% decline), quillwort species (57% decline), and white water crowfoot (100% decline). While some of these species have seen large declines in their occurrence between 2010 and 2019, these same species also saw declines in Big Saint Germain Lake and Fawn Lake, indicating these changes are not localized to Lake Content. If the populations of these plants are combined across all three of these lakes, the white-stem pondweed population has seen a decline of over 80%, large-leaf pondweed nearly 60%, and white water crowfoot 90%. While five species in Lake Content saw declines in their occurrence, the occurrences of the remaining species were not statistically different between 2010 and 2019.

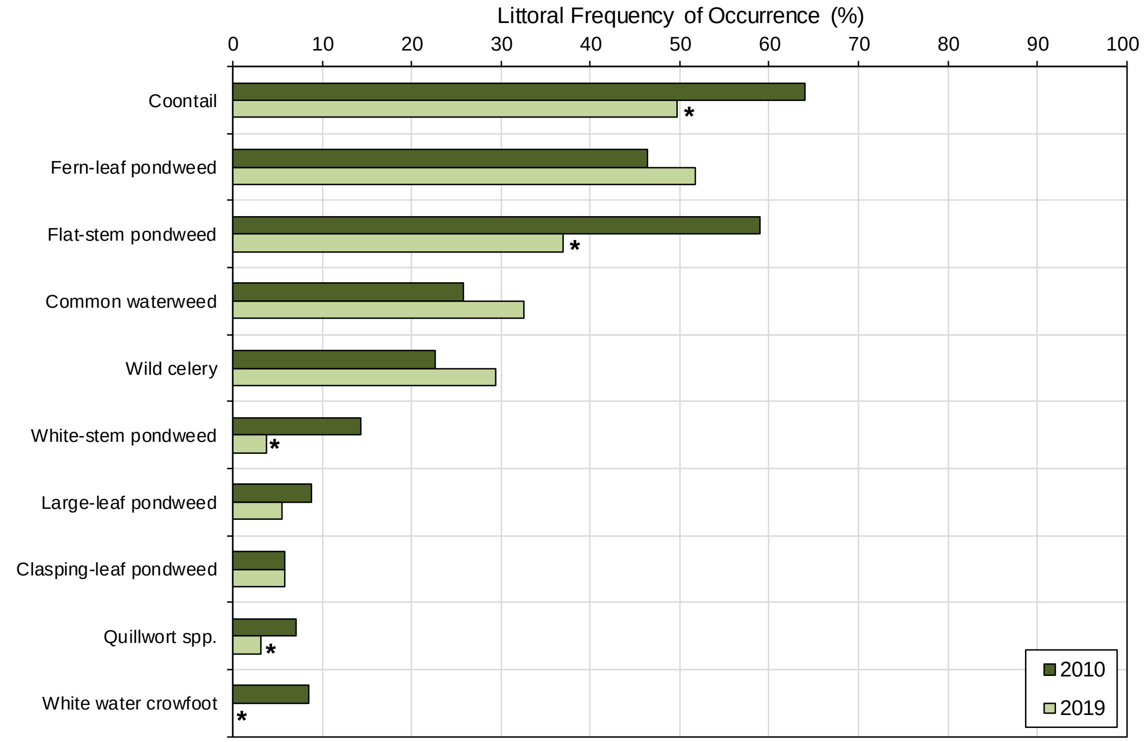


Figure 8.3.4-3. Littoral frequency of occurrence of select aquatic plant species in Lake Content from 2010 and 2019 point-intercept surveys. Species with a littoral frequency of occurrence of at least 5% in one of the two surveys are displayed. * = Statistically valid change in occurrence from 2010. Created using data from Onterra 2010 and 2019 point-intercept surveys.

The data that continues to be collected from Wisconsin lake's is revealing that aquatic plant communities are highly dynamic, and populations of individual species have the capacity to fluctuate, sometimes greatly, in their occurrence from year to year and over longer periods of time. These fluctuations are driven by a combination of interacting natural factors including variations in water levels, temperature, ice and snow cover (winter light availability), nutrient availability, changes in water flow, water clarity, length of the growing season, herbivory, disease, and competition (Lacoul and Freedman 2006). While some of the changes in species abundance have been significant in Lake Content between 2010 and 2019, this is not believed to be an indicator of environmental degradation, but likely responses to a combination of variations in the environmental changes mentioned previously.

Lakes with diverse aquatic plant communities are believed to have higher resilience to environmental disturbances and greater resistance to invasion by non-native plants. In addition, a plant community with a mosaic of species with differing morphological attributes provides zooplankton, macroinvertebrates, fish, and other wildlife with diverse structural habitat and various sources of food. One may assume that because a lake has a high number of aquatic plant species that it also has high species diversity. However, species diversity is influenced by both the number of species and how evenly they a distributed within the community.

While a method for characterizing diversity values of fair, poor, etc. does not exist, lakes within the same ecoregion may be compared to provide an idea of how Lake Content's diversity values rank. Using data collected by Onterra and WDNR Science Services, quartiles were calculated for 212 lakes within the NLFL Ecoregion. The Simpson's Diversity Index values were calculated for Lake Content using the 2010 and 2019 point-intercept survey data. Lake Content's species diversity remained the same between the 2010 and 2019 surveys at a value of 0.86 (Figure 8.3.4-4). This value falls just below the ecoregion median value of 0.88.

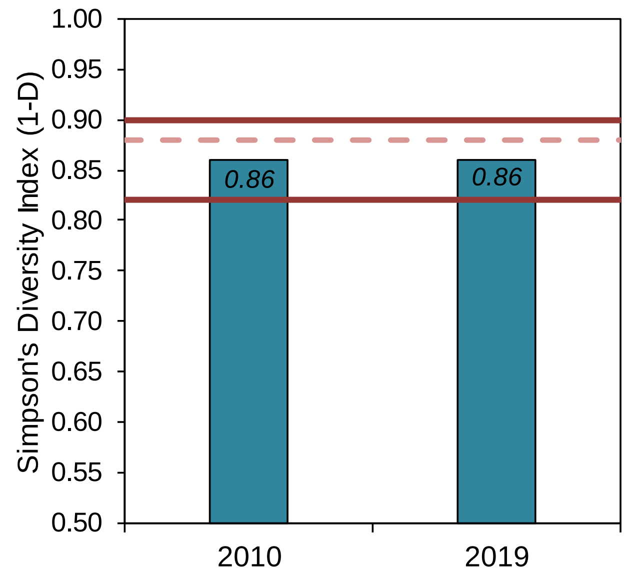


Figure 8.3.4-4. Lake Content Simpson's Diversity Index. Red solid lines represent NLFL upper and lower quartiles; light red dashed line represents NLFL median. Regional and state values calculated with Onterra & WDNR data.

In other words, if plants were randomly sampled from two locations in Lake Content in 2010 or in 2019, there would have been an 86% probability that the plants would be two different species. The consistent Simpson's diversity index value between surveys indicates that the species distribution and individual abundance remained relatively similar between 2010 and 2019.

One way to visualize the diversity of Lake Content's plant community is to examine the relative frequency of occurrence of aquatic plant species. Relative frequency of occurrence is used to evaluate how often each plant species is encountered in relation to all the other species found. For example, while coontail was found at 64% of the littoral sampling locations in 2010 (littoral occurrence), its relative frequency of occurrence was 22% (Figure 8.3.4-5).

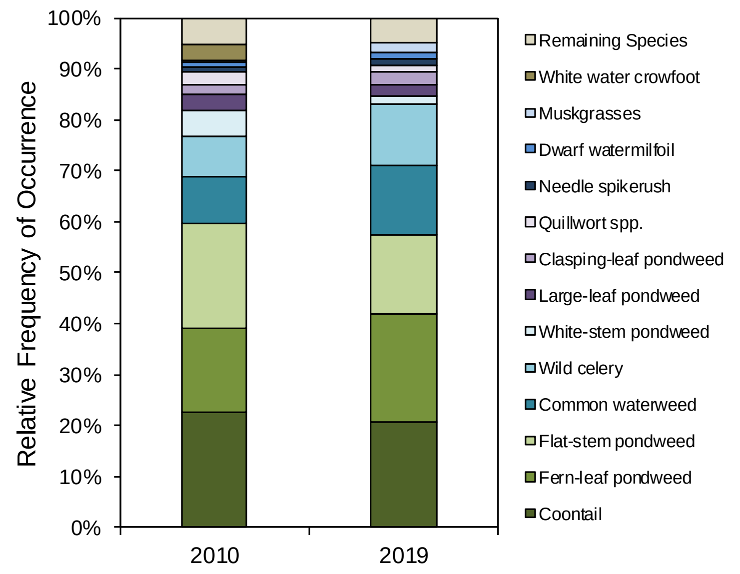


Figure 8.3.4-5. Lake Content aquatic plant relative frequency of occurrence. Created using data from Onterra 2010 and 2019 point-intercept surveys.

Explained another way, if 100 plants were randomly sampled from Lake Content in 2010, 22 of them would have been common waterweed, 16 fern-leaf pondweed, etc. In 2010, 80% of Lake Content's plant community was comprised of just six species: coontail, fern-leaf pondweed, flat-stem pondweed, common waterweed, wild celery, and white-stem pondweed. This dominance of the plant community by a few species results in lower species diversity. In 2019, the majority of the species distribution of dominant species was similar resulting in an identical Simpson's diversity value.

Submersed aquatic plants can be grouped into one of two general categories based upon their morphological growth form and habitat preferences. These two groups include species of the *isoetid* growth form and those of the *elodeid* growth form. Plants of the isoetid growth form are small, slow-growing, inconspicuous submerged plants (Figure 8.3.4-6). These species often have evergreen, succulent-like leaves and are usually found growing in sandy/rocky soils within near-shore areas of a lake (Boston and Adams 1987) (Vestergaard and Sand-Jensen 2000).

Figure 8.3.4-6. Lake quillwort (Isoetes lacustris) of the isoetid growth form (left) and large-leaf pondweed (Potamogeton amplifolius) of the elodeid growth form (right). Photo credit: Onterra.

In contrast, aquatic plant species of the elodeid growth form have leaves on tall, erect stems which grow up into the water column, and are the plants that lake users are likely more familiar with (Figure 8.3.4-6). It is important to note that the definition of these two groups is based solely on morphology and physiology and not on species' relationships. For example, dwarf watermilfoil (*Myriophyllum tenellum*) is classified as an isoetid, while all of the other milfoil species in Wisconsin such as northern watermilfoil (*Myriophyllum sibiricum*) are classified as elodeids.

Alkalinity, as it relates to the amount of bicarbonate within the water, is the primary water chemistry factor for determining a lake's aquatic plant community composition in terms of isoetid versus elodeid growth forms (Vestergaard and Sand-Jensen 2000). Most aquatic plant species of the elodeid growth form cannot inhabit lakes with little or no alkalinity because their carbon demand for photosynthesis cannot be met solely from the dissolved carbon dioxide within the water and must be supplemented from dissolved bicarbonate.

On the other hand, aquatic plant species of the isoetid growth form can thrive in lakes with little or no alkalinity because they have the ability to derive carbon dioxide directly from the sediment, and many also have a modified form of photosynthesis to maximize their carbon storage (Madsen 2002). While isoetids are able to grow in lakes with higher alkalinity, their short stature makes them poor competitors for space and light against the taller elodeid species. Thus, isoetids are most prevalent in lakes like Alma or Moon Lakes that have little to no alkalinity where they can avoid competition from elodeids.

In Lake Content and the other Town of Saint Germain lakes which have more moderate alkalinity levels, isoetids are generally restricted to shallower, wave-swept areas where elodeids are unable to grow, or scattered amongst less dense elodeid communities where light can penetrate to the bottom. Lake Content supports dense growth of the larger elodeid plant communities, and the isoetid species found in the lake such as the quillworts, waterwort, and dwarf watermilfoil are found growing in sandy, shallow near-shore areas that are unsuitable for larger plants. Isoetid communities are vulnerable to sedimentation and eutrophication (Smolders, Lucassen and Roelofs 2002), and a number are listed as special concern or threatened in Wisconsin due to their rarity and susceptibility to environmental degradation.

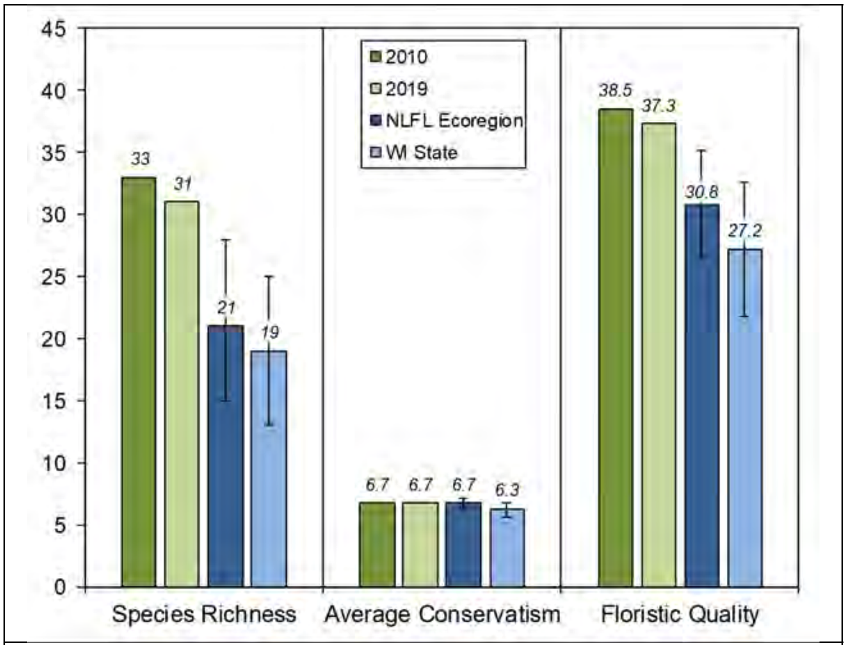


Figure 8.3.4-7. Lake Content Floristic Quality Assessment. Error bars represent interquartile range. Created using data from Onterra 2010 and 2019 point-intercept surveys. Regional and state medians calculated with Onterra and WDNR data. Analysis follows Nichols 1999.

Using the aquatic plant species recorded on the rake during the point-intercept surveys completed on Lake Content, the Floristic Quality Index (FQI) was also calculated for each survey (Figure 8.3.4-7). Native plant species richness, or the number of native species recorded on the rake was 33 in 2010 and 31 in 2019. Average species conservatism was 6.7 in both 2010 and 2019, while the FQI was 38.5 in 2010 and 37.3 in 2019. Lake Content's species richness is well above the median values for lakes in the NLFL ecoregion (21) and the state (19). Lake Content's average conservatism values are identical to the median values for the ecoregion (6.7) and slightly above the state (6.3), indicating the lake supports a higher number of environmentally-sensitive species when compared to other lakes in the ecoregion and the state. Lake Content's FQI values is also well above both the median values for ecoregion lakes (30.8) and the state (27.2). Overall, this analysis shows that Lake Content's aquatic plant community is of similar quality when compared to the majority of lakes in the ecoregion and the state. The reduction in Lake Content's FQI value between 2010 and 2019 is likely due to the slight reduction in species diversity and species distribution, which is a natural fluctuation and it is not an indication of degrading conditions.

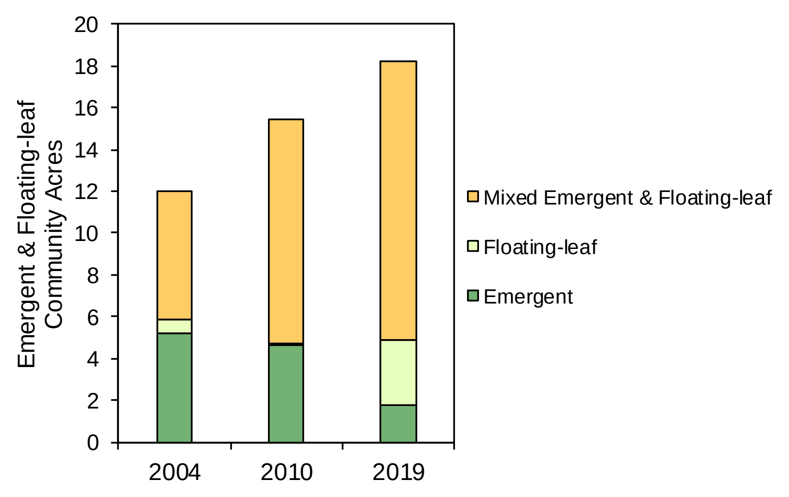


Figure 8.3.4-8. Lake Content emergent and floating-leaf community acres from 2004, 2010, and 2019.

In 2019, Onterra ecologists also re-mapped emergent and floating-leaf aquatic plant communities in Lake Content (Lake Content – Map 5). Figure 8.3.4-8 illustrates that the size of these communities has increased since they were first mapped by NES Ecological Services in 2004. These communities have increased from 12.0 acres in 2004, 15.4 acres in 2010, and 18.2 acres in 2019. Many of these communities have expanded lakeward over this time period, most notably in the northeastern portion of the lake.

The relatively small changes in Lake Content's aquatic plant community compared to some of the other project lakes is likely due to the fact that the lake has maintained relatively stable water levels and water clarity over this period. Alma and Moon lakes have seen large fluctuations in water levels while Found Lake has seen a significant reduction in water clarity, disturbances which have caused more significant changes in the plant communities of these lakes.

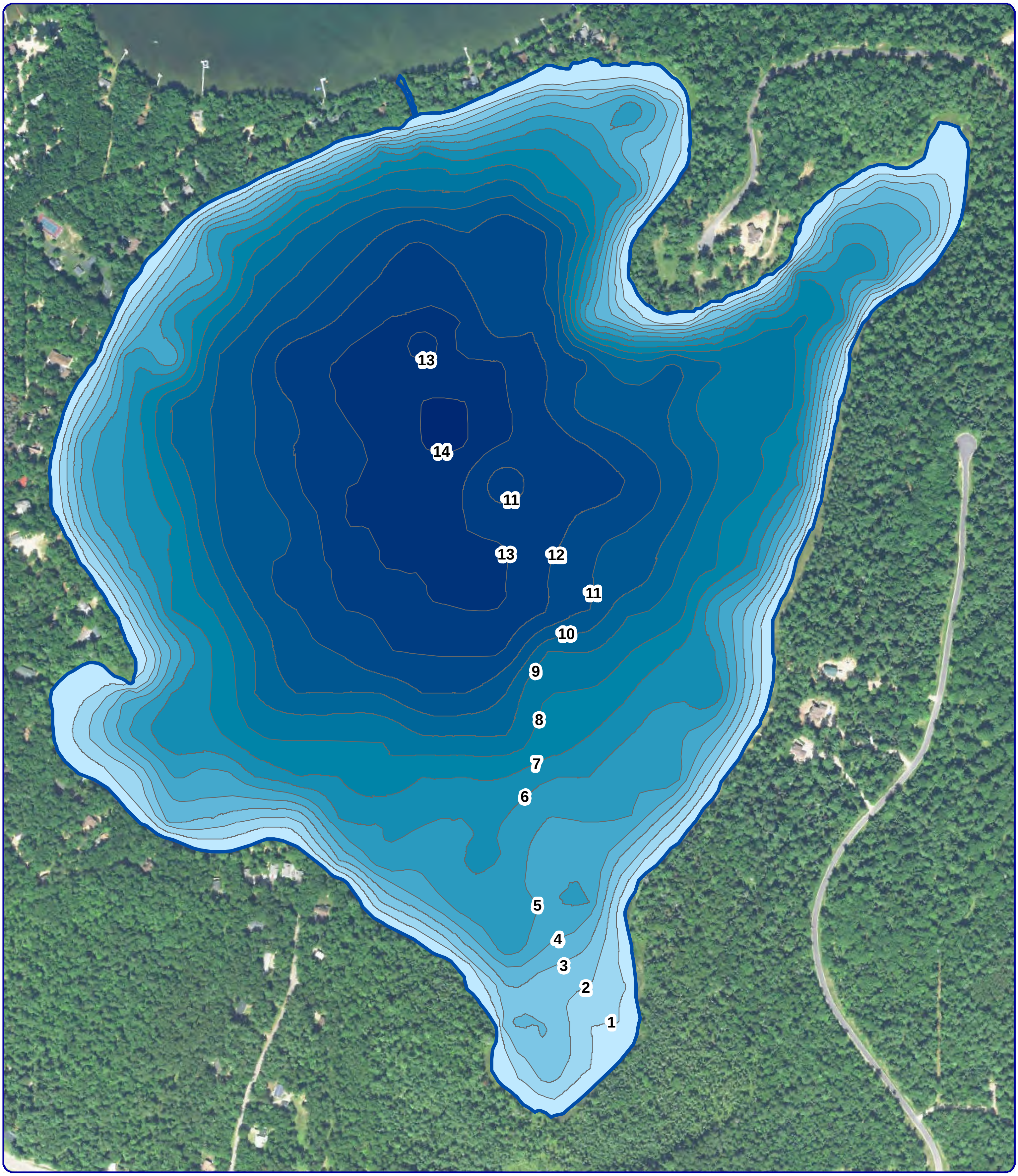
Aquatic Invasive Species in Lake Content

Narrow-leaved Cattail (Typha angustifolia)

Narrow-leaved cattail is a perennial invasive wetland plant which invades shallow marshes and other wet areas. Like Wisconsin's native broad-leaved cattail (*T. latifolia*), narrow-leaved cattail produces tall, erect, sword-like leaves that can grow nearly 10 feet tall (Photograph 8.3.4-1). The leaves are generally narrower than broad-leaf cattail, typically 0.15-0.5 inches wide. Unlike broad-leaf cattail in which the male and female flowers are typically touching, there is typically a gap of 0.5-4.0 inches between the male and female flowers of narrow-leaved cattail.

Photograph 8.3.4-1. Colony of the non-native narrow-leaved cattail in Lake Content in 2019. Locations of narrow-leaved cattail can be found on Lake Content – Map 5.

In 2019, a 0.1-acre colony of narrow-leaved cattail was located on the northern shore of Lake Content, while two smaller colonies were located on the eastern and southern shorelines (Lake Content – Map 5). Given the isolated nature of these colonies, the best method of control is likely the cutting of stems (both green and dead) in mid- to late-summer or early fall to below the water line. The following growing season, continually cut-back emerging stems to maintain them below the water for the remainder of the growing season. This process should be repeated until the plants do not reemerge.



Onterra LLC
Lake Management Planning
815 Prosper Road
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Hydro: WDNR
Bathymetry: WDNR, digitized by Onterra
Orthophotography: 2018 NAIP
Map Date: March 3, 2020 BTB
File Name Map1_Content_Location.mxd

Project Location in Wisconsin

Legend

Lake Content
(239 acres - WDNR definition)

Lake Content - Map 1
Town of Saint Germain
Vilas County, Wisconsin

Project Location & Lake Boundaries

N

W E

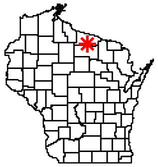
S

1,000

Feet

Onterra LLC
Lake Management Planning
815 Prosper Road
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Hydro: WDNR
Watershed: Onterra 2019
Orthophotography: 2018 NAIP
Map Date: March 3, 2020 BTB
File Name Map2_Content_WS.mxd



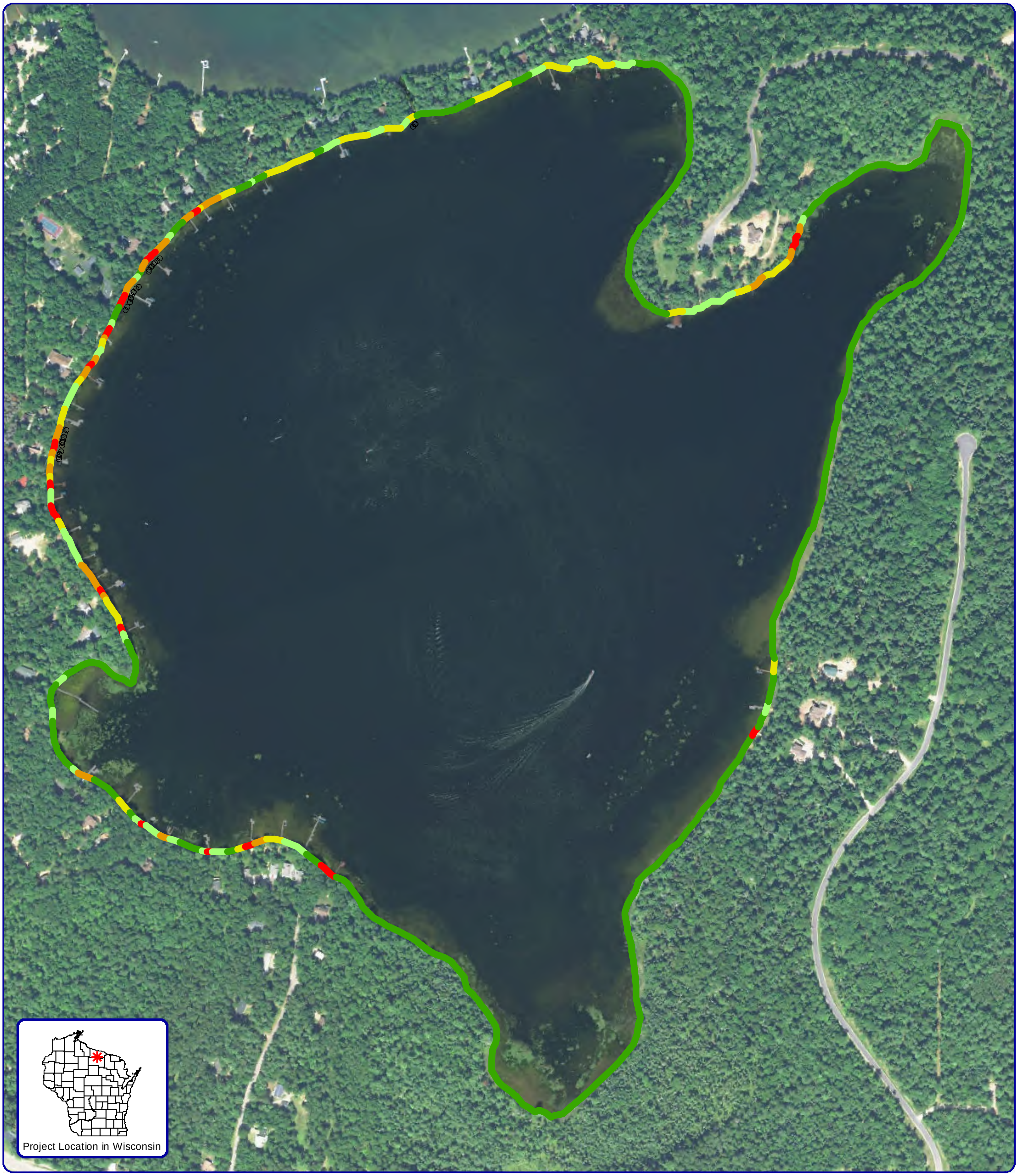
Project Location in Wisconsin

Legend

- Watershed Boundary
- Lake Content
- Forest
- Forested Wetlands
- Pasture/Grass (None)
- Rural Open Space
- Rural Residential
- Non-Forested Wetlands
- Open Water

Lake Content - Map 2
Town of Saint Germain
Vilas County, Wisconsin

Watershed Boundaries & Land Cover Types



Legend

- 🟩 Natural/Undeveloped
- 🟩 Developed-Natural
- 🟨 Developed-Semi-Natural
- 🟧 Developed-Unnatural
- 🟥 Urbanized

Seawall

- ▬ Masonry/Wood/Metal
- ○○○ Rip-Rap

Lake Content - Map 3

Town of Saint Germain

Vilas County, Wisconsin

2019 Shoreland Condition Assessment

Sources:
Hydro: WDNR
Bathymetry: WDNR, digitized by Onterra
Orthophotography: 2018 NAIP
Map Date: March 3, 2020 BTB
File Name Map3_Content_SCA_2019.mxd

Onterra LLC
Lake Management Planning
815 Prosper Road
De Pere, WI 54115
920.338.8860
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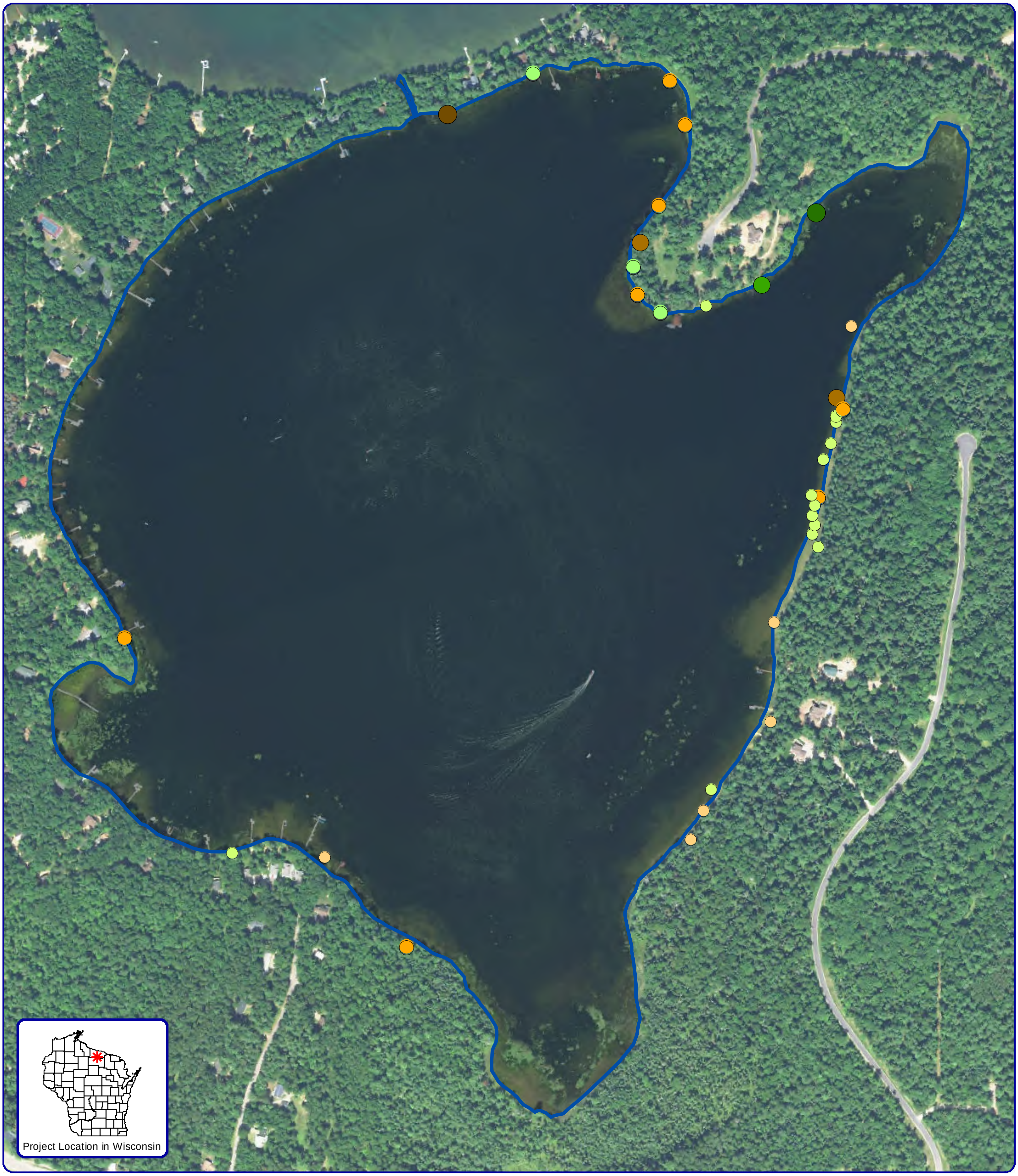

Legend

2-8 Inch Pieces	8+ Inch Pieces	Cluster of Pieces
● No Branches	● No Branches	■ No Branches
● Minimal Branches	● Minimal Branches	■ Minimal Branches
● Moderate Branches	● Moderate Branches	■ Moderate Branches
● Full Canopy	● Full Canopy	■ Full Canopy

Onterra LLC
Lake Management Planning
815 Prosper Road
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Hydro: WDNR
Bathymetry: WDNR, digitized by Onterra
Orthophotography: 2018 NAIP
Map Date: March 3, 2020 BTB
File Name Map4_Content_CWH_2019.mxd

Lake Content - Map 4
Town of Saint Germain
Vilas County, Wisconsin
2019 Coarse Woody Habitat Assessment

Note: Species located in each lettered or numbered community can be found in the table on the subsequent page

590
Feet

Onterra LLC
Lake Management Planning
815 Prosper Road
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Hydro: WDNR
Plants: Onterra 2019
Orthophotography: 2018 NAIP
Map Date: March 3, 2020 BTB
File Name Map5_Content_CM_2019.mxd

Large Plant Community
- 🟩 Native - Emergent
- 🟩 Native - Floating-leaf
- 🟧 Native - Mixed Floating-leaf & Emergent
- 🟥 Non-Native - Narrow-leaved Cattail

Small Plant Community
- ● Native - Emergent
- ○ Native - Floating-leaf
- ● Native - Mixed Floating-leaf & Emergent
- ◆ Non-Native - Narrow-leaved Cattail

Lake Content - Map 5
Town of Saint Germain
Vilas County, Wisconsin
2019 Emergent & Floating-leaf Aquatic Plant Communities

Content Lake 2019 Emergent & Floating-Leaf Plant Species

Corresponding Community Polygons and Points are displayed on Content Lake - Map 5

Large Plant Community (Polygons)

Emergent	Species 1	Species 2	Species 3	Species 4	Species 5	Species 6	Species 7	Species 8	Species 9	Species 10	Species 11	Species 12	Acres
A	Common bur-reed												0.53
B	Common bur-reed	Pickerelweed	Stiff arrowhead	Wool-grass	Broad-leaved cattail	Water arum							0.23
C	Common bur-reed	Broad-leaved cattail	Water arum	Wool-grass	Bristly sedge								0.23
D	Narrow-leaved cattail												0.11
E	Creeping spikerush	Common bur-reed											0.27
F	Common bur-reed	Broad-leaved cattail	Pickerelweed	Nothern yellow lake sedge	Stiff arrowhead								0.44
Floating-leaf	**Species 1**	**Species 2**	**Species 3**	**Species 4**	**Species 5**	**Species 6**	**Species 7**	**Species 8**	**Species 9**	**Species 10**	**Species 11**	**Species 12**	**Acres**
G	White water lily												0.81
H	White water lily	Narrow-leaf bur-reed											0.42
I	White water lily	Spatterdock	Watershield										1.62
J	Narrow-leaf bur-reed	White water lily											0.11
K	Watershield	White water lily											0.12
Floating-leaf & Emergent	**Species 1**	**Species 2**	**Species 3**	**Species 4**	**Species 5**	**Species 6**	**Species 7**	**Species 8**	**Species 9**	**Species 10**	**Species 11**	**Species 12**	**Acres**
L	Common bur-reed	White water lily	Pickerelweed	Creeping spikerush									0.23
M	Common bur-reed	White water lily	Pickerelweed	Watershield	Wool-grass	Water arum							0.61
N	Broad-leaved cattail	Common bur-reed	White water lily	Spatterdock	Stiff arrowhead	Wool-grass	Water arum	Pickerelweed					2.39
O	Common bur-reed	White water lily	Three-way sedge	Eastern bur-reed									0.38
P	Common bur-reed	Broad-leaved cattail	Pickerelweed	Hardstem bulrush	Stiff arrowhead	Common arrowhead	Water arum	Northern yellow lake sedge	Creeping spikerush	Wool-grass	White water lily	Narrow-leaf bur-reed	5.87
Q	Broad-leaved cattail	Common bur-reed	Pickerelweed	White water lily									0.22
R	Common bur-reed	Broad-leaved cattail	Northern yellow lake sedge	Pickerelweed	White water lily	Narrow-leaf bur-reed	Wool-grass						0.30
S	Broad-leaved cattail	Pickerelweed	Common bur-reed	Northern yellow lake sedge	White water lily	Narrow-leaf bur-reed	Wool-grass	Water arum	Creeping spikerush				0.20
T	Broad-leaved cattail	Common bur-reed	Pickerelweed	Wool-grass									1.84
U	Pickerelweed	Common bur-reed	Broad-leaved cattail	Watershield	White water lily	Wool-grass	Water arum	Eastern bur-reed					0.39
V	Narrow-leaf bur-reed	Watershield	Common bur-reed										0.16
W	Pickerelweed	Watershield	Narrow-leaf bur-reed	Common bur-reed	White water lily	Creeping spikerush							0.09
X	Pickerelweed	Watershield	White water lily	Common bur-reed	Narrow-leaf bur-reed	Creeping spikerush							0.13
Y	Broad-leaved cattail	Pickerelweed	Common bur-reed	White water lily	Wool-grass								0.32
Z	Common bur-reed	Broad-leaved cattail	White water lily	Water arum									0.21

Small Plant Community (Points)

Emergent	Species 1	Species 2	Species 3	Species 4	Species 5	Species 6	Species 7	Species 8
1	Broad-leaved cattail	Wool-grass						
2	Hardstem bulrush							
3	Pickerelweed	Stiff arrowhead						
4	Pickerelweed							
5	Broad-leaved cattail	Wool-grass						
6	Wool-grass	Broad-leaved cattail						
7	Narrow-leaved cattail							
8	Creeping spikerush							
9	Eastern bur-reed							
10	Common bur-reed							
11	Narrow-leaf bur-reed							
12	Broad-leaved cattail							
13	Common bur-reed	Pickerelweed						
14	Pickerelweed	Broad-leaved cattail	Common bur-reed					
15	Common bur-reed	Broad-leaved cattail						
Floating-leaf	**Species 1**	**Species 2**	**Species 3**	**Species 4**	**Species 5**	**Species 6**	**Species 7**	**Species 8**
16	White water lily	Watershield						
17	Narrow-leaf bur-reed							
18	White water lily	Narrow-leaf bur-reed						
19	White water lily							

Species are listed in order of dominance within the community; Scientifc names can be found in the secies list in the Lake Content Aquatic Vegetation Section 8.3.4