Technical Reference

Black Dog Watershed Management Organization Habitat Monitoring Background Summary

In 2002, the Black Dog Watershed Management Organization (BDWMO) created a program for monitoring the habitat quality of strategic water resources in the watershed. The BDWMO lies south of the Minnesota River in the northwest portion of Dakota County. **Figure 1** shows the subwatersheds to the BDWMO's strategic water bodies. The BDWMO began implementing the habitat monitoring program in 2003 and continued the program through 2009. In 2004, based on feedback from the participating cities and to better define the vegetative quality, several improvements were made to the rating system. The BDWMO used this system for the annual habitat monitoring of each strategic water body through 2009. From 2003-2009 Barr staff annually evaluated the habitat quality of each of the following strategic water bodies:

- Crystal Lake (Burnsville)
- Keller Lake (Burnsville)
- Kingsley Lake (Lakeville)
- Lac Lavon (Apple Valley and Burnsville)
- Orchard Lake (Lakeville)
- Sunset Pond (Burnsville)

In 2010, the BDWMO suspended the habitat monitoring program and re-evaluated the program for its effectiveness. Based on feedback obtained from city staff, the BDWMO revised the habitat monitoring program to provide more effective monitoring, more useful and holistic results, and to reduce the monitoring costs. The BDWMO began implementing the revised habitat monitoring program in 2011. Also in 2011, the BDWMO removed Sunset Pond from its list of strategic water bodies.

The revised program includes monitoring habitat quality at one strategic water body per year, such that the BDWMO monitors all five strategic water bodies over a five-year cycle. The 2011 through 2015 reports provide a new baseline for the strategic water bodies—Kingsley Lake (2011), Orchard Lake (2012), Crystal Lake (2013), Lac Lavon (2014), and Keller Lake (2015). This report provides the results of the 2017 habitat monitoring conducted for Orchard Lake.

The 2017 Orchard Lake monitoring includes transect, plot, and meandering surveys. Supplemental photographs were taken to document conditions. Private versus public ownership was identified along the entire shoreline. The survey results, along with parcel data, are used to identify possible locations for restoration and preservation. Table 1 of the Technical Memo summarizes the 2017 Orchard Lake monitoring results.

Habitat Quality

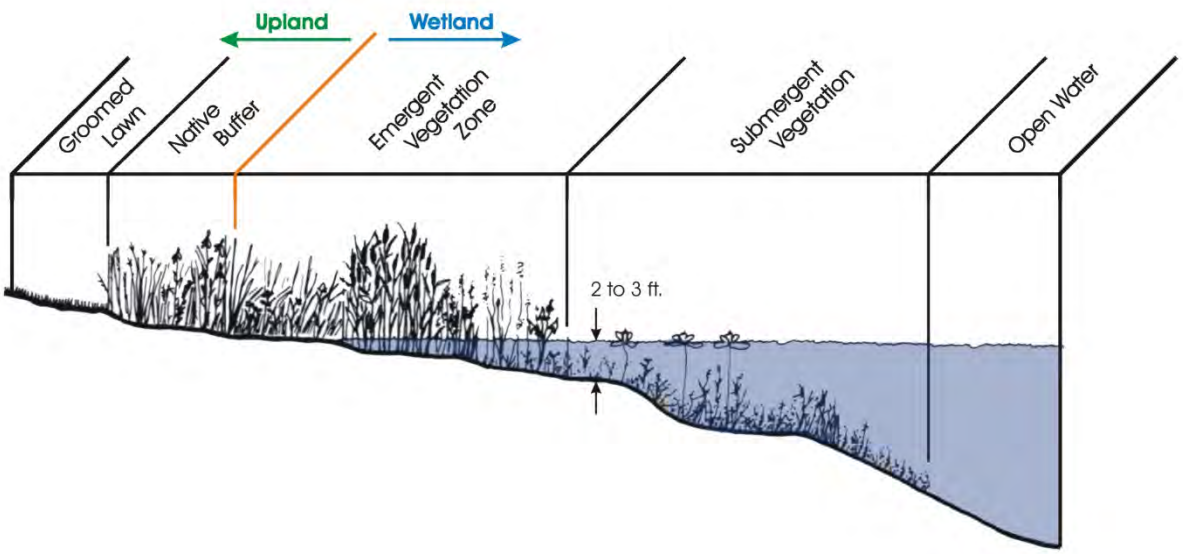
The BDWMO's assessment of the BDWMO strategic water bodies provides baseline and ongoing information regarding the habitat quality of the water bodies and a method for detecting change. Habitat quality was evaluated within the following four general zones:

1. **Submergent vegetation zone—**The submergent zone refers to the areas of the water body where water depths are typically 2 to 20 feet (normal maximum rooting depth) and the vegetation is typically submerged or has floating leaves. The vegetation quality within the submergent zone is normally rated as "excellent" when there are: (a) a diverse assemblage of native plant species (more than 14), (b) a moderate plant density or plant occurrence rating, and (c) no exotic species present.

2. **Emergent vegetation zone—**The emergent zone typically refers to the areas of the water body where water depths are less than 2 feet and vegetation grows out of the water. The vegetation quality within the emergent zone is typically rated as "excellent" when there are more than 15 species of native and non-invasive plants present, with few exotic plants present.

3. **Condition of the upland buffer area—**The upland buffer is characterized as the upland area immediately surrounding the water body. An excellent quality buffer should extend upslope at least 25 feet from the wetland edge, consist of native vegetation that is not routinely mowed, and be present continuously around the perimeter of the water body.

4. **Sedimentation and shoreline erosion problems—**The presence of sedimentation may come from erosion on slopes, from storm sewer outfalls, or from other sources. The presence of a regular sediment load to the water body can cause a significant reduction in water quality. Shoreline erosion can be caused by natural forces such as ice and wave action, but can also be human induced (e.g., vegetation removal, grading, runoff, structures, etc.). Identifying and correcting these problems early can prevent habitat degradation.



Vegetation Zones

Appendix C summarizes the overall ratings from 2003 through 2016. **Appendix D** includes the previous management recommendations for water bodies assessed from 2009 through 2016. **Table 2 of the Technical Memo** provides the 2017 management recommendations for Orchard Lake.

Wildlife Habitat Characteristics

The strategic water bodies within the BDWMO range from shallow wetland systems to deeper lake systems. Some of them support sustainable fisheries, while others may only periodically support fish. All of the water bodies appear to have some potential for supporting waterfowl and shorebirds. To evaluate the wildlife value of these water bodies, it is important to understand the characteristics that will benefit wildlife.

In general, a more diverse assemblage of native plant species will provide a source of food and protective cover for a wider range of wildlife species. Typically, although not always, native plant species do not become established as monocultures to the detriment of other species, as is often the case with many exotic species. As vegetation diversity increases, so does the likelihood that the water body will support a more diverse assemblage of wildlife.

A diverse interspersion of various plant communities also leads to the potential for attracting a wider range of wildlife. For instance, some waterfowl prefer deeper, open water areas while others tend to inhabit the shallow emergent zones. Some furbearers rely heavily on the shallow, emergent zone and upland areas around the water body while others spend most of their time in the deep marsh areas. Amphibians will typically need a permanently inundated water body, but rely on diverse vegetative structure in the upland areas surrounding the water body for critical components of their life cycle. Fish also require permanent inundation to a depth that will not result in freeze-out and where oxygen will not become depleted. A diverse habitat structure is also important for fish.

The upland buffer surrounding these water bodies is important for a number of reasons. A high quality upland buffer will have a diverse vegetative structure dominated by self-sustaining native vegetation. A high quality upland buffer is used by wildlife for shelter, feeding, resting, nesting, and reproduction. In contrast, adjacent upland areas that are maintained in turf grass or paved trails provide little value to wildlife or water quality improvement. Turf grass and trails typically provide feeding and resting grounds only for geese and some species of ducks. Wide and contiguous natural buffers are important as they provide feeding, nesting and safe travel corridors. Upland buffers also help protect the water quality of the water body. Diverse native vegetation helps maintain an open soil structure that promotes infiltration, reduces surface runoff, and increases nutrient uptake.

Wetland Functions and Values Assessment—MNRAM

In addition to the specific habitat parameters described above, the Minnesota Routine Assessment Method for Evaluating Wetland Functions (MNRAM) Version 3.0 was used to evaluate the hydrologic system and ecosystem making up each water resource, first in 2003 and then again in 2006. The results of the 2003 and 2006 MNRAM 3.0 assessments were provided in previous year's reports. Orchard Lake was re-assessed in 2012, Crystal Lake was re-assessed in 2013, Lac Lavon was re-assessed in 2014, Keller Lake was re-assessed in 2015, and Kinsley was re-assessed in 2016 with the more updated MNRAM version 3.4. The results of the 2012 Orchard Lake MNRAM are provided in **Appendix E**. Evaluating each ecosystem with MNRAM is a way to get a detailed picture of the overall health of the watershed and the water resource itself. Instead of just looking at specific parameters that are direct indicators of habitat quality, the MNRAM evaluates many different parameters of the water body and its watershed that contribute to sustaining the wetland functions, which are described in **Appendix F**. In general, the MNRAM assessments compare favorably with the BDWMO habitat vegetation assessment results. This method identifies land use or ecological changes, which might affect the water body in the long term. In addition, the MNRAM assessment provides an independent evaluation of the overall wildlife habitat of the water body.

Appendices

Appendix A

Orchard Lake Aquatic Plant Survey Results

Heavy Growth of Buttercup, a Native Species, Orchard Lake, 2017

Aquatic Plant Surveys for Orchard Lake, Lakeville, Minnesota, 2017

Curlyleaf Pondweed Delineation: April 17, 2017
Treatment of Curlyleaf: May 2017 (14.5 acres with Aquathol K)
Eurasian Watermilfoil Found July 3, 2017
Treatment of Eurasian Watermilfoil: July 2017 (1.15 acres)
Aquatic Plant Surveys: June 9 and July 12, 2017

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November 15, 2017

Aquatic Plant Surveys for Orchard Lake, Lakeville, Minnesota, 2017

Summary

A curlyleaf pondweed delineation (conducted on April 17, 2017) and two aquatic plant surveys were conducted by Blue Water Science on Orchard Lake (234 acres) in 2017. An early season stratified line transect survey on June 9, 2017 was conducted to evaluate curlyleaf pondweed. The early season surveys evaluated the distribution and abundance of curlyleaf pondweed. The late summer survey on July 12 (also a stratified line transect survey conducted by Blue Water Science) characterized changes in the plant community and checked for Eurasian watermilfoil (Figure S1).

Curlyleaf Pondweed Delineation: On April 17, 2017, a curlyleaf delineation was conducted to determine where curlyleaf pondweed could be a problem in 2017. There was 3 areas where curlyleaf could have produced moderate to heavy growth. A total of 14.5 acres were treated in May 2017 using Aquathol K.

Early Season Plant Survey and Curlyleaf Pondweed Assessment: On the June 9, 2017 survey, the most abundant plant in Orchard Lake was northern watermilfoil and it was found at 67% of the stations (26 out of 39 sites) but at light to moderate densities (Table S1). Three areas were treated for curlyleaf pondweed control in May 2017 had good control. No curlyleaf was observed in the June survey. A summary of curlyleaf conditions from 2002 through 2017 is shown in Figure S2.

Discovery of Eurasian Watermilfoil: Researchers from the University of Minnesota were on Orchard Lake on July 3, 2017 conducting aquatic plant research when they discovered Eurasian watermilfoil. A subsequent EWM delineation was conducted and EWM was found at only 1 location. An area of 1.15 acres was treated.

Late Summer Plant Survey: The dominant plant on July 12, 2017 in Orchard Lake was coontail (Table S1). Coontail was found at 85% of the sites (33 out of 39 sites). No Eurasian watermilfoil was found in the late summer survey. Overall, aquatic plants grew out to a depth of about 12 feet around much of the lake (Figure S1).

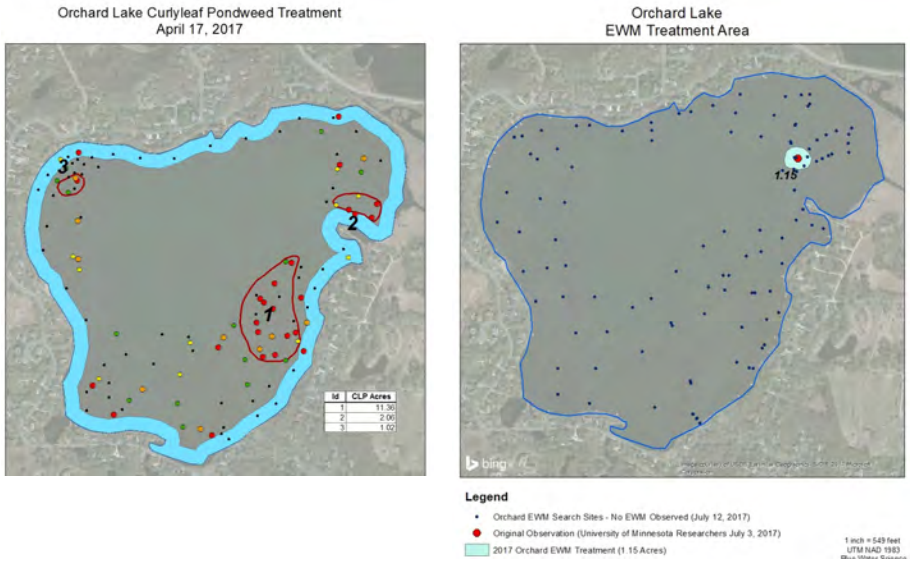
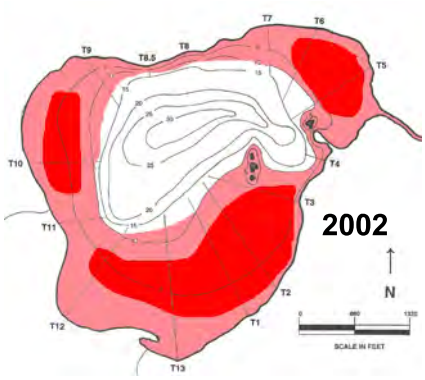
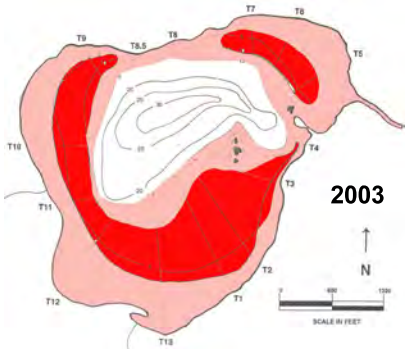


Figure S1. [left] Curlyleaf delineation on April 17, 20017 and 14.5 acres were treated.
[right] Treatment location for EWM. No additional EWM was found on July 12, 2017.

Curlyleaf Pondweed Coverage form 2002 - 2017



No harvesting



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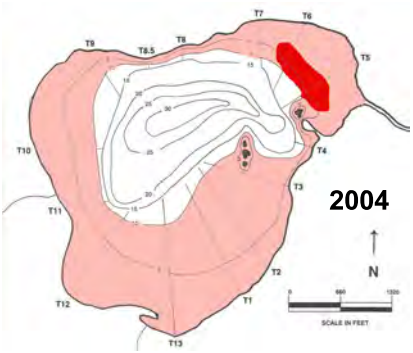
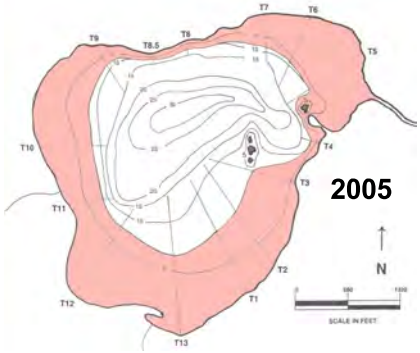
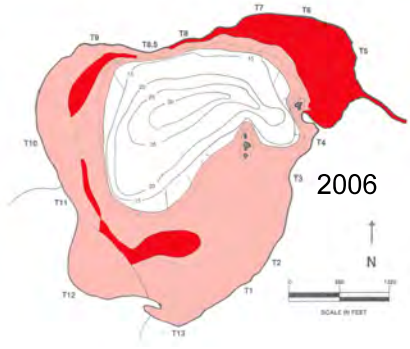




Post Harvesting Conditions



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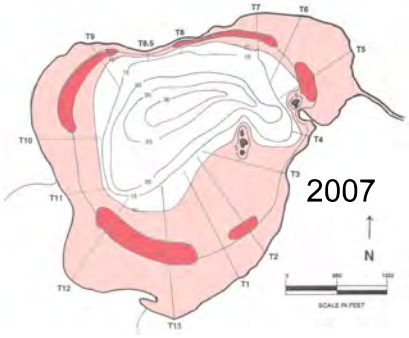

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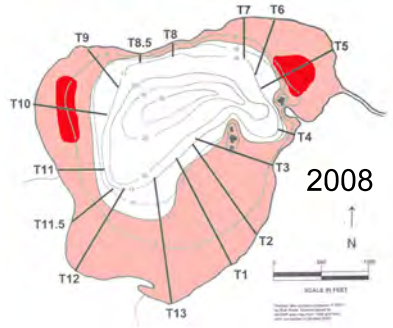
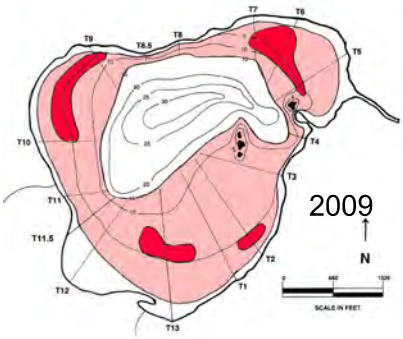
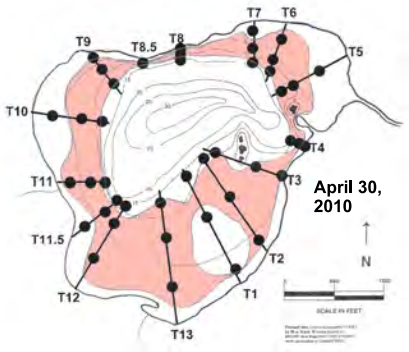


Pre Harvesting Conditions



Pre Harvesting/Herbicide



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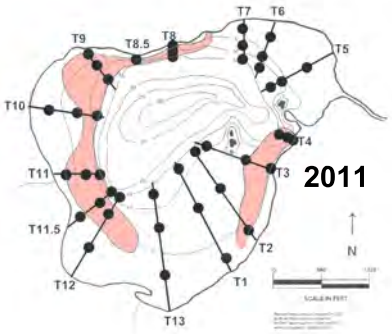

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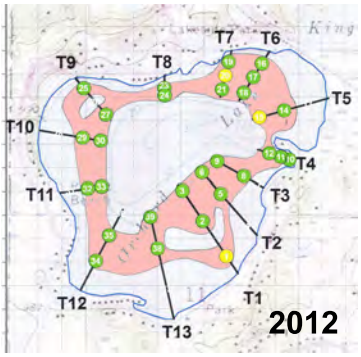

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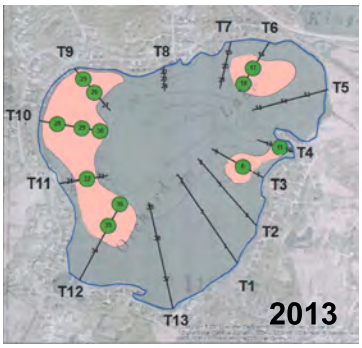
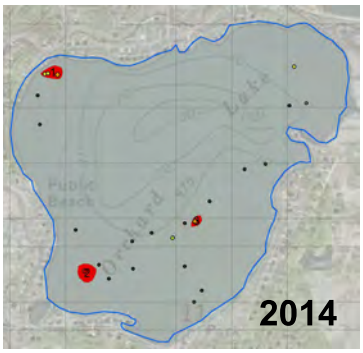
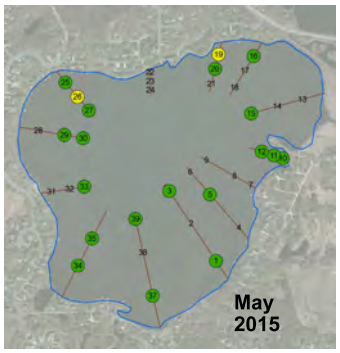


No Herbicides

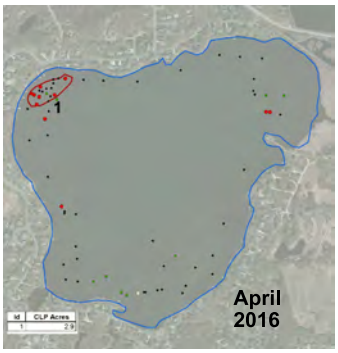
Figure S2. The coverage of curlyleaf pondweed in early summer from 2002 to 2013 is shown in pink and heavy growth of curlyleaf pondweed is shown in red. Mechanical weed harvesting was conducted from 2004 through 2008, and herbicides were applied in 2009 through 2012 and 2015-2017. The area of nuisance coverage for pre-treatment conditions has decreased since 2006.



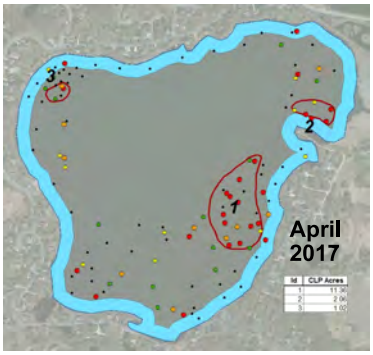
No Herbicides



Post Herbicide Conditions



Pre Herbicide Conditions



Pre Herbicide Conditions

Figure S2. Concluded. The coverage of curlyleaf pondweed in early summer for 2014 through 2017 is shown in green = light growth, yellow = moderate growth, and red = heavy growth of curlyleaf pondweed. The area of nuisance coverage for pre-treatment conditions has decreased since 2006.

Characterizing Aquatic Plants in June and July, 2017: Two aquatic plant surveys were conducted in 2017 using a stratified line transect survey on June 9 and July 12. In July, coontail and northern watermilfoil were the most common plants in the lake (Table S1).

Table S1. Summary of early summer aquatic plants surveys for Orchard Lake in 2017. Percent frequency of occurrence is calculated based on the number of times a plant species occurs at a sampling station on transects divided into the number of total stations for the survey. For example, if coontail was found in 25 out of 50 stations, its percent occurrence would be 50%.

	June 9, 2017 Line Transect with depth ranges (% frequency of occurrence)(39 points)	July 12, 2017 Line Transect with depth ranges (% frequency of occurrence)(39 points)
Spatterdock (*Nuphar variegatum*)	5	
Coontail (*Ceratophyllum demersum*)	51	85
Chara (*Chara sp.*)	36	36
Elodea (*Elodea canadensis*)	8	
Star duckweed (*Lemna trisulca*)	18	10
Northern watermilfoil (*Myriophyllum sibiricum*)	67	79
Cabbage (*Potamogeton amplifolius*)		3
Curlyleaf pondweed (*P. crispus*)		3
Whitestem pondweed (*P. praelongus*)	5	
Claspingleaf pondweed (*P. Richardsonii*)	3	8
Stringy pondweed (*P. sp*)	5	
Flatstem pondweed (*P. zosteriformis*)		5
Buttercup (*Ranunculus sp*)	18	8
Water celery (*Vallisneria americana*)		5
Water stargrass (*Zosterella dubia*)	21	15
Filamentous algae	33	51
Number of Submerged Species	10	11

Early Summer Aquatic Plant Surveys: The City of Lakeville has sponsored early and late summer aquatic plant surveys since 1999. A summary of the percent occurrence of individual species on a lakewide basis for early summer surveys is shown in Table S2. Since 1995, for the early summer survey results, it appears that 6 submerged native species have increased and the other species are found sparingly or have not changed in abundance. Curlyleaf is usually the most common early season plant. The number of species found in Orchard Lake in early summer has been stable since 1995 (Table S2).

Table S2. The percent occurrence of aquatic plants for Orchard Lake for 1995 and 1999 through 2017 for early summer surveys. Mechanical harvesting has occurred from 2004 to 2008 (blue shading) and herbicides were applied in 2009 through 2012 and 2015-2017 (green shading)(1995 data are from Barr Engineering Company, Diagnostic Study of Orchard Lake, 1999).

	Early Summer Aquatic Plant Surveys																			
	Jun 16, 1995 % Occur (based on 57 stat)	Jun 5, 1999 % Occur (based on 39 stat)	May 26, 2000 % Occur (based on 39 stat)	Jun 8, 2001 % Occur (based on 39 stat)	May 31, 2002 % Occur (based on 42 stat)	May 17, 2003 % Occur (based on 39 stat)	Jun 7, 2004 % Occur (based on 24 stat)	May 21, 2005 % Occur (based on 26 stat)	May 26, 2006 % Occur (based on 30 stat)	May 22, 2007 % Occur (based on 26 stat)	May 30, 2008 % Occur (based on 26 stat)	May 13, 2009 % Occur (based on 45 stat)	Apr 30, 2010 % Occur (based on 42 stat)	May 27, 2011 % Occur (based on 39 stat)	May 7, 2012 % Occur (based on 39 stat)	May 5, 2013 % Occur (based on 39 stat)	Jun 17, 2014 % Occur (based on 42 stat)	May 22, 2015 % Occur (based on 39 stat)	May 20, 2016 % Occur (based on 39 stat)	June 9, 2017 % Occur (based on 39 stat)
Duckweed (*Lemna sp*)	--	--	--	--	--	--	--	--	--	--	--	--	21	--	--	--	--	--	--	--
Spatterdock (*Nuphar variegatum*)	--	5	10	5	5	8	13	15	10	12	--	2	2	--	3	--	5	5	--	5
White waterlily (*Nymphaea sp*)	--	5	3	3	7	5	4	--	7	12	12	--	--	3	3	--	3	3	--	--
Marsh marigold (*Bidens beckii*)	--	--	--	--	5	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--
Coontail (*Ceratophyllum demersum*)	12	18	28	74	38	38	88	62	13	27	35	24	43	59	49	69	74	51	38	51
Chara (*Chara sp*)	12	13	13	28	12	10	4	15	10	8	12	18	19	15	18	18	13	28	31	36
Elodea (*Elodea canadensis*)	--	--	--	--	--	--	--	--	--	--	--	--	--	5	5	8	10	3	--	8
Star duckweed (*Lemna trisulca*)	--	--	--	--	--	--	--	--	7	8	4	--	--	10	3	--	3	8	--	18
Northern watermilfoil (*Myriophyllum sibiricum*)	18	23	3	41	12	3	25	19	33	12	8	15	52	64	36	15	64	31	15	67
Nitella (*Nitella sp*)	--	--	--	--	2	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cabbage (*Potamogeton amplifolius*)	5	8	3	13	14	10	13	19	33	31	4	11	12	10	21	15	18	18	5	--
Curlyleaf pondweed (*P. crispus*)	98	74	95	92	74	100	92	96	100	100	96	89	76	38	77	31	74	54	69	--
Illinois pondweed (*P. illinoensis*)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	--
Whitestem pondweed (*P. praelongus*)	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	5
Claspingleaf pondweed (*P. Richardsonii*)	9	5	--	10	5	--	--	--	7	4	4	--	--	--	10	--	13	10	18	3
Stringy/Narrowleaf (*P. sp*)	--	--	--	10	--	--	--	--	--	--	8	--	--	--	3	--	--	3	3	5
Flatstem pondweed (*P. zosteriformis*)	2	--	--	5	--	--	4	--	7	--	--	--	--	--	--	--	3	3	3	--
Buttercup (*Ranunculus sp*)	--	8	3	--	--	3	4	12	3	8	--	11	14	13	26	36	21	13	5	18
Sago pondweed (*Stuckenia pectinatus*)	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Water celery (*Vallisneria americana*)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	--
Water stargrass (*Zosterella dubia*)	4	--	--	--	--	--	--	--	--	--	--	7	21	28	--	8	13	15	15	21
Number of submerged species	9	7	6	8	8	7	7	6	9	8	9	7	8	9	10	8	13	12	10	10

Late Summer Aquatic Plant Surveys: A summary of the percent occurrence of individual species on a lakewide basis for late summer surveys is shown in Table S3. Since 1995, it appears up to five native submerged plant species have increased in distribution with coontail being the dominant plant. Curlyleaf appears to have decreased. The species diversity has remained relatively stable.

Table S3. The percent occurrence of aquatic plants for Orchard Lake for 1995 and 1999 through 2017 for late summer surv eys. For curlyleaf control, early in the summer mechanical harvesting has occurred from 2004 to 2008 (blue shading) and herbicides w ere applied in 2009 through 2012 and 2015 and 2016 (green shading)(1995 data are from Barr Engineering Company , Diagnostic Study of Orchard Lake, 1999).

	Late Summer Aquatic Plant Surveys																			
	Aug 20, 1995 % Occur (based on 57 stat)	Aug 14, 1999 % Occur (based on 39 stat)	Oct 6, 2000 % Occur (based on 39 stat)	Sep 17, 2001 % Occur (based on 39 stat)	Sep 8, 2002 % Occur (based on 39 stat)	Aug 20, 2003 % Occur (based on 39 stat)	Aug 29, 2004 % Occur (based on 26 stat)	Aug 22, 2005 % Occur (based on 30 stat)	Aug 21, 2006 % Occur (based on 30 stat)	Aug 26, 2007 % Occur (based on 26 stat)	Sep 1, 2008 % Occur (based on 28 stat)	Aug 4, 2009 % Occur (based on 31 stat)	Aug 10, 2010 % Occur (based on 39 stat)	Aug 1, 2011 % Occur (based on 39 stat)	Jul 27 2012 % Occur (based on 39 stat)	Jul 30, 2013 % Occur (based on 39 stat)	Jul 29, 2014 % Occur (based on 39 stat)	Jul 24, 2015 % Occur (based on 39 stat)	Jul 27, 2016 % Occur (based on 39 stat)	Jul 12, 2017 % Occur (based on 39 stat)
Duckweed (*Lemna sp*)	--	--	--	--	--	3	--	3	--	--	4	10	8	8	8	3	--	--	--	--
Spatterdock (*Nuphar variegatum*)	--	10	8	8	10	8	12	13	10	12	14	13	5	8	8	5	3	5	--	--
White waterlily (*Nymphaea sp*)	--	8	13	12	10	13	27	17	17	19	11	16	8	13	8	10	10	5	10	--
Marsh marigold (*Bidens beckii*)	--	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--
Coontail (*Ceratophyllum demersum*)	74	85	56	88	90	90	100	90	93	88	82	74	69	72	87	74	77	85	67	85
Chara (*Chara sp.*)	18	26	8	27	10	5	19	13	17	19	25	26	18	21	15	13	15	15	49	36
Elodea (*Elodea canadensis*)	--	--	--	--	--	--	--	--	--	--	--	--	5	5	8	5	10	--	--	--
Star duckweed (*Lemna trisulca*)	--	--	3	--	5	5	8	17	17	15	4	3	--	10	--	10	13	10	5	10
Northern watermilfoil (*Myriophyllum sibiricum*)	21	5	23	46	33	13	54	33	27	27	36	84	62	56	46	41	59	31	36	79
Naiads (*Najas sp*)	13	--	--	--	--	3	--	3	--	--	4	--	--	--	--	--	--	--	--	--
Cabbage (*Potamogeton amplifolius*)	8	3	13	23	10	8	27	27	27	19	7	10	13	18	13	23	31	10	5	3
Curlyleaf pondweed (*P. crispus*)	55	--	23	4	5	26	--	7	--	4	11	13	--	--	--	--	--	3	3	3
Illinois pondweed (*P. illinoensis*)	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	5	--	--	--
Whitestem pondweed (*P. praelongus*)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	--	3	--
Claspingleaf pondweed (*P. Richardsonii*)	18	3	5	8	3	8	8	--	7	4	4	--	5	8	13	18	28	10	15	8
Stringy/Narrowleaf (*P. sp*)	--	--	--	--	--	--	--	--	--	--	--	3	--	3	--	--	--	3	--	--
Flatstem pondweed (*P. zosteriformis*)	13	5	--	4	8	--	4	3	--	--	--	--	--	--	--	--	8	--	--	5
Buttercup (*Ranunculus sp*)	--	--	--	--	--	--	8	--	--	--	--	6	10	8	15	13	18	5	5	8
Sago pondweed (*Stuckenia pectinatus*)	8	--	8	4	--	--	8	3	3	--	--	--	3	--	3	3	3	3	3	--
Water celery (*Vallisneria americana*)	--	--	3	--	3	13	12	13	3	12	4	--	15	5	10	5	18	8	13	5
Water stargrass (*Zosterella dubia*)	--	--	--	--	--	3	27	13	3	8	11	29	23	3	13	8	28	10	13	15
Number of submerged species	9	6	10	8	9	10	11	11	9	9	11	12	10	11	11	11	13	12	12	11

Summary of Orchard Lake Water Quality: Summer averages for clarity (using a Secchi disc), phosphorus, and algae (using chlorophyll analysis) are shown in Table S4. An average of water quality parameters for years with no curlyleaf treatment, years with harvesting, and years with herbicide use are shown in Table S5. Orchard Lake is not in the impaired status category (impaired criteria are shown in Table S6). In fact, water quality has improved in Orchard Lake over the years when curlyleaf control was conducted.

Table S4. Water quality summary for Orchard Lake. Data are May-September averages from the Met Council CAMP program. Blue shading represents years of significant curlyleaf pondweed harvesting and green shading represents a herbicide application for curlyleaf pondweed in 2009 through 2012, 2015, and 2016.

	Secchi Disc (m)	Total Phosphorus (ppb)	Chlorophyll a (ppb)
1980	2.0	40	16
1981	3.0	26	11
1983	2.9	31	11
1987	1.8	--	--
1988	2.3	--	--
1989	2.1	28	14
1990	1.0	--	--
1991	1.9	--	--
1993	2.0	35	17
1995	1.3	44	31
1996	2.3	28	15
1998	1.9	38	24
1999	2.1	34	30
2000	2.0	39	20
2001	2.3	25	13
2004	2.6	38	17
2005	2.4	32	12
2006	2.2	34	14
2007	1.6	41	23
2008	3.0	24	11
2009	3.7	15	3.7
2010	3.0	27	7.6
2011	2.7	20	5.6
2012	2.8	23	4.7
2013	3.1	16	4.0
2014	2.4	19	5.6
2015	2.7	17	9.8
2016	2.7	23	5.9

Table S5. Water quality averages for years of no lakewide curlyleaf control (1993-2001) and harvesting (2004-2008), and with herbicide applications (2009-2012 and 2015 and 2016). No herbicides were used in 2013 and 2014.

	Secchi Disc (m)	Total Phosphorus (ppb)	Chlorophyll a (ppb)
1993 - 2001 Average (no CLP management)	2.1	35	21
2004 - 2008 Average (harvesting)	2.4	34	15
2009 - 2012 Average (herbicides)	3.3	21	5.4
2013-2014 Average (no CLP management)	2.8	18	4.8
2009-2012, 2015 & 2016 Average (herbicides)	2.9	21	6.2

Table S6. MPCA nutrient criteria for impaired lakes (MPCA 2005). Orchard Lake is a deep lake. Water quality results indicate Orchard Lake is not in the impaired category.

	Secchi Disc (m)	Total Phosphorus (ppb)	Chlorophyll a (ppb)
Shallow Lake	>1.0	<60	<20
Deep Lake	>1.4	<40	<14

Recommendations for Curlyleaf Pondweed in Orchard Lake

The aquatic plant community in Orchard Lake is fairly diverse and 11 submerged aquatic plant species were observed in July of 2017. Native plants cover nearly 50% of the lake bottom in summer. If native plant distribution is maintained, water clarity should remain high as well. Because the curlyleaf pondweed dieback contributes phosphorus and can increase algal growth, continuing the curlyleaf pondweed control program is recommended. The harvesting program was used for curlyleaf control from 2004-2008 and remains an option. However, herbicide treatments can also be effective. From 2009 through 2012, between 20 to 26 acres of curlyleaf were treated with an endothall herbicide. In 2013 and 2014, curlyleaf growth was light and no treatment was conducted. In 2015, curlyleaf was treated on 7.3 acres. In 2016, curlyleaf was treated on 2.9 acres. In 2017, curlyleaf was treated in 14.5 acres. In 2018, a partial lake endothall treatment for curlyleaf pondweed is recommended where growth is predicted to be heavy.

Table S7. Curlyleaf pondweed treatment in Orchard Lake.

	Harvesting (ac)	Herbicide Treatment (ac)
2004	63	--
2005	68	--
2006	70	--
2007	70	--
2008	70	--
2009	50*	20
2010	--	24.5
2011	--	26.1
2012	--	23
2013	--	--
2014	--	--
2015	--	7.34
2016	--	2.9
2017	--	14.5

* 50 acres were proposed to be harvested but less than 10 acres actually required harvesting. The herbicide treatment in 2009 appeared to have a wider control on curlyleaf than expected. The harvesters did not find very much standing curlyleaf to harvest.

Appendix B

Orchard Lake Floristic Quality Assessment Data

2004 Orchard Lake Submergent Zone Vegetation Floristic Quality Index

Species	Common Name	Coefficient of Conservatism Value (C-value)
Ceratophyllum demersum	coontail	2
Chara sp.	muskgrass	7
Lemna trisulca	star duckweed	5
Myriophyllum sibiricum	Siberian Water-Milfoil	7
Nuphar lutea	yellow pond-lily	6
Nymphaea odorata	white waterlily	6
Potamogeton amplifolius	largeleaf pondweed	7
Potamogeton crispus	curlyleaf pondweed	0
Potamogeton richardsonii	clasping-leaf pondweed	5
Potamogeton zosteriformis	flatstem pondweed	6
Ranunculus sp. **	crowfoot	5.5
Stuckenia pectinatus	sago pondweed	3
Vallisneria americana	wild celery	6
Zosterella dubia	water stargrass	6
Mean C-value		5.1
S (Number of Species of Submergent/Floating-leaf Plants in the Lake)		14
Floristic Quality Index (FQI) = (Mean C-value)* (Square Root of S)		19.11

2005 Orchard Lake Submergent Zone Vegetation Floristic Quality Index

Species	Common Name	Coefficient of Conservatism Value (C-value)
Ceratophyllum demersum	coontail	2
Chara sp.	muskgrass	7
Lemna minor	common duckweed	5
Lemna trisulca	star duckweed	5
Myriophyllum sibiricum	Siberian Water-Milfoil	7
Najas flexilis	flexuous naiad	5
Nuphar lutea	yellow pond-lily	6
Nymphaea odorata	white waterlily	6
Potamogeton amplifolius	largeleaf pondweed	7
Potamogeton crispus	curlyleaf pondweed	0
Potamogeton zosteriformis	flatstem pondweed	6
Ranunculus sp. **	crowfoot	5.5
Stuckenia pectinatus	sago pondweed	3
Vallisneria americana	wild celery	6
Zosterella dubia	water stargrass	6
Mean C-value		5.1
S (Number of Species of Submergent/Floating-leaf Plants in the Lake)		15
Floristic Quality Index (FQI) = (Mean C-value)* (Square Root of S)		19.75

2006 Orchard Lake Submergent Zone Vegetation Floristic Quality Index

Species	Common Name	Coefficient of Conservatism Value (C-value)
Ceratophyllum demersum	coontail	2
Chara sp.	muskgrass	7
Lemna minor	common duckweed	5
Lemna trisulca	star duckweed	5
Myriophyllum sibiricum	Siberian Water-Milfoil	7
Najas flexilis	flexuous naiad	5
Nuphar lutea	yellow pond-lily	6
Nymphaea odorata	white waterlily	6
Potamogeton amplifolius	largeleaf pondweed	7
Potamogeton crispus	curlyleaf pondweed	0
Potamogeton richardsonii	clasping-leaf pondweed	5
Potamogeton zosteriformis	flatstem pondweed	6
Ranunculus sp. **	crowfoot	5.5
Stuckenia pectinatus	sago pondweed	3
Vallisneria americana	wild celery	6
Zosterella dubia	water stargrass	6
Mean C-value		5.1
S (Number of Species of Submergent/Floating-leaf Plants in the Lake)		16
Floristic Quality Index (FQI) = (Mean C-value)* (Square Root of S)		20.38

2007 Orchard Lake Submergent Zone Vegetation Floristic Quality Index

Species	Common Name	Coefficient of Conservatism Value (C-value)
Ceratophyllum demersum	coontail	2
Chara sp.	muskgrass	7
Lemna trisulca	star duckweed	5
Myriophyllum sibiricum	Siberian Water-Milfoil	7
Nuphar lutea	yellow pond-lily	6
Nymphaea odorata	white waterlily	6
Potamogeton amplifolius	largeleaf pondweed	7
Potamogeton crispus	curlyleaf pondweed	0
Potamogeton richardsonii	clasping-leaf pondweed	5
Ranunculus sp. **	crowfoot	5.5
Vallisneria americana	wild celery	6
Zosterella dubia	water stargrass	6
Mean C-value		5.2
S (Number of Species of Submergent/Floating-leaf Plants in the Lake)		12
Floristic Quality Index (FQI) = (Mean C-value)* (Square Root of S)		18.04

2008 Orchard Lake Submergent Zone Vegetation Floristic Quality Index

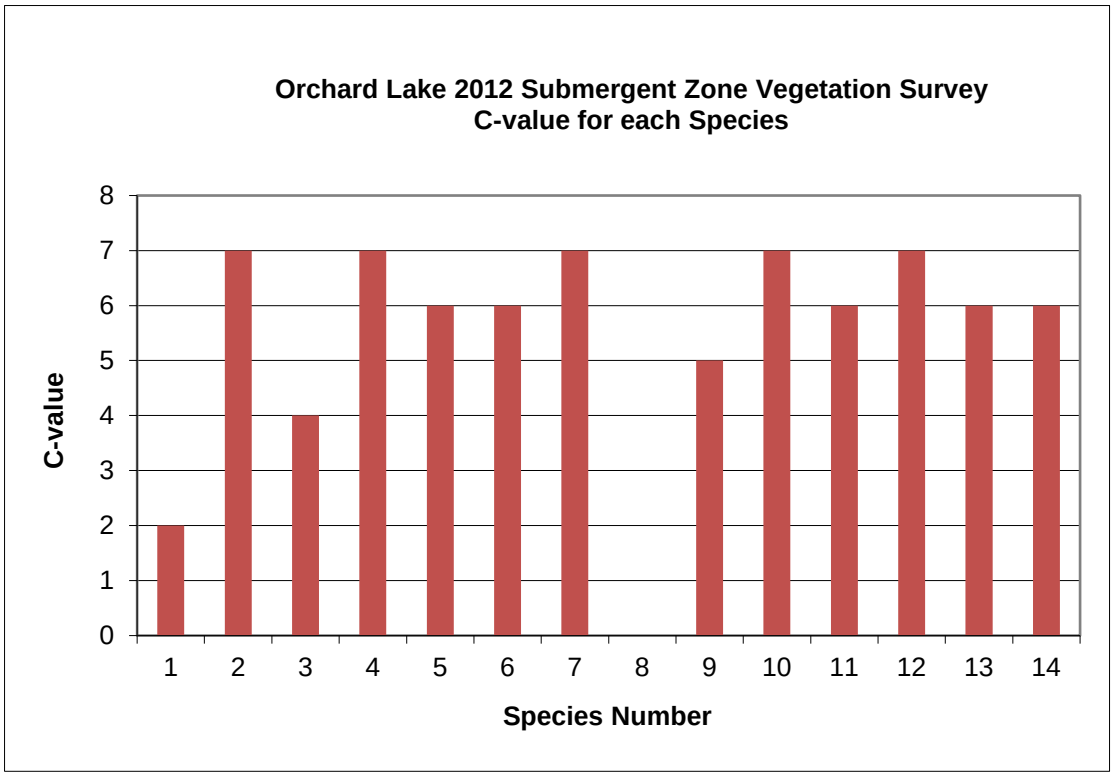
Species	Common Name	Coefficient of Conservatism Value (C-value)
Bidens beckii	Beck's water marigold	8
Ceratophyllum demersum	coontail	2
Chara sp.	muskgrass	7
Lemna sp. **	duckweed	5
Lemna trisulca	star duckweed	5
Myriophyllum sibiricum	Siberian Water-Milfoil	7
Najas flexilis	flexuous naiad	5
Nuphar lutea	yellow pond-lily	6
Nymphaea odorata	white waterlily	6
Potamogeton amplifolius	largeleaf pondweed	7
Potamogeton crispus	curlyleaf pondweed	0
Potamogeton pusillus	leafy pondweed	7
Potamogeton richardsonii	clasping-leaf pondweed	5
Vallisneria americana	wild celery	6
Zosterella dubia	water stargrass	6
Mean C-value		5.5
S (Number of Species of Submergent/Floating-leaf Plants in the Lake)		15
Floristic Quality Index (FQI) = (Mean C-value)* (Square Root of S)		21.17

2009 Orchard Lake Submergent Zone Vegetation Floristic Quality Index

Species	Common Name	Coefficient of Conservatism Value (C-value)
Ceratophyllum demersum	coontail	2
Chara sp.	muskgrass	7
Lemna sp.	duckweed	5
Lemna trisulca	star duckweed	5
Myriophyllum sibiricum	Siberian Water-Milfoil	7
Nuphar lutea	yellow pond-lily	6
Nymphaea odorata	white waterlily	6
Potamogeton amplifolius	largeleaf pondweed	7
Potamogeton crispus	curlyleaf pondweed	0
Potamogeton pusillus	leafy pondweed	7
Ranunculus sp.	crowfoot	5
Zosterella dubia	water stargrass	6
Mean C-value		5.3
S (Number of Species of Submergent/Floating-leaf Plants in the Lake)		12
Floristic Quality Index (FQI) = (Mean C-value)* (Square Root of S)		18.19

2012 Orchard Lake Submergent Zone Vegetation Floristic Quality Index

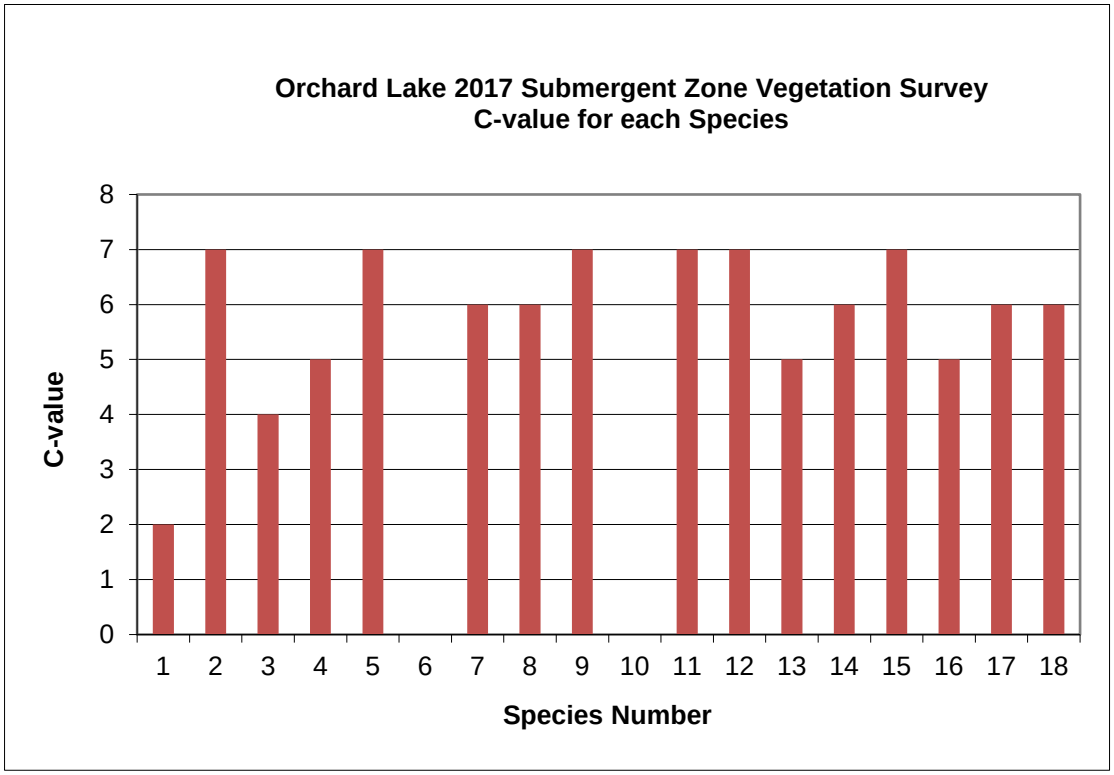
Species	Common Name	Coefficient of Conservatism Value (C-value)
Ceratophyllum demersum	coontail	2
Chara sp.	muskgrass	7
Elodea canadensis	elodea	4
Myriophyllum sibiricum	Siberian Water-Milfoil	7
Nuphar lutea	yellow pond-lily	6
Nymphaea odorata	white waterlily	6
Potamogeton amplifolius	largeleaf pondweed	7
Potamogeton crispus	curlyleaf pondweed	0
Potamogeton richardsonii	clasping-leaf pondweed	5
Potamogeton pusillus	leafy pondweed	7
Potamogeton zosteriformis	flatstem pondweed	6
Ranunculus longirostris	white water crowfoot	7
Vallisneria americana	wild celery	6
Zosterella dubia	water stargrass	6
Mean C-value		5.4
S (Number of Species of Submergent/Floating-leaf Plants in the Lake)		14
Floristic Quality Index (FQI) = (Mean C-value)* (Square Root of S)		20.31



Species Number	Scientific Name	Common Name	C-value
1	*Ceratophyllum demersum*	coontail	2
2	*Chara sp.*	muskgrass	7
3	*Elodea canadensis*	elodea	4
4	*Myriophyllum sibiricum*	Siberian Water-Milfoil	7
5	*Nuphar lutea*	yellow pond-lily	6
6	*Nymphaea odorata*	white waterlily	6
7	*Potamogeton amplifolius*	largeleaf pondweed	7
8	*Potamogeton crispus*	curlyleaf pondweed	0
9	*Potamogeton richardsonii*	clasping-leaf pondweed	5
10	*Potamogeton pusillus*	leafy pondweed	7
11	*Potamogeton zosteriformis*	flatstem pondweed	6
12	*Ranunculus longirostris*	white water crowfoot	7
13	*Vallisneria americana*	wild celery	6
14	*Zosterella dubia*	water stargrass	6

2017 Orchard Lake Submergent Zone Vegetation Floristic Quality Index

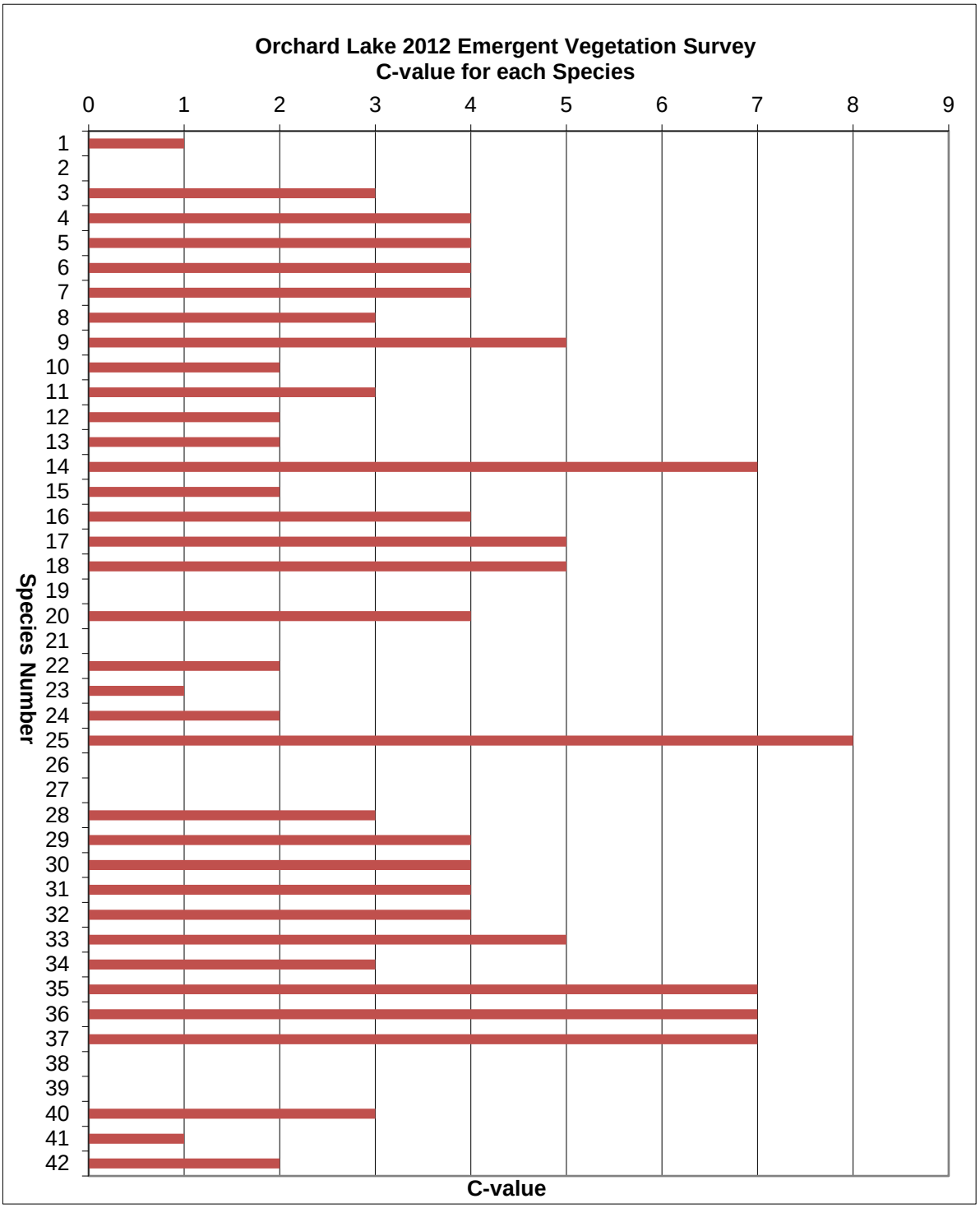
Species	Common Name	Coefficient of Conservatism Value (C-value)
Ceratophyllum demersum	coontail	2
Chara sp.	muskgrass	7
Elodea canadensis	elodea	4
Lemna trisulca	star duckweed	5
Myriophyllum sibiricum	Siberian Water-Milfoil	7
Myriophyllum spicatum	Eurasian watermilfoil	0
Nuphar lutea	yellow pond-lily	6
Nymphaea odorata	white waterlily	6
Potamogeton amplifolius	largeleaf pondweed	7
Potamogeton crispus	curlyleaf pondweed	0
Potamogeton praelongus	white stemmed pondweed	7
Potamogeton pusillus	leafy pondweed	7
Potamogeton richardsonii	clasping-leaf pondweed	5
Potamogeton zosteriformis	flatstem pondweed	6
Ranunculus longirostris	white water crowfoot	7
Utricularia macrorhiza	common bladderwort	5
Vallisneria americana	wild celery	6
Zosterella dubia	water stargrass	6
Mean C-value		5.2
S (Number of Species of Submergent/Floating-leaf Plants in the Lake)		18
Floristic Quality Index (FQI) = (Mean C-value)* (Square Root of S)		21.92



Species Number	Scientific Name	Common Name	C-value
1	*Ceratophyllum demersum*	coontail	2
2	*Chara sp.*	muskgrass	7
3	*Elodea canadensis*	elodea	4
4	*Lemna trisulca*	star duckweed	5
5	*Myriophyllum sibiricum*	Siberian Water-Milfoil	7
6	*Myriophyllum spicatum*	Eurasian watermilfoil	0
7	*Nuphar lutea*	yellow pond-lily	6
8	*Nymphaea odorata*	white waterlily	6
9	*Potamogeton amplifolius*	largeleaf pondweed	7
10	*Potamogeton crispus*	curlyleaf pondweed	0
11	*Potamogeton praelongus*	white stemmed pondweed	7
12	*Potamogeton pusillus*	leafy pondweed	7
13	*Potamogeton richardsonii*	clasping-leaf pondweed	5
14	*Potamogeton zosteriformis*	flatstem pondweed	6
15	*Ranunculus longirostris*	white water crowfoot	7
16	*Utricularia macrorhiza*	common bladderwort	5
17	*Vallisneria americana*	wild celery	6
18	*Zosterella dubia*	water stargrass	6

2012 Orchard Lake Emergent Vegetation Floristic Quality Index

Species	Common Name	Coefficient of Conservatism Value
Acer negundo	boxelder	1
Ambrosia trifida	great ragweed	0
Anemone canadensis	Canadian anemone	3
Asclepias incarnata	swamp milkweed	4
Calamagrostis canadensis	Bluejoint	4
Carex comosa	Bearded Sedge	4
Carex scoparia	broom sedge	4
Carex stipata	Stalk-Grain Sedge	3
Carex stricta	Uptight Sedge	5
Cornus racemosa	gray dogwood	2
Eleocharis obtusa	blunt spikerush	3
Equisetum hyemale	scouringrush horsetail	2
Fraxinus pennsylvanica	green ash	2
Glyceria canadensis	Rattlesnake Manna Grass	7
Impatiens capensis	jewelweed	2
Iris versicolor	harlequin blueflag	4
Lemna minor	common duckweed	5
Lycopus uniflorus	northern bugleweed	5
Lythrum salicaria	purple loosestrife	0
Persicaria sagittata	Arrow-Leaf Tearthumb	4
Phalaris arundinacea	reed canarygrass	0
Polygonum lapathifolium	curlytop knotweed	2
Populus deltoides	eastern cottonwood	1
Populus tremuloides	quaking aspen	2
Quercus bicolor	Swamp White Oak	8
Rhamnus cathartica	common buckthorn	0
Rumex crispus ssp. Crispus	curly dock	0
Sagittaria latifolia	Duck-Potato	3
Salix nigra	black willow	4
Schoenoplectus fluviatilis	river bulrush	4
Schoenoplectus tabernaemontani	softstem bulrush	4
Scirpus atrovirens	green bulrush	4
Sium suave	hemlock waterparsnip	5
Solidago gigantea	Late Goldenrod	3
Streptopus lanceoloatus	Rose Twistedstalk	7
Thelypteris palustris	marsh fern	7
Toxicodendron radicans	eastern poison ivy	7
Typha angustifolia	narrowleaf cattail	0
Typha X glauca	hybrid cattail	0
Ulmus americana	American elm	3
Urtica dioica	Stinging Nettle	1
Vitis riparia	riverbank grape	2
Mean C-value		3.1
S (Number of Species of Emergent Plants in the Lake)		42
Floristic Quality Index (FQI) = (Mean C-value)* (Square Root of S)		20.21


Orchard Lake 2012 Emergent Vegetation Survey
C-value for each Species
0
1
2
3
4
5
6
7
8
9
1
2
3
4
5
6
7
8
9
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37
38
39
40
41
42
Species Number
C-value

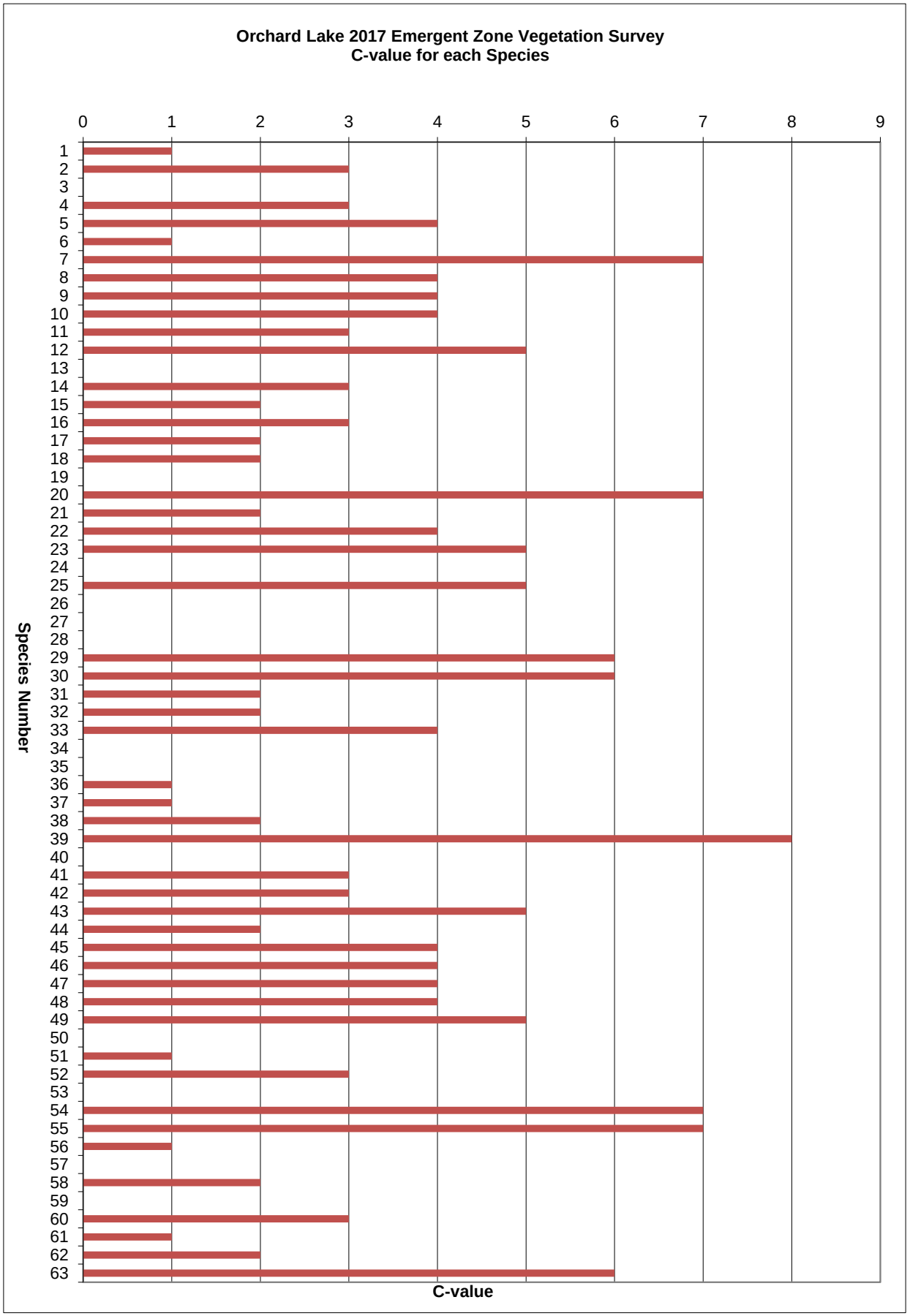
Orchard Lake 2012 Emergent Vegetation Survey

Species Number	Scientific Name	Common Name	C-value
1	*Acer negundo*	boxelder	1
2	*Ambrosia trifida var. trifida*	great ragweed	0
3	*Anemone canadensis*	Canadian anemone	3
4	*Asclepias incarnata ssp. Incarnata*	swamp milkweed	4
5	*Calamagrostis canadensis*	Bluejoint	4
6	*Carex comosa*	Bearded Sedge	4
7	*Carex scoparia var. scoparia*	broom sedge	4
8	*Carex stipata*	Stalk-Grain Sedge	3
9	*Carex stricta*	Uptight Sedge	5
10	*Cornus racemosa*	gray dogwood	2
11	*Eleocharis obtusa*	blunt spikerush	3
12	*Equisetum hyemale var. affine*	scouringrush horsetail	2
13	*Fraxinus pennsylvanica*	green ash	2
14	*Glyceria canadensis*	Rattlesnake Manna Grass	7
15	*Impatiens capensis*	jewelweed	2
16	*Iris versicolor*	harlequin blueflag	4
17	*Lemna minor*	common duckweed	5
18	*Lycopus uniflorus*	northern bugleweed	5
19	*Lythrum salicaria*	purple loosestrife	0
20	*Persicaria sagittata*	Arrow-Leaf Tearthumb	4
21	*Phalaris arundinacea*	reed canarygrass	0
22	*Polygonum lapathifolium*	curlytop knotweed	2
23	*Populus deltoides ssp. Monilifera*	eastern cottonwood	1
24	*Populus tremuloides*	quaking aspen	2
25	*Quercus bicolor*	Swamp White Oak	8
26	*Rhamnus cathartica*	common buckthorn	0
27	*Rumex crispus ssp. Crispus*	curly dock	0
28	*Sagittaria latifolia*	Duck-Potato	3
29	*Salix nigra*	black willow	4
30	*Schoenoplectus fluviatilis*	river bulrush	4
31	*Schoenoplectus tabernaemontani*	softstem bulrush	4
32	*Scirpus atrovirens*	green bulrush	4
33	*Sium suave*	hemlock waterparsnip	5
34	*Solidago gigantea*	Late Goldenrod	3
35	*Streptopus lanceoloatus*	Rose Twistedstalk	7
36	*Thelypteris palustris var. pubescens*	marsh fern	7
37	*Toxicodendron radicans*	eastern poison ivy	7
38	*Typha angustifolia*	narrowleaf cattail	0
39	*Typha X glauca*	hybrid cattail	0
40	*Ulmus americana*	American elm	3
41	*Urtica dioica*	Stinging Nettle	1
42	*Vitis riparia*	riverbank grape	2

2017 Orchard Lake Emergent Zone Vegetation Floristic Quality Index

Species	Common Name	Coefficient of Conservatism Value
Acer negundo	boxelder	1
Alnus incana	speckled alder	3
Ambrosia trifida	great ragweed	0
Anemone canadensis	Canadian anemone	3
Asclepias incarnata	swamp milkweed	4
Asclepias syriaca *	common milkweed	1
Brasenia schreberi	watershield	7
Calamagrostis canadensis	Bluejoint	4
Carex comosa	Bearded Sedge	4
Carex scoparia	broom sedge	4
Carex stipata	Stalk-Grain Sedge	3
Carex stricta	Uptight Sedge	5
Cirsium arvense	Canada thistle	0
Cornus alba	red-osier dogwood	3
Cornus racemosa	gray dogwood	2
Eleocharis obtusa	blunt spikerush	3
Equisetum hyemale	scouringrush horsetail	2
Fraxinus pennsylvanica	green ash	2
Gleditsia triacanthos	Honey-Locust	0
Glyceria canadensis	Rattlesnake Manna Grass	7
Impatiens capensis	jewelweed	2
Iris versicolor	harlequin blueflag	4
Lemna minor	common duckweed	5
Lotus corniculatus	bird's-foot trefoil	0
Lycopus uniflorus	northern bugleweed	5
Lythrum salicaria	purple loosestrife	0
Melilotus officinalis	yellow sweetclover	0
Miscanthus sacchariflorus	amur silver grass	0
Nuphar lutea	yellow pond-lily	6
Nymphaea odorata	white waterlily	6
Parthenocissus vitacea	woodbine	2
Persicaria lapathifolium	curlytop knotweed	2
Persicaria sagittata	Arrow-Leaf Tearthumb	4
Phalaris arundinacea	reed canarygrass	0
Phleum pratense	Common Timothy	0
Phragmites australis	common reed grass	1
Populus deltoides	eastern cottonwood	1
Populus tremuloides	quaking aspen	2
Quercus bicolor	Swamp White Oak	8
Rhamnus cathartica	common buckthorn	0
Rubus idaeus	Common Red Raspberry	3
Sagittaria latifolia	Duck-Potato	3
Salix amygdaloides	peach leaved willow	5
Salix interior	sandbar willow	2
Salix nigra	black willow	4

Schoenoplectus fluviatilis	river bulrush	4
Schoenoplectus tabernaemontani	softstem bulrush	4
Scirpus atrovirens	green bulrush	4
Sium suave	hemlock waterparsnip	5
Solanum dulcamara	nightshade	0
Solidago canadensis	Canada goldenrod	1
Solidago gigantea	Late Goldenrod	3
Sonchus arvensis	sow thistle	0
Streptopus lanceoloatus	Rose Twistedstalk	7
Thelypteris palustris	marsh fern	7
Toxicodendron rydbergii	western poison ivy	1
Typha angustifolia	narrowleaf cattail	0
Typha latifolia	broad leaf cattail	2
Typha X glauca	hybrid cattail	0
Ulmus americana	American elm	3
Urtica dioica	Stinging Nettle	1
Vitis riparia	riverbank grape	2
Zizia aurea	golden alexanders	6
Mean C-value		2.7
S (Number of Species of Emergent Plants in the Lake)		63
Floristic Quality Index (FQI) = (Mean C-value)* (Square Root of S)		21.80


Orchard Lake 2017 Emergent Zone Vegetation Survey
C-value for each Species
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Species Number
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C-value

Orchard Lake 2017 Emergent Zone Vegetation Survey

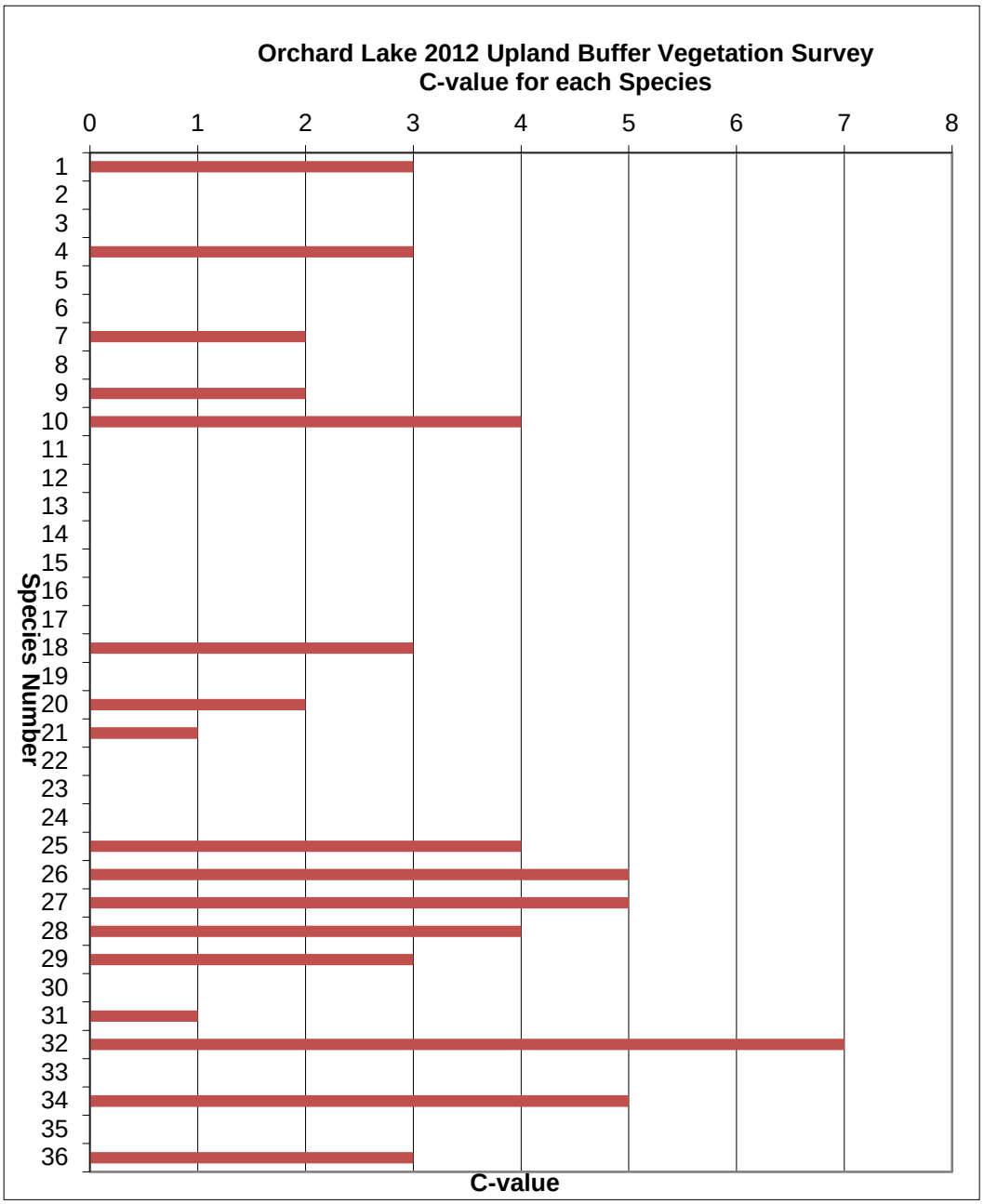
Species Number	Scientific Name	Common Name	C-value
1	*Acer negundo*	boxelder	1
2	*Alnus incana*	speckled alder	3
3	*Ambrosia trifida*	great ragweed	0
4	*Anemone canadensis*	Canadian anemone	3
5	*Asclepias incarnata*	swamp milkweed	4
6	*Asclepias syriaca* *	common milkweed	1
7	*Brasenia schreberi*	watershield	7
8	*Calamagrostis canadensis*	Bluejoint	4
9	*Carex comosa*	Bearded Sedge	4
10	*Carex scoparia*	broom sedge	4
11	*Carex stipata*	Stalk-Grain Sedge	3
12	*Carex stricta*	Uptight Sedge	5
13	*Cirsium arvense*	Canada thistle	0
14	*Cornus alba*	red-osier dogwood	3
15	*Cornus racemosa*	gray dogwood	2
16	*Eleocharis obtusa*	blunt spikerush	3
17	*Equisetum hyemale*	scouringrush horsetail	2
18	*Fraxinus pennsylvanica*	green ash	2
19	*Gleditsia triacanthos*	Honey-Locust	0
20	*Glyceria canadensis*	Rattlesnake Manna Grass	7
21	*Impatiens capensis*	jewelweed	2
22	*Iris versicolor*	harlequin blueflag	4
23	*Lemna minor*	common duckweed	5
24	*Lotus corniculatus*	bird's-foot trefoil	0
25	*Lycopus uniflorus*	northern bugleweed	5
26	*Lythrum salicaria*	purple loosestrife	0
27	*Melilotus officinalis*	yellow sweetclover	0
28	*Miscanthus sacchariflorus*	amur silver grass	0
29	*Nuphar lutea*	yellow pond-lily	6
30	*Nymphaea odorata*	white waterlily	6
31	*Parthenocissus vitacea*	woodbine	2
32	*Persicaria lapathifolium*	curlytop knotweed	2
33	*Persicaria sagittata*	Arrow-Leaf Tearthumb	4
34	*Phalaris arundinacea*	reed canarygrass	0
35	*Phleum pratense*	Common Timothy	0
36	*Phragmites australis*	common reed grass	1
37	*Populus deltoides*	eastern cottonwood	1
38	*Populus tremuloides*	quaking aspen	2
39	*Quercus bicolor*	Swamp White Oak	8
40	*Rhamnus cathartica*	common buckthorn	0
41	*Rubus idaeus*	Common Red Raspberry	3
42	*Sagittaria latifolia*	Duck-Potato	3
43	*Salix amygdaloides*	peach leaved willow	5
44	*Salix interior*	sandbar willow	2
45	*Salix nigra*	black willow	4
46	*Schoenoplectus fluviatilis*	river bulrush	4
47	*Schoenoplectus tabernaemontani*	softstem bulrush	4
48	*Scirpus atrovirens*	green bulrush	4
49	*Sium suave*	hemlock waterparsnip	5
50	*Solanum dulcamara*	nightshade	0
51	*Solidago canadensis*	Canada goldenrod	1
52	*Solidago gigantea*	Late Goldenrod	3
53	*Sonchus arvensis*	sow thistle	0
54	*Streptopus lanceoloatus*	Rose Twistedstalk	7
55	*Thelypteris palustris*	marsh fern	7
56	*Toxicodendron rydbergii*	western poison ivy	1
57	*Typha angustifolia*	narrowleaf cattail	0
58	*Typha latifolia*	broad leaf cattail	2
59	*Typha X glauca*	hybrid cattail	0
60	*Ulmus americana*	American elm	3
61	*Urtica dioica*	Stinging Nettle	1
62	*Vitis riparia*	riverbank grape	2
63	*Zizia aurea*	golden alexanders	6

2012 Orchard Lake Upland Buffer Vegetation Floristic Quality Index

Species	Common Name	Coefficient of Conservatism Value (C-value)
Acer saccharinum	Silver Maple	3
Arctium minus	burrdock	0
Asclepias syriaca *	common milkweed	1
Carex pensylvanica *	Pennsylvania sedge	3
Centaurea biebersteinii	Spotted Knapweed	0
Cirsium arvense	Canada thistle	0
Cornus racemosa	gray dogwood	2
Dactylis glomerata	Orchard Grass	0
Erigeron strigosus	Prairie Fleabane	2
Geranium maculatum	Spotted Crane's-Bill	4
Gleditsia triacanthos	Honey-Locust	0
Hemerocallis fulva	orange day lily	0
Lactuca serriola	prickly lettuce	0
Lonicera tatarica	Tatarian honeysuckle	0
Lotus corniculatus	bird's-foot trefoil	0
Medicago lupulina	black medick	0
Melilotus officinalis	yellow sweetclover	0
Monarda fistulosa	Oswego-Tea	3
Oxalis stricta	Upright Yellow Wood-Sorrel	0
Parthenocissus vitacea	woodbine	2
Persicaria pensylvanica	Pinkweed	1
Phleum pratense	Common Timothy	0
Plantago major	common plantain	0
Poa pratensis	Kentucky bluegrass	0
Polygonatum biflorum	Solomon's seal	4
Quercus ellipsoidalis *	pin oak	5
Quercus rubra	northern red oak	5
Rhus spp. * **	sumac	4
Rubus idaeus	Common Red Raspberry	3
Sedum sp.	stonecrop	0
Solidago canadensis	Canada goldenrod	1
Streptopus lanceolatus	Lance-Leaf Twistedstalk	7
Taraxacum officinale	common dandelion	0
Tilia americana	American basswood	5
Trifolium pratense	red clover	0
Ulmus americana	American elm	3
Mean C-value		1.6
S (Number of Species of Upland Buffer Plants)		36
Floristic Quality Index (FQI) = (Mean C-value)* (Square Root of S)		9.67

* A C-value for this species has not been determined in Minnesota.
The C-value used is from the Wisconsin Floristic Quality Assessment.

** An average C-value was used for this genus, since the species were not verified.


Orchard Lake 2012 Upland Buffer Vegetation Survey
C-value for each Species
0
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Species Number
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C-value

Orchard Lake 2012 Upland Buffer Vegetation Survey

Species Number	Scientific Name	Common Name	C-value
1	*Acer saccharinum*	Silver Maple	3
2	*Arctium minus*	burrdock	0
3	*Asclepias syriaca*	common milkweed	0
4	*Carex pensylvanica* *	Pennsylvania sedge	3
5	*Centaurea biebersteinii*	Spotted Knapweed	0
6	*Cirsium arvense*	Canada thistle	0
7	*Cornus racemosa*	gray dogwood	2
8	*Dactylis glomerata*	Orchard Grass	0
9	*Erigeron strigosus*	Prairie Fleabane	2
10	*Geranium maculatum*	Spotted Crane's-Bill	4
11	*Gleditsia triacanthos*	Honey-Locust	0
12	*Hemerocallis fulva*	orange day lily	0
13	*Lactuca serriola*	prickly lettuce	0
14	*Lonicera tatarica*	Tatarian honeysuckle	0
15	*Lotus corniculatus*	bird's-foot trefoil	0
16	*Medicago lupulina*	black medick	0
17	*Melilotus officinalis*	yellow sweetclover	0
18	*Monarda fistulosa*	Oswego-Tea	3
19	*Oxalis stricta*	Upright Yellow Wood-Sorrel	0
20	*Parthenocissus vitacea*	woodbine	2
21	*Persicaria pensylvanica*	Pinkweed	1
22	*Phleum pratense*	Common Timothy	0
23	*Plantago major*	common plantain	0
24	*Poa pratensis*	Kentucky bluegrass	0
25	*Polygonatum biflorum*	Solomon's seal	4
26	*Quercus ellipsoidalis* *	pin oak	5
27	*Quercus rubra*	northern red oak	5
28	*Rhus spp.* * **	sumac	4
29	*Rubus idaeus*	Common Red Raspberry	3
30	*Sedum sp.*	stonecrop	0
31	*Solidago canadensis*	Canada goldenrod	1
32	*Streptopus lanceolatus*	Lance-Leaf Twistedstalk	7
33	*Taraxacum officinale*	common dandelion	0
34	*Tilia americana*	American basswood	5
35	*Trifolium pratense*	red clover	0
36	*Ulmus americana*	American elm	3

2017 Orchard Lake Upland Buffer Vegetation Floristic Quality Index

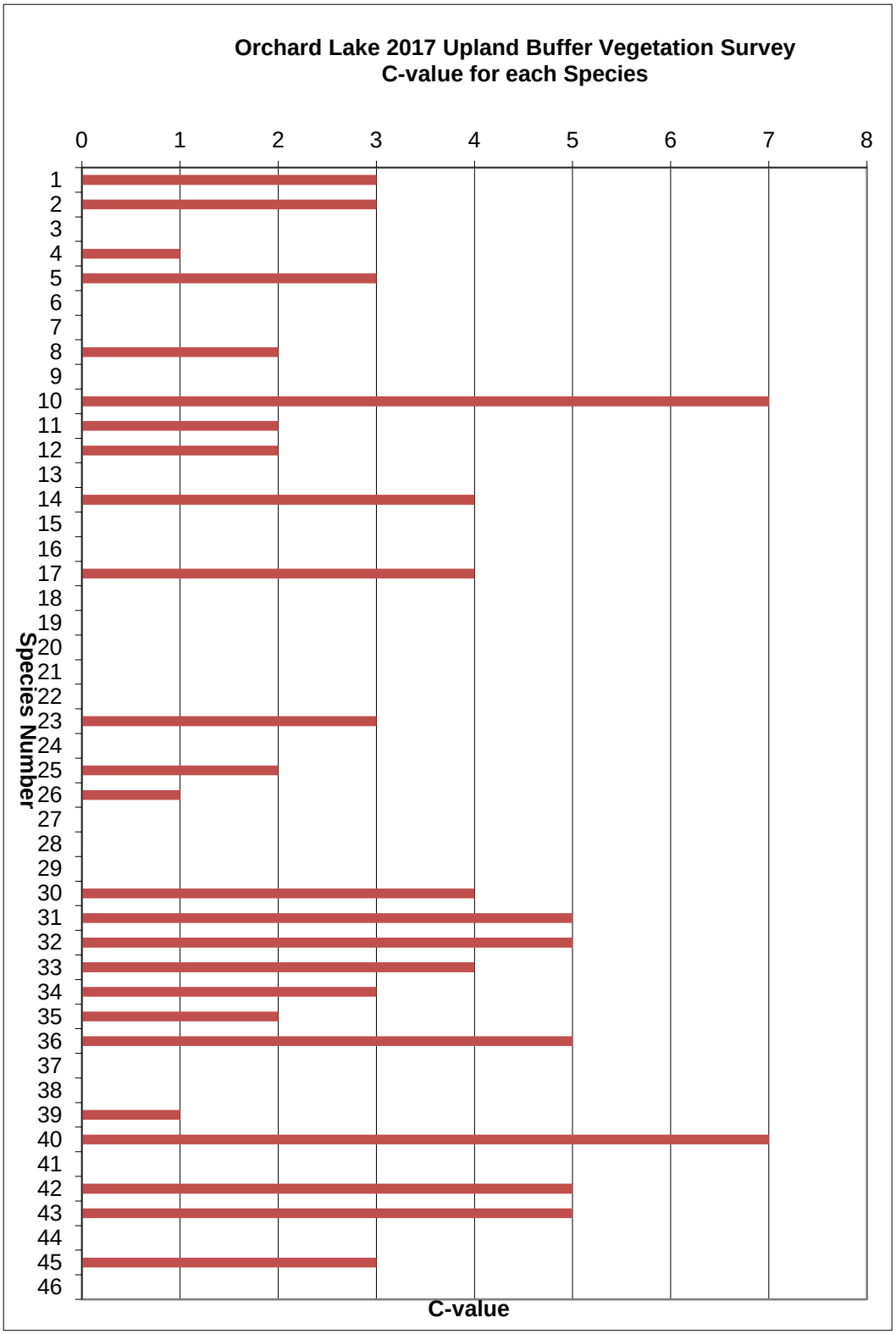
Species	Common Name	Coefficient of Conservatism Value (C-value)
Acer saccharinum	Silver Maple	3
Apocynum cannabinum	dogbane	3
Arctium minus	burrdock	0
Asclepias syriaca *	common milkweed	1
Carex pensylvanica *	Pennsylvania sedge	3
Centaurea biebersteinii	Spotted Knapweed	0
Cirsium arvense	Canada thistle	0
Cornus racemosa	gray dogwood	2
Dactylis glomerata	Orchard Grass	0
Dalea purpurea *	purple prairie clover	7
Equisetum hyemale	scouringrush horsetail	2
Erigeron strigosus	Prairie Fleabane	2
Euphorbia esula	leafy spurge	0
Geranium maculatum	Spotted Crane's-Bill	4
Gleditsia triacanthos	Honey-Locust	0
Hemerocallis fulva	orange day lily	0
Juglans nigra	black walnut	4
Lactuca serriola	prickly lettuce	0
Lonicera tatarica	Tatarian honeysuckle	0
Lotus corniculatus	bird's-foot trefoil	0
Medicago lupulina	black medick	0
Melilotus officinalis	yellow sweetclover	0
Monarda fistulosa	Oswego-Tea	3
Oxalis stricta	Upright Yellow Wood-Sorrel	0
Parthenocissus vitacea	woodbine	2
Persicaria pensylvanica	Pinkweed	1
Phleum pratense	Common Timothy	0
Plantago major	common plantain	0
Poa pratensis	Kentucky bluegrass	0
Polygonatum biflorum	Solomon's seal	4
Quercus ellipsoidalis *	pin oak	5
Quercus rubra	northern red oak	5
Rhus spp. * **	sumac	4
Rubus idaeus	Common Red Raspberry	3
Rubus occidentalis *	black raspberry	2
Sambucus racemosa	red-berried elder	5
Securigera varia	crown vetch	0
Sedum sp.	stonecrop	0
Solidago canadensis	Canada goldenrod	1
Streptopus lanceolatus	Lance-Leaf Twistedstalk	7
Taraxacum officinale	common dandelion	0
Thalictrum dioicum	early meadow-rue	5
Tilia americana	American basswood	5
Trifolium pratense	red clover	0

2017 Orchard Lake Upland Buffer Vegetation Floristic Quality Index

Species	Common Name	Coefficient of Conservatism Value (C-value)
Ulmus americana	American elm	3
Verbascum thapsus	common mullein	0
Mean C-value		1.9
S (Number of Species of Upland Buffer Plants)		46
Floristic Quality Index (FQI) = (Mean C-value)* (Square Root of S)		12.68

* A C-value for this species has not been determined in Minnesota.
The C-value used is from the Wisconsin Floristic Quality Assessment.

** An average C-value was used for this genus, since the species were not verified.


Orchard Lake 2017 Upland Buffer Vegetation Survey
C-value for each Species
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Species Number
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C-value

Orchard Lake 2017 Upland Buffer Vegetation Survey

Species Number	Scientific Name	Common Name	C-value
1	*Acer saccharinum*	Silver Maple	3
2	*Apocynum cannabinum*	dogbane	3
3	*Arctium minus*	burrdock	0
4	*Asclepias syriaca* *	common milkweed	1
5	*Carex pensylvanica* *	Pennsylvania sedge	3
6	*Centaurea biebersteinii*	Spotted Knapweed	0
7	*Cirsium arvense*	Canada thistle	0
8	*Cornus racemosa*	gray dogwood	2
9	*Dactylis glomerata*	Orchard Grass	0
10	*Dalea purpurea* *	purple prairie clover	7
11	*Equisetum hyemale*	scouringrush horsetail	2
12	*Erigeron strigosus*	Prairie Fleabane	2
13	*Euphorbia esula*	leafy spurge	0
14	*Geranium maculatum*	Spotted Crane's-Bill	4
15	*Gleditsia triacanthos*	Honey-Locust	0
16	*Hemerocallis fulva*	orange day lily	0
17	*Juglans nigra*	black walnut	4
18	*Lactuca serriola*	prickly lettuce	0
19	*Lonicera tatarica*	Tatarian honeysuckle	0
20	*Lotus corniculatus*	bird's-foot trefoil	0
21	*Medicago lupulina*	black medick	0
22	*Melilotus officinalis*	yellow sweetclover	0
23	*Monarda fistulosa*	Oswego-Tea	3
24	*Oxalis stricta*	Upright Yellow Wood-Sorrel	0
25	*Parthenocissus vitacea*	woodbine	2
26	*Persicaria pensylvanica*	Pinkweed	1
27	*Phleum pratense*	Common Timothy	0
28	*Plantago major*	common plantain	0
29	*Poa pratensis*	Kentucky bluegrass	0
30	*Polygonatum biflorum*	Solomon's seal	4
31	*Quercus ellipsoidalis* *	pin oak	5
32	*Quercus rubra*	northern red oak	5
33	*Rhus spp.* * **	sumac	4
34	*Rubus idaeus*	Common Red Raspberry	3
35	*Rubus occidentalis* *	black raspberry	2
36	*Sambucus racemosa*	red-berried elder	5
37	*Securigera varia*	crown vetch	0
38	*Sedum sp.*	stonecrop	0
39	*Solidago canadensis*	Canada goldenrod	1
40	*Streptopus lanceolatus*	Lance-Leaf Twistedstalk	7
41	*Taraxacum officinale*	common dandelion	0
42	*Thalictrum dioicum*	early meadow-rue	5
43	*Tilia americana*	American basswood	5
44	*Trifolium pratense*	red clover	0
45	*Ulmus americana*	American elm	3
46	*Verbascum thapsus*	common mullein	0

Community #1

Eggers & Reed Plant Community Type: Shallow Open Water

Percent of AA Occupied by Type: 75

Spp. #	Scientific Name	Common Name	Cover Class	CC Range	Midpoint CC	Native Status	Rapid FQA Stratum	NWI-GP	NWI-MW	NWI-NCNE	C	p	pC
1	Ceratophyllum demersum	Coon's-Tail	5	> 50 - 75%	62.5	Native	Aquatic	OBL	OBL	OBL	2	0.4864	0.9728
2	Elodea canadensis	Canadian Waterweed	3	> 5 - 25%	15	Native	Aquatic	OBL	OBL	OBL	4	0.1167	0.4669
3	Lemna trisulca	Ivy-Leaf Duckweed	3	> 5 - 25%	15	Native	Aquatic	OBL	OBL	OBL	5	0.1167	0.5837
4	Nuphar variegata	0	2	> 1 - 5%	3	Native	Aquatic	OBL	OBL	OBL	6	0.0233	0.1401
5	Nymphaea odorata	American White Water-Lily	2	> 1 - 5%	3	Native	Aquatic	OBL	OBL	OBL	6	0.0233	0.1401
6	Potamogeton amplifolius	Large-Leaf Pondweed	2	> 1 - 5%	3	Native	Aquatic	OBL	OBL	OBL	7	0.0233	0.1634
7	Potamogeton crispus	Curly Pondweed	2	> 1 - 5%	3	Introduced	Aquatic	OBL	OBL	OBL	0	0.0233	0
8	Potamogeton zosteriformis	Flat-Stem Pondweed	2	> 1 - 5%	3	Native	Aquatic	OBL	OBL	OBL	6	0.0233	0.1401
9	Ranunculus longirostris	Long-Beak Water-Crowfoot	3	> 5 - 25%	15	Native	Aquatic	OBL	OBL	OBL	7	0.1167	0.8171
10	Utricularia macrorhiza	Greater Bladderwort	2	> 1 - 5%	3	Native	Aquatic	OBL	OBL	OBL	5	0.0233	0.1167
11	Vallisneria americana	American Eel-Grass	2	> 1 - 5%	3	Native	Aquatic	OBL	OBL	OBL	6	0.0233	0.1401
12		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
13		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
14		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
15		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
16		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
17		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
18		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
19		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
20		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
21		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
22		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
23		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
24		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
25		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
26		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
27		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
28		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
29		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
30		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
31		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
32		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
33		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
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37		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
38		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
39		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
40		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
41		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
42		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
43		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
44		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
45		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
46		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
47		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
48		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
49		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
50		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
51		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
52		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
53		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
54		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
55		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
56		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
57		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
58		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
59		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
60		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

Community #2

Eggers & Reed Plant Community Type: Deep Marsh

Percent of AA Occupied by Type: 15

Spp. #	Scientific Name	Common Name	Cover Class	CC Range	Midpoint CC	Native Status	Rapid FQA Stratum	NWI-GP	NWI-MW	NWI-NCNE	C	p	pC
1	Asclepias incarnata	Swamp Milkweed	2	> 1 - 5%	3	Native	Herb	FACW	OBL	OBL	4	0.0258	0.103
2	Calamagrostis canadensis	Bluejoint	1	> 0 - 1%	0.5	Native	Herb	FACW	OBL	OBL	4	0.0043	0.0172
3	Carex comosa	Bearded Sedge	1	> 0 - 1%	0.5	Native	Herb	OBL	OBL	OBL	4	0.0043	0.0172
4	Carex stipata	Stalk-Grain Sedge	1	> 0 - 1%	0.5	Native	Herb	OBL	OBL	OBL	3	0.0043	0.0129
5	Carex stricta	Uptight Sedge	1	> 0 - 1%	0.5	Native	Herb	OBL	OBL	OBL	5	0.0043	0.0215
6	Alnus incana	Speckled Alder	1	> 0 - 1%	0.5	Native	Shrub	FACW	FACW	FACW	3	0.0043	0.0129
7	Brasenia schreberi	Watershield	3	> 5 - 25%	15	Native	Aquatic	OBL	OBL	OBL	7	0.1288	0.9013
8	Eleocharis obtusa	Blunt Spike-Rush	2	> 1 - 5%	3	Native	Herb	OBL	OBL	OBL	3	0.0258	0.0773
9	Glyceria canadensis	Rattlesnake Manna Grass	1	> 0 - 1%	0.5	Native	Herb	OBL	OBL	OBL	7	0.0043	0.03
10	Impatiens capensis	Spotted Touch-Me-Not	2	> 1 - 5%	3	Native	Herb	FACW	FACW	FACW	2	0.0258	0.0515
11	Iris versicolor	Harlequin Blueflag	2	> 1 - 5%	3	Native	Herb	OBL	OBL	OBL	4	0.0258	0.103
12	Lemna minor	Common Duckweed	2	> 1 - 5%	3	Native	Aquatic	OBL	OBL	OBL	5	0.0258	0.1288
13	Lycopus uniflorus	Northern Water-Horehound	1	> 0 - 1%	0.5	Native	Herb	OBL	OBL	OBL	5	0.0043	0.0215
14	Lythrum salicaria	Purple Loosestrife	2	> 1 - 5%	3	Introduced	Herb	OBL	OBL	OBL	0	0.0258	0
15	Nuphar variegata	0	2	> 1 - 5%	3	Native	Aquatic	OBL	OBL	OBL	6	0.0258	0.1545
16	Nymphaea odorata	American White Water-Lily	2	> 1 - 5%	3	Native	Aquatic	OBL	OBL	OBL	6	0.0258	0.1545
17	Phragmites australis	Common Reed	1	> 0 - 1%	0.5	Native	Herb	FACW	FACW	FACW	1	0.0043	0.0043
18	Sagittaria latifolia	Duck-Potato	1	> 0 - 1%	0.5	Native	Herb	OBL	OBL	OBL	3	0.0043	0.0129
19	Schoenoplectus fluviatilis	River Club-Rush	1	> 0 - 1%	0.5	Native	Herb	OBL	OBL	OBL	4	0.0043	0.0172
20	Schoenoplectus tabernaemontani	Soft-Stem Club-Rush	1	> 0 - 1%	0.5	Native	Herb	OBL	OBL	OBL	4	0.0043	0.0172
21	Sium suave	Hemlock Water-Parsnip	1	> 0 - 1%	0.5	Native	Herb	OBL	OBL	OBL	5	0.0043	0.0215
22	Thelypteris palustris	Eastern Marsh Fern	2	> 1 - 5%	3	Native	Herb	OBL	OBL	FACW	7	0.0258	0.1803
23	Typha angustifolia	Narrow-Leaf Cat-Tail	5	> 50 - 75%	62.5	Introduced	Herb	OBL	OBL	OBL	0	0.5365	0
24	Typha latifolia	Broad-Leaf Cat-Tail	2	> 1 - 5%	3	Native	Herb	OBL	OBL	OBL	2	0.0258	0.0515
25	Typha X glauca	0	2	> 1 - 5%	3	Introduced	Herb	OBL	OBL	OBL	0	0.0258	0
26		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
27		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
28		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
29		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
30		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
31		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
32		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
33		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
34		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
35		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
36		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
37		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
38		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
39		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
40		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
41		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
42		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
43		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
44		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
45		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
46		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
47		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
48		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
49		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
50		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
51		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
52		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
53		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
54		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
55		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
56		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
57		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
58		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
59		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
60		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

Community #3

Eggers & Reed Plant Community Type: Floodplain Forest

Percent of AA Occupied by Type: 10

Spp. #	Scientific Name	Common Name	Cover Class	CC Range	Midpoint CC	Native Status	Rapid FQA Stratum	NWI-GP	NWI-MW	NWI-NCNE	C	p	pC
1	Acer negundo	Ash-Leaf Maple	2	> 1 - 5%	3	Native	Tree	FAC	FAC	FAC	1	0.0179	0.0179
2	Ambrosia trifida	Great Ragweed	1	> 0 - 1%	0.5	Native	Herb	FAC	FAC	FAC	0	0.003	0
3	Anemone canadensis	Round-Leaf Thimbleweed	1	> 0 - 1%	0.5	Native	Herb	FACW	FACW	FACW	3	0.003	0.0089
4	Cirsium arvense	Canadian Thistle	1	> 0 - 1%	0.5	Introduced	Herb	FACU	FACU	FACU	0	0.003	0
5	Cornus alba	Red Osier	2	> 1 - 5%	3	Native	Shrub	FACW	FACW	FACW	3	0.0179	0.0536
6	Cornus racemosa	Gray Dogwood	1	> 0 - 1%	0.5	Native	Shrub	FAC	FAC	FAC	2	0.003	0.006
7	Fraxinus pennsylvanica	Green Ash	3	> 5 - 25%	15	Native	Tree	FAC	FACW	FACW	2	0.0893	0.1786
8	Parthenocissus inserta	Thicket-Creeper	2	> 1 - 5%	3	Native	Woody Vine	FAC	FACU	FACU	2	0.0179	0.0357
9	Persicaria lapathifolia	Dock-Leaf Smartweed	1	> 0 - 1%	0.5	Native	Herb	OBL	FACW	FACW	2	0.003	0.006
10	Persicaria sagittata	Arrow-Leaf Tearthumb	1	> 0 - 1%	0.5	Native	Herb	OBL	OBL	OBL	4	0.003	0.0119
11	Phalaris arundinacea	Reed Canary Grass	4	> 25 - 50%	37.5	Introduced	Herb	FACW	FACW	FACW	0	0.2232	0
12	Populus deltoides	Eastern Cottonwood	3	> 5 - 25%	15	Native	Tree	FAC	FAC	FAC	1	0.0893	0.0893
13	Populus tremuloides	Quaking Aspen	2	> 1 - 5%	3	Native	Tree	FAC	FAC	FAC*	2	0.0179	0.0357
14	Rhamnus cathartica	European Buckthorn	3	> 5 - 25%	15	Introduced	Shrub	FACU	FAC	FAC	0	0.0893	0
15	Rubus idaeus	Common Red Raspberry	2	> 1 - 5%	3	Native	Shrub	FACU	FACU	FAC*	3	0.0179	0.0536
16	Salix amygdaloides	Peach-Leaf Willow	2	> 1 - 5%	3	Native	Tree	FACW	FACW	FACW	5	0.0179	0.0893
17	Salix interior	Sandbar Willow	2	> 1 - 5%	3	Native	Shrub	FACW	FACW	FACW	2	0.0179	0.0357
18	Salix nigra	Black Willow	2	> 1 - 5%	3	Native	Tree	FACW	OBL	OBL	4	0.0179	0.0714
19	Solanum dulcamara	Climbing Nightshade	2	> 1 - 5%	3	Introduced	Woody Vine	FACU	FAC	FAC	0	0.0179	0
20	Solidago canadensis	Canadian Goldenrod	3	> 5 - 25%	15	Native	Herb	FACU	FACU	FACU	1	0.0893	0.0893
21	Solidago gigantea	Late Goldenrod	3	> 5 - 25%	15	Native	Herb	FAC	FACW	FACW	3	0.0893	0.2679
22	Sonchus arvensis	Field Sow-Thistle	1	> 0 - 1%	0.5	Introduced	Herb	FAC	FACU	FACU	0	0.003	0
23	Streptopus lanceolatus	Lance-Leaf Twistedstalk	1	> 0 - 1%	0.5	Native	Herb	FAC	FAC	FACU	7	0.003	0.0208
24	Toxicodendron rydbergii	Western Poison Ivy	2	> 1 - 5%	3	Native	Herb	FACU	FAC	FAC	1	0.0179	0.0179
25	Ulmus americana	American Elm	2	> 1 - 5%	3	Native	Tree	FAC	FACW	FACW	3	0.0179	0.0536
26	Urtica dioica	Stinging Nettle	2	> 1 - 5%	3	Native	Herb	FAC	FACW	FAC	1	0.0179	0.0179
27	Vitis riparia	River-Bank Grape	3	> 5 - 25%	15	Native	Woody Vine	FAC	FACW	FAC	2	0.0893	0.1786
28	Zizia aurea	Golden Alexanders	1	> 0 - 1%	0.5	Native	Herb	FAC	FAC	FAC	6	0.003	0.0179
29		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
30		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
31		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
32		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
33		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
34		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
35		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
36		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
37		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
38		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
39		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
40		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
41		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
42		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
43		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
44		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
45		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
46		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
47		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
48		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
49		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
50		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
51		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
52		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
53		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
54		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
55		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
56		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
57		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
58		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
59		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
60		#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

Metric Summary & Community Assessments

	Community #1	Community #2	Community #3
Community Type	Shallow Open Water	Deep Marsh	Floodplain Forest
wC	3.7	2.1	1.4
Numerical Condition Category	3	3	4
Condition Category	Fair	Fair	Poor

Additional Metrics			
Native Species Richness	10	22	23
Introduced Species Richness	1	3	5
Mean C	4.9	3.8	2.1
FQI	15.5	17.6	10.3
Total Midpoint % Cover	128.5	116.5	168
Total Introduced Spp. Cover	3	68.5	56.5
Proportion of Introduced Cover	0.02	0.59	0.34

Overall Assessment

Community #	Community Type	*wC*	Condition Category	Numerical Category	Proportion of AA	Proportion x Numerical Category
1	Shallow Open Water	3.7	Fair	3	0.75	2.25
2	Deep Marsh	2.1	Fair	3	0.15	0.45
3	Floodplain Forest	1.4	Poor	4	0.1	0.4

Weighted Average Numerical Category for AA **3**

Overall AA Condition **Fair**

Appendix C

2003-2016 Habitat Assessment Monitoring Results

Appendix C: 2003-2009 Habitat Assessment Monitoring Results
Black Dog Watershed Management Organization

Water Body	Monitoring Year	Approximate Proportion of the Water Body Which is Deep Water Habitat (~ > 20 ft. depth)	Vegetation Quality - Wet Areas													Vegetation Quality - Upland							Erosion/Sedimentation	
			Submergent Zone Sampling							Vegetated Emergent Zone Sampling						Upland Buffer Sampling								
			Overall Submergent Vegetative Quality[1]	Approximate Proportion of Water Body Typically Dominated By Submergent Vegetation (~ 2 - 20 ft. depth)	Average Native Plant Occurrence or Density Rating[2,3]	Total Number of Native Species[5]	Exotic Species			Emergent Zone Vegetative Quality[6]	Approximate Proportion of Emergent Zone (0 - 2 ft. depth) Within The Water Body	Approximate Total Percent Vegetative Cover Within The Entire Emergent Zone[7]	Total Number of Native Wetland Plant Species[8]	Exotic Species		Overall Upland Buffer Quality[10]	Unmanicured Buffer Width[11]	Estimated Total Vegetative Cover (Percent Range)[12]	Total Number of Native Plant Species[13]	Buffer Continuity (Percent Surrounding Water Body)[14]	Exotic Species		Shoreline Erosion (Percent of Shoreline)[16]	Sediment Deltas (Yes/No)
							Total Number of Species	Average Exotic Plant Occurrence Rating or Average Density Rating[2, 3]	Maximum Exotic Plant Occurrence Rating or Maximum Density Rating[4]					Number of Species	Total Exotic Emergent Percent Coverage[9]						Number of Species	Percent of Total Coverage[15]		
Crystal	2003	15%	Moderate	80%	1.5	15	2	1.1	1.1	Moderate	5%	26-50%	18	4	26-50%	Moderate	<10 ft.	>95%	16	26-50%	2	15-40%	0-10%	No
	2004		Excellent		1.2	14	2	1.1	2.9	Excellent		26-50%	16	6	26-50%	Moderate	<10 ft.	>95%	16	26-50%	4	15-40%	0-10%	No
	2005		Moderate		1.2	13	2	1.1	2.7	Excellent		26-50%	16	6	26-50%	Moderate	<10 ft.	>95%	17	26-50%	3	15-40%	0-10%	No
	2006		Excellent		1.0	17	2	1.5	3.2	Excellent		26-50%	18	8	26-50%	Moderate	<10 ft.	>95%	17	26-50%	3	15-40%	0-10%	No
	2007		Excellent		1.5	16	2	1.6	3.4	Excellent		26-50%	22	10	26-50%	Moderate	<10 ft.	>95%	15	26-50%	5	15-40%	0-10%	No
	2008		Moderate		1.3	15	2	1.6	2.5	Excellent		26-50%	21	12	26-50%	Moderate	<10 ft.	>95%	15	26-50%	5	15-40%	0-10%	No
	2009		Moderate		1.3	14	2	1.6	2.8	Excellent		26-50%	20	11	26-50%	Moderate	<10 ft.	>95%	15	26-50%	7	15-40%	0-10%	No
Keller	2003	0%	Moderate	90%	1.9	4	1	3.2	3.2	Poor	10%	51-75%	5	2	51-75%	Moderate	<10 ft.	>95%	7	76-100%	6	>40%	0-10%	No
	2004		Moderate		1.7	5	1	1.8	2.5	Moderate		51-75%	6	2	51-75%	Moderate	<10 ft.	>95%	7	76-100%	6	>40%	0-10%	No
	2005		Moderate		1.3	5	2	1.0	1.1	Moderate		51-75%	7	2	26-50%	Moderate	<10 ft.	>95%	8	76-100%	7	>40%	0-10%	No
	2006		Moderate		2.0	5	2	1.8	2.5	Moderate		51-75%	8	2	26-50%	Moderate	<10 ft.	>95%	8	76-100%	8	>40%	0-10%	No
	2007		Moderate		2.1	3	2	2.4	3.8	Moderate		51-75%	9	3	26-50%	Moderate	<10 ft.	>95%	5	76-100%	9	>40%	0-10%	No
	2008		Moderate		2.2	3	2	2.2	2.9	Moderate		51-75%	9	3	26-50%	Moderate	<10 ft.	>95%	6	76-100%	12	>40%	0-10%	No
	2009		Poor		3.0	2	2	2.7	3.3	Moderate		51-75%	9	4	26-50%	Moderate	<10 ft.	>95%	4	76-100%	11	>40%	0-10%	No
Kingsley	2003	0%	Moderate	95%	2.7	7	0	0.0	0.0	Excellent	5%	51-75%	11	2	0-25%	Excellent	25-50 ft.	>95%	15	51-75%	4	15-40%	0-10%	No
	2004		Moderate		2.7	7	0	0.0	0.0	Excellent		51-75%	11	2	0-25%	Excellent	25-50 ft.	>95%	15	51-75%	4	15-40%	0-10%	No
	2005		Moderate		2.6	7	1	1.0	1.0	Excellent		51-75%	15	6	0-25%	Excellent	25-50 ft.	>95%	19	76-100%	2	15-40%	0-10%	No
	2006		Excellent		1.8[17]	13[18]	1	1.0	1.0	Excellent		51-75%	15	6	0-25%	Excellent	25-50 ft.	>95%	19	76-100%	3	15-40%	0-10%	No
	2007		Excellent		1.6	13	1	1.0	1.0	Excellent		51-75%	19	6	0-25%	Excellent	25-50 ft.	>95%	21	76-100%	4	15-40%	0-10%	No
	2008		Moderate		2.9	5	0	0.0	0.0	Excellent		51-75%	18	5	0-25%	Excellent	25-50 ft.	>95%	25	76-100%	4	15-40%	0-10%	No
	2009		Excellent		2.0	11	1	1.0	1.0	Excellent		51-75%	16	5	0-25%	Excellent	25-50 ft.	>95%	23	76-100%	5	15-40%	0-10%	No
Lac Lavon	2003	25%	Poor	70%	2.0	7	1	1.0	1.0	Poor	5%	0-25%	14	5	0-25%	Poor	<10 ft.	<75%	12	0-25%	17	>40%	0-10%	No
	2004		Moderate		0.9	9	2	1.6	1.9	Moderate		0-25%	15	5	0-25%	Poor	<10 ft.	<75%	12	0-25%	17	>40%	0-10%	No
	2005		Moderate		2.3	5	1	2.0	2.0	Excellent		0-25%	20	10	0-25%	Poor	<10 ft.	<75%	12	0-25%	16	>40%	0-10%	No
	2006		Moderate		1.6	10[19]	2	2.5	4.0	Excellent		0-25%	16	13	0-25%	Poor	<10 ft.	<75%	11	0-25%	19	>40%	0-10%	No
	2007		Excellent		1.8	10[20]	3	1.8	4.0	Excellent		0-25%	16	12	0-25%	Poor	<10 ft.	<75%	12	0-25%	18	>40%	0-10%	No
	2008		Poor		1.0	5	2	1.0	1.0	Moderate		0-25%	14	9	0-25%	Poor	<10 ft.	<75%	9	0-25%	13	>40%	0-10%	No
	2009		Moderate		1.6	10	2	2.5	4.0	Moderate		0-25%	13	8	0-25%	Poor	<10 ft.	<75%	9	0-25%	11	>40%	0-10%	No
Orchard	2003	20%	Poor	75%	1.2	13	1	2.3	3.4	Moderate	5%	26-50%	16	5	26-50%	Moderate	<10 ft.	>95%	5	26-50%	5	>40%	0-10%	No
	2004		Moderate		1.2	13	1	2.3	2.3	Excellent		26-50%	17	5	26-50%	Moderate	<10 ft.	>95%	5	26-50%	5	>40%	0-10%	No
	2005		Moderate		1.3	14	1	1.8	2.6	Moderate		26-50%	14	6	26-50%	Moderate	<10 ft.	>95%	5	26-50%	5	>40%	0-10%	No
	2006		Moderate		1.2	13	1	1.7	3.4	Excellent		26-50%	18	9	26-50%	Moderate	<10 ft.	>95%	5	26-50%	5	>40%	0-10%	No
	2007		Moderate		1.3	11	1	1.9	3.3	Excellent		26-50%	18	9	26-50%	Moderate	<10 ft.	>95%	3	26-50%	5	>40%	0-10%	No
	2008		Moderate		1.3	14	1	1.6	2.8	Excellent		26-50%	16	8	26-50%	Moderate	<10 ft.	>95%	3	26-50%	7	>40%	0-10%	No
	2009		Moderate		1.6	11	1	1.7	2.5	Excellent		26-50%	16	8	26-50%	Moderate	<10 ft.	>95%	3	26-50%	6	>40%	0-10%	No
Sunset Pond	2003	0%	Moderate	75%	3.0	11	1	1.0	1.0	Poor	25%	76 - 100%	5	5	76-100%	Moderate	10-25 ft.	75-95%	10	51-75%	15	15-40%	0-10%	Yes
	2004		Excellent		2.2	11	0	0.0	0.0	Poor		76 - 100%	4	3	76-100%	Moderate	10-25 ft.	75-95%	10	51-75%	18	15-40%	0-10%	Yes
	2005		Excellent		2.1	10	1	1.0	1.0	Poor		76 - 100%	6	4	76-100%	Moderate	10-25 ft.	75-95%	9	76-100%	20	>40%	0-10%	Yes
	2006		Moderate		2.6	11	1	1.0	1.0	Poor		76 - 100%	7	4	76-100%	Moderate	10-25 ft.	75-95%	9	76-100%	19	>40%	0-10%	No
	2007		Excellent		1.9	12	1	1.0	1.0	Moderate		76-100%	11	6	76-100%	Moderate	10-25 ft.	75-95%	8	76-100%	19	>40%	0-10%	No
	2008		Excellent		1.8	10	1	2.0	3.0	Poor		76-100%	10	5	76-100%	Moderate	10-25 ft.	75-95%	5	76-100%	15	>40%	0-10%	No
	2009		Moderate		2.2	11	1	3.0	3.0	Poor		76-100%	10	5	76-100%	Moderate	10-25 ft.	75-95%	6	76-100%	17	>40%	0-10%	Yes

Appendix C: 2003-2009 Habitat Assessment Monitoring Results
Black Dog Watershed Management Organization

The following footnotes pertain to 2003-2009 data.

[1]Overall Submergent Vegetative Quality rating is the average of the exotic species density, macrophyte density, and total number of native: >0.66 = Excellent, 0.33-0.66 = Moderate, <0.33 = Poor.

Overall Submergent Vegetative Quality	Avg. Exotic Species Density	Exotic Species Density/ Occurrence Rating Score	Avg. Macrophyte Density	Avg. Macrophyte Density Rating Score	Total Number of Native Species In Submergent Zone	Species Richness Rating	Total Overall Diversity Score
Poor	>2.0	0.1	0.0 - 1.0 and >3.0	0.1	<9	0.1	< 0.33
Moderate	>0 - 2.0	0.5	1.0 - 1.5 and > 2.5 to 3.0	0.5	9-14	.25-.75	0.33 - 0.66
Excellent	0	1.0	1.5 to 2.5	1.0	>14	1.0	> 0.66

[2]Plant occurrence ratings are a relative measure of the amount of native submergent vegetation with a scale from 1 to 5; 1 = lowest density (present on only 1 of 4 casts), 5 = highest density (hook full of vegetation on 4 of 4 casts).

[3]Density data for Crystal, Keller, and Orchard Lakes were collected by Blue Water Science. Numerous sample plots were conducted over the entire water body. A density scale of 1 to 4 was utilized (max = 4) by estimating the amount of vegetation obtained by rake casts and also transforming visual observations.

[4]Maximum exotic plant occurrence ratings represent the worst case scenario of curlyleaf pondweed density early in the growing season and/or Eurasian watermilfoil when it is most prolific later in the growing season.

[5]The Total Number of Native Species within the submergent zone for Crystal, Keller and Orchard Lakes is based on a detailed survey conducted by Blue Water Science; and for Kingsley Lake, Lac Lavon, and Sunset Pond, based on a survey by Barr Engineering and volunteers. The survey of the 3 water bodies conducted by Blue Water Science involved the sampling of numerous sample plots or stations. The survey for Lac Lavon, Kingsley, and Sunset Pond is based on 3 sampling locations and a visual survey during travels on the water body: <7 = Poor, 7-14 = Moderate, >14 = Excellent.

[6]Emergent Zone Vegetative Quality is the average of the following parameters within the emergent zone: the approximate total percent coverage, the total number of native wetland species, and the percent coverage of exotic species: >0.66 = Excellent, 0.33-0.66 = Moderate, <0.33 = Poor.

Emergent Zone Vegetative Quality	Percent Cover	Percent Cover Rating Score		Total Number of Native Wetland Plants	Number of Native Wetland Plants Rating Score	Percent Cover of Exotics	Percent Cover of Exotics Rating Score	Overall Emergent Zone Quality Score
Poor	0-25%	0.1		<or= 5	0.1	76-100%	0.1	< 0.33
Moderate	76-100% or 26-50%	0.5		>5 - 15	0.66 - 0.33	26-75%	.33-.66	0.33 - 0.66
Excellent	51-75%	1.0		> 15	1.0	0-25%	1.0	> 0.66

[7]Approximate Total Percent Vegetative Cover Within the Entire Emergent Zone (0-2 ft. depth) is estimated based on the three sampling locations and a visual survey during travels around the water body. Estimates are broken into four categories: 0-25%=Poor, 26-50%=Moderate, 51-75%=Excellent, 76-100%=Moderate.

[8]The Total Number of Native Wetland Plant Species within the emergent zone is based on 3 sampling locations and a visual survey during travels on the water body: 0-5 = Poor, 6-15 = Moderate, >15 = Excellent.

[9]Total Exotic Emergent Percent Coverage, out of the entire emergent zone area, is estimated based on the three sampling locations and a visual survey during travels around the water body. Estimates are broken into four categories: 0-25%=Excellen(1.0), 26-50%=Moderate(0.5), 51-75%=Poor(0.0), 76-100%=Poor(0.1)

[10]Overall Upland Buffer Quality is determined based on the average of the four upland buffer quality parameters, with the exception of the number of exotic species present and the number of native plant species: >0.66 = Excellent, 0.33-0.66 = Moderate, <0.66 = Poor.

Overall Upland Buffer Quality	Percent Cover	Percent Cover Rating Score	Exotics Percent Cover Range	Exotics Percent Cover Rating Score	Buffer Width Range	Buffer Width Rating Score	Buffer Continuity Percent Range	Buffer Continuity Rating Score	Overall Upland Buffer QualityScore
Poor	<75%	0.1	>40%	0.1	<10 ft.	0.1	0-25%	0.1	< 0.33
Moderate	75-95%	0.5	15-40%	0.5	10-50 ft.	0.4 - 0.7	25-75%	.4-.7	0.33 - 0.66
Excellent	>95%	1.0	<15%	1.0	>50 ft.	1.0	76-100%	1.0	> 0.66

[11]Unmanicured (upland) Buffer Width is divided into four categories: Excellent(1.0) = >50 ft, High(0.7) = 25-50 ft, Moderate(0.4) = 10-25 ft, and Low(0.1) = <10 ft.

[12]Estimated Total Vegetative Cover (Percent Range) for upland buffer is the proportion of the ground covered by vegetation within 50 feet of the wetland/upland transition zone. The percent cover is divided into three categories: Excellent(1.0) = >95%, Moderate(0.5) = 75 - 95%, and Poor(0.1) = <75%.

[13]The Total Number of Native Plant Species within the unmanicured upland buffer zone is based on 3 sampling locations and a visual survey.

[14](Upland) Buffer Continuity is a measure of the proportion of the water body surrounded by the unmanicured, native upland buffer. This measure is divided into four categories: Excellent(1.0) = 76 - 100%, High(0.7) = 51 - 75%, Medium(0.4) = 26 - 50%, and Low(0.1) = 0 - 25%.

[15]Upland buffer exotic species "Percent of Total Coverage" is the percent cover of exotic species within the unmanicured upland buffer, which is divided into three categories: Excellent(1.0) = <15%, Moderate(0.5) = 15 - 40%, and Poor(0.1) = >40%.

[16]The presence of shoreline erosion is determined by the approximate percentage of the shoreline affected and is divided into the following three categories: 0 - 10%, 11 - 25%, 26 - 100%.

[17]The 2006 plant occurrence rating is lower (has improved), when compared to past assessment years primarily due to the low occurrence of additional plants found during a more detailed survey of the lake. The more detailed plant survey was conducted to better understand the extent of curlyleaf pondweed.

[18]The number of plant species documented in 2006, when compared to past assessment years, increased primarily due to additional plants found during a more detailed survey of the lake. The more detailed plant survey was conducted to better understand the extent of curlyleaf pondweed.

[19]The number of native submergent plant species documented in 2006, was incorrectly represented as 11 in the 2006 annual report. The actual number of native submergent plant species documented in 2006 was 10.

[20]Native plant species were noted by the Minnesota Department of Natural Resouces during an October 25, 2007 macropyte survey and used in the 2007 annual report.

Rating Code: **Poor** **Moderate** **Excellent**

Appendix C: Kingsley Lake 2011 Habitat Assessment Monitoring Results
Black Dog Watershed Management Organization

		Submergent Zone Sampling							
Monitoring Year	Approximate Proportion of the Water Body Which is Deep Water Habitat (~ > 20 ft. depth)	Overall Submergent Vegetative Quality[1]	Approximate Proportion of Water Body Typically Dominated By Submergent Vegetation (~ 2 20 ft. depth)	Average Native Plant Occurrence or Density Rating[2,3]	Total Number of Native Species[5]	Mean Coefficient of Conservatism Value	Exotic Species		
							Total Number of Species	Average Exotic Plant Occurrence Rating or Average Density Rating[2, 3]	Maximum Exotic Plant Occurrence Rating or Maximum Density Rating[4]
2011	0%	**High**	95%	1.4	18	5.8	0	0.0	0.0

	Vegetated Emergent Zone Sampling						
Monitoring Year	Emergent Zone Vegetative Quality[6]	Approximate Proportion of Emergent Zone (0 - 2 ft. depth) Within The Water Body	Approximate Total Percent Vegetative Cover Within The Entire Emergent Zone[7]	Total Number of Native Wetland Plant Species[8]	Mean Coefficient of Conservatism Value	Exotic Species	
						Number of Species	Total Exotic Emergent Percent Coverage[9]
2011	**High**	5%	51-75%	22	3.3	4	26-50%

	Vegetation Quality - Upland								Erosion/Sedimentation	
	Upland Buffer Sampling									
Monitoring Year	Overall Upland Buffer Quality[10]	Unmanicured Buffer Width[11]	Estimated Total Vegetative Cover (Percent Range)[12]	Total Number of Native Plant Species[13]	Mean Coefficient of Conservatism Value	Buffer Continuity (Percent Surrounding Water Body)[14]	Exotic Species		Shoreline Erosion (Percent of Shoreline)[16]	Sediment Deltas (Yes/No)
							Number of Species	Percent of Total Coverage[15]		
2011	**High**	25-50 ft.	>95%	45	2.2	76-100%	25	15-40%	0-10%	No

Appendix C: Kingsley Lake 2011 Habitat Assessment Monitoring Results
Black Dog Watershed Management Organization

The following changes were made to 2011 monitoring and analysis:

Monitor one water body per year. Kingsley Lake in 2011 - Conduct a meandering survey of submergent, emergent, and upland buffer zones rather than monitoring of plot locations.

Changes were made in 2011 to the calculations to include floristic quality as part of the assessment. These changes include adding a rating of "High" to the categories to accommodate MPCA ratings for floristic quality. Rating Code: **Poor** **Moderate** **High or Excellent**

N/A = Not Available. The 2003 submergent vegetation list was not found, and therefore not included in this table.

N/C = Not Calculated. The Mean Coefficient of Conservatism value (C-value) was not calculated for 2003-2009 for emergent and upland buffer vegetation. The C-value was calculated and is listed on this table for submergent vegeation in previous years, for purposes of comparison, but was only used in 2011 for the overal ratings.

The following footnotes pertain to 2011 data:

[1]Overall Submergent Vegetative Quality rating is the average of the exotic species density, macrophyte density, total number of native species, and coefficient of conservatism value: >0.80 = Excellent, 0.67-0.80 = High, 0.33-0.66 = Moderate, <0.33 = Poor.

Overall Submergent Vegetative Quality	Avg. Exotic Species Density	Exotic Species Density/ Occurrence Rating Score	Avg. Macrophyte Density	Avg. Macrophyte Density Rating Score	Total Number of Native Species In Submergent Zone	Species Richness Rating	Coefficient of Conservatism Value (C-Value)	C-Value Rating (using MPCA values, 2007)	Total Overall Diversity Score
Poor	>2.0	0.1	> 1.75	0.1	<7	0.1	0 - <3	0.10	< 0.33
Moderate	>1.0 - 2.0	0.5	1.25 - 1.75	0.5	>7 - <9	0.5	>3 - <6	0.50	0.33 - 0.66
High	>0 - 1.0	0.75			>9 - <14	0.75	>6 - <9	0.75	0.67 - 0.80
Excellent	0	1.0	1.0 to 1.25	1.0	>14	1.0	>9 - 10	1.00	> 0.80

[2]Plant Occurrence Ratings are a relative measure of the total amount of submergent vegetation covering the submergent zone, with a scale from 1 to 3 utilizing a 6-tined hook; 1 = light density (plant species found on only 1 tine), 2 = moderate density (plant species found on 2 to 4 tines), 3 = heavy density (plant species found on 5 or 6 tines).

[3]Density data for Kingsley Lake in 2011 were collected by Barr using a meandering survey throughout the lake.

[4]Maximum exotic plant occurrence ratings represent the worst case scenario of curlyleaf pondweed density early in the growing season and/or Eurasian watermilfoil when it is most prolific later in the growing season.

[5]In 2011, the Kingsley survey was based on a meandering survey throughout the lake. The additional category of "High" was added in 2011 and values were adjusted to: <7 = Poor, 7-9 = Moderate, 9-14 = High, >14 = Excellent.

[6]Emergent Zone Vegetative Quality is the average of the following parameters within the emergent zone: the approximate total percent coverage, the total number of native wetland species, the percent coverage of exotic species, and the C-Value Rating: >0.80 = Excellent, 0.67-0.80 = High, 0.33-0.66 = Moderate, <0.33 = Poor.

Emergent Zone Vegetative Quality	Percent Cover	Percent Cover Rating Score	Total Number of Native Wetland Plant Species	Number of Native Wetland Plant Species Rating Score	Percent Cover of Exotics	Percent Cover of Exotics Rating Score	Coefficient of Conservatism Value (C-Value)	C-Value Rating (using MPCA values, 2007)	Overall Emergent Zone Quality Score
Poor	0-25%	0.1	<or= 5	0.1	76-100%	0.1	0 - <3	0.10	< 0.33
Moderate	76-100% or 26-50%	0.5	6 - 10	0.33	51-75%	0.33	>3 - <6	0.50	0.33 - 0.66
High	51-75%	1.0	11 - 15	0.66	26-50%	0.66	>6 - <9	0.75	0.67 - 0.80
Excellent	51-75%	1.0	> 15	1.0	0-25%	1.0	>9 - 10	1.00	> 0.80

[7]Approximate Total Percent Vegetative Cover Within the Entire Emergent Zone (0-2 ft. depth) is estimated based on the three sampling locations and a visual survey during travels around the water body. Estimates are broken into four categories: 0-25%=Poor, 26-50%=Moderate, 51-75%= High/Excellent, 76-100%=Moderate.

[8]The Total Number of Native Wetland Plant Species within the emergent zone is based on a meandering visual survey during travels on the water body and walking along the shoreline: 0-5 = Poor, 6-10 = Moderate, 11-15 = High, and >15 = Excellent.

[9]Total Exotic Emergent Percent Coverage, out of the entire emergent zone area, is estimated based on a meandering visual survey during travels around the water body and walking along the shoreline. Estimates are broken into four categories: 0-25%=Excellent(1.0), 26-50%=High(0.66), 51-75%=Moderate(0.33), 76-100%=Poor(0.1)

[10]Overall Upland Buffer Quality is determined based on the average of the five upland buffer quality parameters : >0.80 = Excellent, 0.67-0.80 = High, 0.33-0.66 = Moderate, <0.33 = Poor.

Overall Upland Buffer Quality	Percent Cover	Percent Cover Rating Score	Exotics Percent Cover Range	Exotics Percent Cover Rating Score	Buffer Width Range	Buffer Width Rating Score	Buffer Continuity Percent Range	Buffer Continuity Rating Score	Coefficient of Conservatism Value (C-Value)	C-Value Rating (using MPCA values, 2007)	Number of Native Species	Number of Native Species Rating Score	Overall Upland Buffer QualityScore
Poor	<75%	0.1	>40%	0.1	<10 ft.	0.1	0-25%	0.1	0 - <3	0.10	<5	0.1	< 0.33
Moderate	75-95%	0.5	15-40%	0.5	10-25 ft.	0.4	25-50%	0.4	>3 - <6	0.50	5-20	0.33	0.33 - 0.66
High	>95%	1.0	<15%	1.0	25-50 ft.	0.7	51-75%	0.7	>6 - <9	0.75	20-30	0.66	0.67 - 0.80
Excellent	>95%	1.0	<15%	1.0	>50 ft.	1.0	76-100%	1.0	>9 - 10	1.00	>30	1.0	> 0.80

[11]Unmanicured (upland) Buffer Width is divided into four categories: Excellent(1.0) = >50 ft, High(0.7) = 25-50 ft, Moderate(0.4) = 10-25 ft, and Low(0.1) = <10 ft.

[12]Estimated Total Vegetative Cover (Percent Range) for upland buffer is the proportion of the ground covered by vegetation within 50 feet of the wetland/upland transition zone. The percent cover is divided into three categories: High and Excellent(1.0) = >95%, Moderate(0.5) = 75 - 95%, and Poor(0.1) = <75%.

[13]The Total Number of Native Plant Species within the unmanicured upland buffer zone is based on a meandering visual survey along the shoreline.

[14](Upland) Buffer Continuity is a measure of the proportion of the water body surrounded by the unmanicured, native upland buffer. This measure is divided into four categories: Excellent(1.0) = 76 - 100%, High(0.7) = 51 - 75%, Medium(0.4) = 26 - 50%, and Low(0.1) = 0 - 25%.

[15]Upland buffer exotic species "Percent of Total Coverage" is the percent cover of exotic species within the unmanicured upland buffer, which is divided into three categories: High and Excellent(1.0) = <15%, Moderate(0.5) = 15 - 40%, and Poor(0.1) = >40%.

[16]The presence of shoreline erosion is determined by the approximate percentage of the shoreline affected and is divided into the following three categories: 0 - 10%, 11 - 25%, 26 - 100%.

Table 1: Orchard Lake 2012 Habitat Assessment Monitoring Results Black Dog Watershed Management Organization

Submergent Zone Sampling								
Approximate Proportion of the Water Body Which is Deep Water Habitat (~ > 20 ft. depth)	Overall Submergent Vegetative Quality[1]	Approximate Proportion of Water Body Typically Dominated By Submergent Vegetation (~ 2 - 20 ft. depth)	Average Native Plant Occurrence or Density Rating[2,3]	Total Number of Native Species[5]	Mean Coefficient of Conservatism Value	Exotic Species		
						Total Number of Species	Average Exotic Plant Occurrence Rating or Average Density Rating[2, 3]	Maximum Exotic Plant Occurrence Rating or Maximum Density Rating[4]
20%	**Moderate**	75%	2.0	13	5.4	1	1.7	3.0

Vegetated Emergent Zone Sampling						
Emergent Zone Vegetative Quality[6]	Approximate Proportion of Emergent Zone (0 - 2 ft. depth) Within The Water Body	Approximate Total Percent Vegetative Cover Within The Entire Emergent Zone[7]	Total Number of Native Wetland Plant Species[8]	Mean Coefficient of Conservatism Value	Exotic Species	
					Number of Species	Total Exotic Emergent Percent Coverage[9]
Moderate	5%	26-50%	43	3.1	12	51-75%

Upland Buffer Sampling								Erosion/Sedimentation	
Overall Upland Buffer Quality[10]	Unmanicured Buffer Width[11]	Estimated Total Vegetative Cover (Percent Range)[12]	Total Number of Native Plant Species[13]	Mean Coefficient of Conservatism Value	Buffer Continuity (Percent Surrounding Water Body)[14]	Exotic Species		Shoreline Erosion (Percent of Shoreline)[16]	Sediment Deltas (Yes/No)
						Number of Species	Percent of Total Coverage[15]		
Poor	<10 ft.	>95%	19	1.6	0-25%	20	>40%	0-10%	No

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Table 1: Orchard Lake 2012 Habitat Assessment Monitoring Results Black Dog Watershed Management Organization

The following changes were made to the 2011 and 2012 monitoring and analysis:

- Monitor one or two water bodies per year. Kingsley Lake only in 2011 - Conduct a meandering survey of submergent, emergent, and upland buffer zones rather than monitoring of plot locations. Orchard Lake only in 2012 - Conduct a meandering survey of submergent, emergent, and upland buffer zones. In addition, the emergent and upland buffer plot locations were evaluated.
- Changes were made in 2011 and 2012 to the calculations to include floristic quality as part of the assessment. These changes include adding a rating of "High" to the categories to accommodate MPCA ratings for floristic quality. These changes included adding a Rating Code:

Poor	Moderate	High or Excellent

The following footnotes pertain to 2012 data:

[1]**Overall Submergent Vegetative Quality** rating is the average of the exotic species density, macrophyte density, total number of native species, and coefficient of conservatism value: >0.80 = Excellent, 0.67-0.80 = High, 0.33-0.66 = Moderate, <0.33 = Poor.

Overall Submergent Vegetative Quality	Avg. Exotic Species Density	Exotic Species Density/ Occurrence Rating Score	Avg. Macrophyte Density	Avg. Macrophyte Density Rating Score	Total Number of Native Species In Submergent Zone	Species Richness Rating	Coefficient of Conservatism Value (C-Value)	C-Value Rating (using MPCA values, 2007)	Total Overall Diversity Score
Poor	>2.0	0.1	> 1.75	0.1	<7	0.1	0 - <3	0.10	< 0.33
Moderate	>1.0 - 2.0	0.5	1.25 - 1.75	0.5	>7 - <9	0.5	>3 - <6	0.50	0.33 - 0.66
High	>0 - 1.0	0.75			>9 - <14	0.75	>6 - <9	0.75	0.67 - 0.80
Excellent	0	1.0	1.0 to 1.25	1.0	>14	1.0	>9 - 10	1.00	> 0.80

[2]Plant Occurrence Ratings are a relative measure of the total amount of submergent vegetation covering the submergent zone, with a scale from 1 to 3 utilizing a 6-tined hook; 1 = light density (plant species found on only 1 tine), 2 = moderate density (plant species found on 2 to 4 tines), 3 = heavy density (plant species found on 5 or 6 tines).

[3]Density data for Orchard Lake in 2012 were collected by Barr using a meandering survey throughout the lake.

[4]Maximum exotic plant occurrence ratings represent the worst case scenario of curlyleaf pondweed density early in the growing season and/or Eurasian watermilfoil when it is most prolific later in the growing season.

[5]The Total Number of Native Species within the submergent zone for Orchard Lake in 2012 were collected by Barr using a meandering survey throughout the lake. The additional category of "High" was added in 2011 and 2012 and values were adjusted to: <7 = Poor, 7-9 = Moderate, 9-14 = High, >14 = Excellent.

[6]**Emergent Zone Vegetative Quality** is the average of the following parameters within the emergent zone: the approximate total percent coverage, the total number of native wetland species, the percent coverage of exotic species, and the C-Value Rating: >0.80 = Excellent, 0.67-0.80 = High, 0.33-0.66 = Moderate, <0.33 = Poor.

Emergent Zone Vegetative Quality	Percent Cover	Percent Cover Rating Score	Total Number of Native Wetland Plant Species	Number of Native Wetland Plant Species Rating Score	Percent Cover of Exotics	Percent Cover of Exotics Rating Score	Coefficient of Conservatism Value (C-Value)	C-Value Rating (using MPCA values, 2007)	Overall Emergent Zone Quality Score
Poor	0-25%	0.1	< or= 5	0.1	76-100%	0.1	0 - <3	0.10	< 0.33
Moderate	76-100% or 26-50%	0.5	6 - 10	0.33	51-75%	0.33	>3 - <6	0.50	0.33 - 0.66
High	51-75%	1.0	11 - 15	0.66	26-50%	0.66	>6 - <9	0.75	0.67 - 0.80
Excellent	51-75%	1.0	> 15	1.0	0-25%	1.0	>9 - 10	1.00	> 0.80

Table 1: Orchard Lake 2012 Habitat Assessment Monitoring Results Black Dog Watershed Management Organization

[7]Approximate Total Percent Vegetative Cover Within the Entire Emergent Zone (0-2 ft. depth) is estimated based on the three sampling locations and a visual survey during travels around the water body. Estimates are broken into four categories: 0-25%=Poor, 26-50%=Moderate, 51-75%=Excellent, 76-100%=Moderate.
[8]The Total Number of Native Wetland Plant Species within the emergent zone is based on 3 sampling locations, a meandering visual survey during travels on the water body, and walking along the shoreline: 0-5 = Poor, 6-10 = Moderate, 11-15 = High, and >15 = Excellent.
[9]Total Exotic Emergent Percent Coverage, out of the entire emergent zone area, is estimated based on 3 sampling locations, a meandering visual survey during travels on the water body, and walking along the shoreline. Estimates are broken into four categories: 0-25%=Excellent(1.0), 26-50%=High(0.66), 51-75%=Moderate(0.33), 76-100%=Poor(0.1)
[10]**Overall Upland Buffer Quality** is determined based on the average of the five upland buffer quality parameters : >0.80 = Excellent, 0.67-0.80 = High, 0.33-0.66 = Moderate, <0.33 = Poor.

Overall Upland Buffer Quality	Percent Cover	Percent Cover Rating Score	Exotics Percent Cover Range	Exotics Percent Cover Rating Score	Buffer Width Range	Buffer Width Rating Score	Buffer Continuity Percent Range	Buffer Continuity Rating Score	Coefficient of Conservatism Value (C-Value)	C-Value Rating (using MPCA values, 2007)	Number of Native Species	Number of Native Species Rating Score	Overall Upland Buffer Quality Score
Poor	<75%	0.1	>40%	0.1	<10 ft.	0.1	0-25%	0.1	0 - <3	0.10	<5	0.1	< 0.33
Moderate	75-95%	0.5	15-40%	0.5	10-25 ft.	0.4	25-50%	0.4	>3 - <6	0.50	5-20	0.33	0.33 - 0.66
High	>95%	1.0	<15%	1.0	25-50 ft.	0.7	51-75%	0.7	>6 - <9	0.75	20-30	0.66	0.67 - 0.80
Excellent	>95%	1.0	<15%	1.0	>50 ft.	1.0	76-100%	1.0	>9 - 10	1.00	>30	1.0	> 0.80

[11]Unmanicured (upland) Buffer Width is divided into four categories: Excellent(1.0) = >50 ft, High(0.7) = 25-50 ft, Moderate(0.4) = 10-25 ft, and Low(0.1) = <10 ft.
[12]Estimated Total Vegetative Cover (Percent Range) for upland buffer is the proportion of the ground covered by vegetation within 50 feet of the wetland/upland transition zone. The percent cover is divided into three categories: High and Excellent(1.0) = >95%, Moderate(0.5) = 75 - 95%, and Poor(0.1) = <75%.
[13]The Total Number of Native Plant Species within the unmanicured upland buffer zone is based on 3 sampling locations and a meandering visual survey along the shoreline.
[14](Upland) Buffer Continuity is a measure of the proportion of the water body surrounded by the unmanicured, native upland buffer. This measure is divided into four categories: Excellent(1.0) = 76 - 100%, High(0.7) = 51 - 75%, Medium(0.4) = 26 - 50%, and Low(0.1) = 0 - 25%.
[15]Upland buffer exotic species "Percent of Total Coverage" is the percent cover of exotic species within the unmanicured upland buffer, which is divided into three categories: High and Excellent(1.0) = <15%, Moderate(0.5) = 15 - 40%, and Poor(0.1) = >40%.
[16]The presence of shoreline erosion is determined by the approximate percentage of the shoreline affected and is divided into the following three categories: 0 - 10%, 11 - 25%, 26 - 100%.

Table 1: Crystal Lake 2013 Habitat Assessment Monitoring Results Black Dog Watershed Management Organization

Submergent Zone Sampling								
Approximate Proportion of the Water Body Which is Deep Water Habitat (~ > 20 ft. depth)	Overall Submergent Vegetative Quality[1]	Approximate Proportion of Water Body Typically Dominated By Submergent Vegetation (~ 2 - 20 ft. depth)	Average Native Plant Density Rating[2,3]	Total Number of Native Species[5]	Mean Coefficient of Conservatism Value	Exotic Species		
						Total Number of Species	Average Exotic Plant Occurrence Rating or Average Density Rating[2, 3]	Maximum Exotic Plant Occurrence Rating or Maximum Density Rating[4]
15%	**High**	80%	1.2	18	4.9	2	1.8	2.2

Vegetated Emergent Zone Sampling						
Emergent Zone Vegetative Quality[6]	Approximate Proportion of Emergent Zone (0 - 2 ft. depth) Within The Water Body	Approximate Total Percent Vegetative Cover Within The Entire Emergent Zone[7]	Total Number of Native Wetland Plant Species[8]	Mean Coefficient of Conservatism Value	Exotic Species	
					Number of Species	Total Exotic Emergent Percent Coverage[9]
High	5%	26-50%	36	3.0	10	26-50%

Upland Buffer Sampling								Erosion/Sedimentation	
Overall Upland Buffer Quality[10]	Unmanicured Buffer Width[11]	Estimated Total Vegetative Cover (Percent Range)[12]	Total Number of Native Plant Species[13]	Mean Coefficient of Conservatism Value	Buffer Continuity (Percent Surrounding Water Body)[14]	Exotic Species		Shoreline Erosion (Percent of Shoreline)[16]	Sediment Deltas (Yes/No)
						Number of Species	Percent of Total Coverage[15]		
Moderate	<10 ft.	>95%	39	2.6	26-50%	16	15-40%	0-10%	No

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Table 1: Crystal Lake 2013 Habitat Assessment Monitoring Results Black Dog Watershed Management Organization

The following changes were made to the 2011 and 2012 monitoring and analysis:

- Monitor one or two water bodies per year. Kingsley Lake only in 2011 - Conduct a meandering survey of submergent, emergent, and upland buffer zones rather than monitoring of plot locations. Orchard Lake only in 2012 and Crystal Lake only in 2013 - Conduct a meandering survey of submergent, emergent, and upland buffer zones. In addition, the emergent and upland buffer plot locations were evaluated.
- Changes were made in 2011 through 2013 to the calculations to include floristic quality as part of the assessment. These changes include adding a rating of "High" to the categories to accommodate MPCA ratings for floristic quality. These changes included adding a Rating Code:

Poor	Moderate	High or Excellent

The following footnotes pertain to 2013 data:

[1]**Overall Submergent Vegetative Quality** rating is the average of the exotic species density, macrophyte density, total number of native species, and coefficient of conservatism value: >0.80 = Excellent, 0.67-0.80 = High, 0.33-0.66 = Moderate, <0.33 = Poor.

Overall Submergent Vegetative Quality	Avg. Exotic Species Density	Exotic Species Density/ Occurrence Rating Score	Avg. Macrophyte Density	Avg. Native Plant Density Rating Score	Total Number of Native Species In Submergent Zone	Species Richness Rating	Coefficient of Conservatism Value (C-Value)	C-Value Rating (using MPCA values, 2007)	Total Overall Diversity Score
Poor	>2.0	0.1	> 1.75	0.1	<7	0.1	0 - <3	0.10	< 0.33
Moderate	>1.0 - 2.0	0.5	1.25 - 1.75	0.5	>7 - <9	0.5	>3 - <6	0.50	0.33 - 0.66
High	>0 - 1.0	0.75			>9 - <14	0.75	>6 - <9	0.75	0.67 - 0.80
Excellent	0	1.0	1.0 to 1.25	1.0	>14	1.0	>9 - 10	1.00	> 0.80

[2]Plant Occurrence Ratings are a relative measure of the total amount of submergent vegetation covering the submergent zone, with a scale from 1 to 3 utilizing a 6-tined hook; 1 = light density (plant species found on only 1 tine), 2 = moderate density (plant species found on 2 to 4 tines), 3 = heavy density (plant species found on 5 or 6 tines).

[3]Density data for Crystal Lake in 2013 were collected by Blue Water Science using a transect survey throughout the lake.

[4]Maximum exotic plant occurrence ratings represent the worst case scenario of curlyleaf pondweed density early in the growing season and/or Eurasian watermilfoil when it is most prolific later in the growing season.

[5]The Total Number of Native Species within the submergent zone for Crystal Lake in 2013 were collected by Blue Water Science using a transect survey. The additional category of "High" was added in 2011 through 2013 and values were adjusted to: <7 = Poor, 7-9 = Moderate, 9-14 = High, >14 = Excellent.

[6]**Emergent Zone Vegetative Quality** is the average of the following parameters within the emergent zone: the approximate total percent coverage, the total number of native wetland species, the percent coverage of exotic species, and the C-Value Rating: >0.80 = Excellent, 0.67-0.80 = High, 0.33-0.66 = Moderate, <0.33 = Poor.

Emergent Zone Vegetative Quality	Percent Cover	Percent Cover Rating Score	Total Number of Native Wetland Plant Species	Number of Native Wetland Plant Species Rating Score	Percent Cover of Exotics	Percent Cover of Exotics Rating Score	Coefficient of Conservatism Value (C-Value)	C-Value Rating (using MPCA values, 2007)	Overall Emergent Zone Quality Score
Poor	0-25%	0.1	< or= 5	0.1	76-100%	0.1	0 - <3	0.10	< 0.33
Moderate	76-100% or 26-50%	0.5	6 - 10	0.33	51-75%	0.33	>3 - <6	0.50	0.33 - 0.66
High	51-75%	1.0	11 - 15	0.66	26-50%	0.66	>6 - <9	0.75	0.67 - 0.80
Excellent	51-75%	1.0	> 15	1.0	0-25%	1.0	>9 - 10	1.00	> 0.80

Table 1: Crystal Lake 2013 Habitat Assessment Monitoring Results Black Dog Watershed Management Organization

[7]Approximate Total Percent Vegetative Cover Within the Entire Emergent Zone (0-2 ft. depth) is estimated based on the three sampling locations and a visual survey during travels around the water body. Estimates are broken into four categories: 0-25%=Poor, 26-50%=Moderate, 51-75%=Excellent, 76-100%=Moderate.
[8]The Total Number of Native Wetland Plant Species within the emergent zone is based on 3 sampling locations, a meandering visual survey during travels on the water body, and walking along the shoreline: 0-5 = Poor, 6-10 = Moderate, 11-15 = High, and >15 = Excellent.
[9]Total Exotic Emergent Percent Coverage, out of the entire emergent zone area, is estimated based on 3 sampling locations, a meandering visual survey during travels on the water body, and walking along the shoreline. Estimates are broken into four categories: 0-25%=Excellent(1.0), 26-50%=High(0.66), 51-75%=Moderate(0.33), 76-100%=Poor(0.1)
[10]**Overall Upland Buffer Quality** is determined based on the average of the five upland buffer quality parameters : >0.80 = Excellent, 0.67-0.80 = High, 0.33-0.66 = Moderate, <0.33 = Poor.

Overall Upland Buffer Quality	Percent Cover	Percent Cover Rating Score	Exotics Percent Cover Range	Exotics Percent Cover Rating Score	Buffer Width Range	Buffer Width Rating Score	Buffer Continuity Percent Range	Buffer Continuity Rating Score	Coefficient of Conservatism Value (C-Value)	C-Value Rating (using MPCA values, 2007)	Number of Native Species	Number of Native Species Rating Score	Overall Upland Buffer Quality Score
Poor	<75%	0.1	>40%	0.1	<10 ft.	0.1	0-25%	0.1	0 - <3	0.10	<5	0.1	< 0.33
Moderate	75-95%	0.5	15-40%	0.5	10-25 ft.	0.4	25-50%	0.4	>3 - <6	0.50	5-20	0.33	0.33 - 0.66
High	>95%	1.0	<15%	1.0	25-50 ft.	0.7	51-75%	0.7	>6 - <9	0.75	20-30	0.66	0.67 - 0.80
Excellent	>95%	1.0	<15%	1.0	>50 ft.	1.0	76-100%	1.0	>9 - 10	1.00	>30	1.0	> 0.80

[11]Unmanicured (upland) Buffer Width is divided into four categories: Excellent(1.0) = >50 ft, High(0.7) = 25-50 ft, Moderate(0.4) = 10-25 ft, and Low(0.1) = <10 ft.
[12]Estimated Total Vegetative Cover (Percent Range) for upland buffer is the proportion of the ground covered by vegetation within 50 feet of the wetland/upland transition zone. The percent cover is divided into three categories: High and Excellent(1.0) = >95%, Moderate(0.5) = 75 - 95%, and Poor(0.1) = <75%.
[13]The Total Number of Native Plant Species within the unmanicured upland buffer zone is based on 3 sampling locations and a meandering visual survey along the shoreline.
[14](Upland) Buffer Continuity is a measure of the proportion of the water body surrounded by the unmanicured, native upland buffer. This measure is divided into four categories: Excellent(1.0) = 76 - 100%, High(0.7) = 51 - 75%, Medium(0.4) = 26 - 50%, and Low(0.1) = 0 - 25%.
[15]Upland buffer exotic species "Percent of Total Coverage" is the percent cover of exotic species within the unmanicured upland buffer, which is divided into three categories: High and Excellent(1.0) = <15%, Moderate(0.5) = 15 - 40%, and Poor(0.1) = >40%.
[16]The presence of shoreline erosion is determined by the approximate percentage of the shoreline affected and is divided into the following three categories: 0 - 10%, 11 - 25%, 26 - 100%.

Table 1: Lac Lavon 2014 Habitat Assessment Monitoring Results Black Dog Watershed Management Organization

Submergent Zone Sampling								
Approximate Proportion of the Water Body Which is Deep Water Habitat (~ > 20 ft. depth)	Overall Submergent Vegetative Quality[1]	Approximate Proportion of Water Body Typically Dominated By Submergent Vegetation (~ 2 - 20 ft. depth)	Average Native Plant Density Rating[2,3]	Total Number of Native Species[5]	Mean Coefficient of Conservatism Value	Exotic Species		
						Total Number of Species	Average Exotic Plant Occurrence Rating or Average Density Rating[2, 3]	Maximum Exotic Plant Occurrence Rating or Maximum Density Rating[4]
25%	**Moderate**	70%	1.4	12	4.6	2	2.0	3.0

Vegetated Emergent Zone Sampling						
Emergent Zone Vegetative Quality[6]	Approximate Proportion of Emergent Zone (0 - 2 ft. depth) Within The Water Body	Approximate Total Percent Vegetative Cover Within The Entire Emergent Zone[7]	Total Number of Native Wetland Plant Species[8]	Mean Coefficient of Conservatism Value	Exotic Species	
					Number of Species	Total Exotic Emergent Percent Coverage[9]
Moderate	5%	0-25%	32	2.3	15	26-50%

Upland Buffer Sampling								Erosion/Sedimentation	
Overall Upland Buffer Quality[10]	Unmanicured Buffer Width[11]	Estimated Total Vegetative Cover (Percent Range)[12]	Total Number of Native Plant Species[13]	Mean Coefficient of Conservatism Value	Buffer Continuity (Percent Surrounding Water Body)[14]	Exotic Species		Shoreline Erosion (Percent of Shoreline)[16]	Sediment Deltas (Yes/No)
						Number of Species	Percent of Total Coverage[15]		
Poor	<10 ft.	<75%	32	1.3	0-25%	31	>40%	0-10%	No

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Table 1: Lac Lavon 2014 Habitat Assessment Monitoring Results Black Dog Watershed Management Organization

The following changes were made to the 2011 - 2014 monitoring and analysis:

- Monitor one or two water bodies per year. Kingsley Lake only in 2011 - Conduct a meandering survey of submergent, emergent, and upland buffer zones rather than monitoring of plot locations. Orchard Lake only in 2012, Crystal Lake only in 2013, Lac Lavon only in 2014 - Conduct a meandering survey of submergent, emergent, and upland buffer zones. In addition, the emergent and upland buffer plot locations were evaluated.
- Changes were made in 2011 through 2014 to the calculations to include floristic quality as part of the assessment. These changes include adding a rating of "High" to the categories to accommodate MPCA ratings for floristic quality. These changes included adding a Rating Code:

Poor	Moderate	High or Excellent

The following footnotes pertain to 2014 data:

[1]**Overall Submergent Vegetative Quality** rating is the average of the exotic species density, macrophyte density, total number of native species, and coefficient of conservatism value: >0.80 = Excellent, 0.67-0.80 = High, 0.33-0.66 = Moderate, <0.33 = Poor.

Overall Submergent Vegetative Quality	Avg. Exotic Species Density	Exotic Species Density/ Occurrence Rating Score	Avg. Macrophyte Density	Avg. Native Plant Density Rating Score	Total Number of Native Species In Submergent Zone	Species Richness Rating	Coefficient of Conservatism Value (C-Value)	C-Value Rating (using MPCA values, 2007)	Total Overall Diversity Score
Poor	>2.0	0.1	> 1.75	0.1	<7	0.1	0 - <3	0.10	< 0.33
Moderate	>1.0 - 2.0	0.5	1.25 - 1.75	0.5	>7 - <9	0.5	>3 - <6	0.50	0.33 - 0.66
High	>0 - 1.0	0.75			>9 - <14	0.75	>6 - <9	0.75	0.67 - 0.80
Excellent	0	1.0	1.0 to 1.25	1.0	>14	1.0	>9 - 10	1.00	> 0.80

[2]Plant Occurrence Ratings are a relative measure of the total amount of submergent vegetation covering the submergent zone, with a scale from 1 to 3 utilizing a 6-tined hook; 1 = light density (plant species found on only 1 tine), 2 = moderate density (plant species found on 2 to 4 tines), 3 = heavy density (plant species found on 5 or 6 tines).

[3]Density data for Lac Lavon were collected by Barr Engineering Co. using a meander survey throughout the lake.

[4]Maximum exotic plant occurrence ratings represent the worst case scenario of curlyleaf pondweed density early in the growing season and/or Eurasian watermilfoil when it is most prolific later in the growing season.

[5]The Total Number of Native Species within the submergent zone for Lac Lavon were collected by Barr Engineering Co. using a meander survey. The additional category of "High" was added in 2011 through 2014 and values were adjusted to: <7 = Poor, 7-9 = Moderate, 9-14 = High, >14 = Excellent.

[6]**Emergent Zone Vegetative Quality** is the average of the following parameters within the emergent zone: the approximate total percent coverage, the total number of native wetland species, the percent coverage of exotic species, and the C-Value Rating: >0.80 = Excellent, 0.67-0.80 = High, 0.33-0.66 = Moderate, <0.33 = Poor.

Emergent Zone Vegetative Quality	Percent Cover	Percent Cover Rating Score	Total Number of Native Wetland Plant Species	Number of Native Wetland Plant Species Rating Score	Percent Cover of Exotics	Percent Cover of Exotics Rating Score	Coefficient of Conservatism Value (C-Value)	C-Value Rating (using MPCA values, 2007)	Overall Emergent Zone Quality Score
Poor	0-25%	0.1	< or= 5	0.1	76-100%	0.1	0 - <3	0.10	< 0.33
Moderate	76-100% or 26-50%	0.5	6 - 10	0.33	51-75%	0.33	>3 - <6	0.50	0.33 - 0.66
High	51-75%	1.0	11 - 15	0.66	26-50%	0.66	>6 - <9	0.75	0.67 - 0.80
Excellent	51-75%	1.0	> 15	1.0	0-25%	1.0	>9 - 10	1.00	> 0.80

Table 1: Lac Lavon 2014 Habitat Assessment Monitoring Results Black Dog Watershed Management Organization

[7]Approximate Total Percent Vegetative Cover Within the Entire Emergent Zone (0-2 ft. depth) is estimated based on the three sampling locations and a visual survey during travels around the water body. Estimates are broken into four categories: 0-25%=Poor, 26-50%=Moderate, 51-75%=Excellent, 76-100%=Moderate.
[8]The Total Number of Native Wetland Plant Species within the emergent zone is based on 3 sampling locations, a meandering visual survey during travels on the water body, and walking along the shoreline: 0-5 = Poor, 6-10 = Moderate, 11-15 = High, and >15 = Excellent.
[9]Total Exotic Emergent Percent Coverage, out of the entire emergent zone area, is estimated based on 3 sampling locations, a meandering visual survey during travels on the water body, and walking along the shoreline. Estimates are broken into four categories: 0-25%=Excellent(1.0), 26-50%=High(0.66), 51-75%=Moderate(0.33), 76-100%=Poor(0.1)
[10]**Overall Upland Buffer Quality** is determined based on the average of the five upland buffer quality parameters : >0.80 = Excellent, 0.67-0.80 = High, 0.33-0.66 = Moderate, <0.33 = Poor.

Overall Upland Buffer Quality	Percent Cover	Percent Cover Rating Score	Exotics Percent Cover Range	Exotics Percent Cover Rating Score	Buffer Width Range	Buffer Width Rating Score	Buffer Continuity Percent Range	Buffer Continuity Rating Score	Coefficient of Conservatism Value (C-Value)	C-Value Rating (using MPCA values, 2007)	Number of Native Species	Number of Native Species Rating Score	Overall Upland Buffer Quality Score
Poor	<75%	0.1	>40%	0.1	<10 ft.	0.1	0-25%	0.1	0 - <3	0.10	<5	0.1	< 0.33
Moderate	75-95%	0.5	15-40%	0.5	10-25 ft.	0.4	25-50%	0.4	>3 - <6	0.50	5-20	0.33	0.33 - 0.66
High	>95%	1.0	<15%	1.0	25-50 ft.	0.7	51-75%	0.7	>6 - <9	0.75	20-30	0.66	0.67 - 0.80
Excellent	>95%	1.0	<15%	1.0	>50 ft.	1.0	76-100%	1.0	>9 - 10	1.00	>30	1.0	> 0.80

[11]Unmanicured (upland) Buffer Width is divided into four categories: Excellent(1.0) = >50 ft, High(0.7) = 25-50 ft, Moderate(0.4) = 10-25 ft, and Low(0.1) = <10 ft.
[12]Estimated Total Vegetative Cover (Percent Range) for upland buffer is the proportion of the ground covered by vegetation within 50 feet of the wetland/upland transition zone. The percent cover is divided into three categories: High and Excellent(1.0) = >95%, Moderate(0.5) = 75 - 95%, and Poor(0.1) = <75%.
[13]The Total Number of Native Plant Species within the unmanicured upland buffer zone is based on 3 sampling locations and a meandering visual survey along the shoreline.
[14](Upland) Buffer Continuity is a measure of the proportion of the water body surrounded by the unmanicured, native upland buffer. This measure is divided into four categories: Excellent(1.0) = 76 - 100%, High(0.7) = 51 - 75%, Medium(0.4) = 26 - 50%, and Low(0.1) = 0 - 25%.
[15]Upland buffer exotic species "Percent of Total Coverage" is the percent cover of exotic species within the unmanicured upland buffer, which is divided into three categories: High and Excellent(1.0) = <15%, Moderate(0.5) = 15 - 40%, and Poor(0.1) = >40%.
[16]The presence of shoreline erosion is determined by the approximate percentage of the shoreline affected and is divided into the following three categories: 0 - 10%, 11 - 25%, 26 - 100%.

Table 1: Keller Lake 2015 Habitat Assessment Monitoring Results Black Dog Watershed Management Organization

Submergent Zone								
Approximate Proportion of the Water Body Which is Deep Water Habitat (~ > 20 ft. depth)	Overall Submergent Zone Quality[1]	Approximate Proportion of Water Body Typically Dominated By Submergent Vegetation (~ 2 - 20 ft. depth)	Native Species		Mean Coefficient of Conservatism Value	Exotic Species		
			Average Native Plant Density Rating[2,3]	Total Number of Native Species[5]		Total Number of Species	Average Exotic Plant Density Rating[2, 3]	Maximum Exotic Plant Density Rating[4]
0%	**Poor**	90%	1.3 (Moderate)	2 (Poor)	1.5 (Poor)	2	1.8 (Moderate)	2.2

Emergent Zone						
Overall Emergent Zone Quality[6]	Approximate Proportion of Emergent Zone (0 - 2 ft. depth) Within The Water Body	Approximate Total Percent Vegetative Cover Within The Entire Emergent Zone[7]	Total Number of Native Wetland Plant Species[8]	Mean Coefficient of Conservatism Value	Exotic Species	
					Number of Species	Total Exotic Emergent Percent Coverage[9]
High	10%	51-75% (High)	28 (Excellent)	2.3 (Poor)	8	26-50% (High)

Upland Buffer								Erosion/Sedimentation	
Overall Upland Buffer Quality[10]	Unmanicured Buffer Width[11]	Estimated Total Vegetative Cover (Percent Range)[12]	Total Number of Native Plant Species[13]	Mean Coefficient of Conservatism Value	Buffer Continuity (Percent Surrounding Water Body)[14]	Exotic Species		Shoreline Erosion (Percent of Shoreline)[16]	Sediment Deltas (Yes/No)
						Number of Species	Percent of Total Coverage[15]		
Moderate	25-50 ft. (High)	>95% (High)	20 (Moderate)	1.6 (Poor)	76-100% (Excellent)	10	>40% (Poor)	0-10%	No

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Table 1: Keller Lake 2015 Habitat Assessment Monitoring Results Black Dog Watershed Management Organization

The following changes were made to the 2011 - 2015 monitoring and analysis:

- Monitor one or two water bodies per year. Kingsley Lake only in 2011 - Conduct a meandering survey of submergent, emergent, and upland buffer zones rather than monitoring of plot locations. Orchard Lake only in 2012, Crystal Lake only in 2013, Lac Lavon only in 2014, Keller Lake only in 2015 - Conduct a meandering survey of submergent, emergent, and upland buffer zones. In addition, the emergent and upland buffer plot locations were evaluated.
- Changes were made in 2011 through 2015 to the calculations to include floristic quality as part of the assessment. These changes include adding a rating of "High" to the categories to accommodate MPCA ratings for floristic quality. These changes included adding a Rating Code:

Poor	Moderate	High or Excellent

The following footnotes pertain to 2015 data:

[1]**Overall Submergent Zone Quality** rating is the average of the rating scores for the following parameters: average exotic plant density, average native plant density, total number of native species, and C-value rating: >0.80 = Excellent, 0.67-0.80 = High, 0.33-0.66 = Moderate, <0.33 = Poor.

Overall Submergent Zone Quality	Avg. Exotic Plant Density	Exotic Plant Density Rating Score	Avg. Native Plant Density	Avg. Native Plant Density Rating Score	Total Number of Native Species In Submergent Zone	Species Richness Rating Score	Mean Coefficient of Conservatism Value (C-Value)	C-Value Rating (using MPCA values, 2007)	Total Overall Submergent Zone Quality Score
Poor	>2.0	0.1	> 1.75	0.1	<7	0.1	0 - <3	0.10	< 0.33
Moderate	>1.0 - 2.0	0.5	1.25 - 1.75	0.5	>7 - <9	0.5	>3 - <6	0.50	0.33 - 0.66
High	>0 - 1.0	0.75			>9 - <14	0.75	>6 - <9	0.75	0.67 - 0.80
Excellent	0	1.0	1.0 to 1.25	1.0	>14	1.0	>9 - 10	1.00	> 0.80

[2]Plant density ratings are a relative measure of the total amount of submergent vegetation covering the submergent zone, with a scale from 1 to 3 utilizing a 6-tined hook; 1 = light density (plant species found on only 1 tine), 2 = moderate density (plant species found on 2 to 4 tines), 3 = heavy density (plant species found on 5 or 6 tines).

[3]Density data for Keller Lake were collected by Blue Water Science using a point intercept survey throughout the lake.

[4]Maximum exotic plant density ratings represent the worst case scenario of curlyleaf pondweed density early in the growing season and/or Eurasian watermilfoil when it is most prolific later in the growing season.

[5]The Total Number of Native Species within the submergent zone for Keller Lake was collected by Blue Water Science using a point intercept survey. The additional category of "High" was added in 2011 through 2015 and values were adjusted to: <7 = Poor, 7-9 = Moderate, 9-14 = High, >14 = Excellent.

[6]**Overall Emergent Zone Quality** is the average of the rating scores for the following parameters within the emergent zone: the total percent coverage, the total number of native wetland plant species, the percent coverage of exotic species, and the C-Value Rating: >0.80 = Excellent, 0.67-0.80 = High, 0.33-0.66 = Moderate, <0.33 = Poor.

Overall Emergent Zone Quality	Percent Cover	Percent Cover Rating Score	Total Number of Native Wetland Plant Species	Number of Native Wetland Plant Species Rating Score	Percent Cover of Exotics	Percent Cover of Exotics Rating Score	Mean Coefficient of Conservatism Value (C-Value)	C-Value Rating (using MPCA values, 2007)	Overall Emergent Zone Quality Score
Poor	0-25%	0.1	< or= 5	0.1	76-100%	0.1	0 - <3	0.10	< 0.33
Moderate	76-100% or 26-50%	0.5	6 - 10	0.33	51-75%	0.33	>3 - <6	0.50	0.33 - 0.66
High	51-75%	1.0	11 - 15	0.66	26-50%	0.66	>6 - <9	0.75	0.67 - 0.80
Excellent	51-75%	1.0	> 15	1.0	0-25%	1.0	>9 - 10	1.00	> 0.80

Table 1: Keller Lake 2015 Habitat Assessment Monitoring Results Black Dog Watershed Management Organization

[7]Approximate Total Percent Vegetative Cover Within the Entire Emergent Zone (0-2 ft. depth) is estimated based on the three sampling locations and a visual survey during travels around the water body. Estimates are broken into the following categories: 0-25%=Poor, 26-50%=Moderate, 51-75%=High and Excellent, 76-100%=Moderate.
[8]The Total Number of Native Wetland Plant Species within the emergent zone is based on 3 sampling locations, a meandering visual survey during travels on the water body, and walking along the shoreline: 0-5 = Poor, 6-10 = Moderate, 11-15 = High, and >15 = Excellent.
[9]Total Exotic Emergent Percent Coverage, out of the entire emergent zone area, is estimated based on two plot locations, a meandering visual survey during travels on the water body, and walking along the shoreline. Estimates are broken into four categories: 0-25%=Excellent (1.0), 26-50%=High (0.66), 51-75%=Moderate (0.33), 76-100%=Poor (0.1)
[10]**Overall Upland Buffer Quality** is determined based on the average of the six upland buffer quality parameter rating scores: >0.80 = Excellent, 0.67-0.80 = High, 0.33-0.66 = Moderate, <0.33 = Poor.

Overall Upland Buffer Quality	Percent Cover	Percent Cover Rating Score	Exotics Percent Cover Range	Exotics Percent Cover Rating Score	Buffer Width Range	Buffer Width Rating Score	Buffer Continuity Percent Range	Buffer Continuity Rating Score	Mean Coefficient of Conservatism Value (C-Value)	C-Value Rating (using MPCA values, 2007)	Number of Native Species	Number of Native Species Rating Score	Overall Upland Buffer Quality Score
Poor	<75%	0.1	>40%	0.1	<10 ft.	0.1	0-25%	0.1	0 - <3	0.10	<5	0.1	< 0.33
Moderate	75-95%	0.5	15-40%	0.5	10-25 ft.	0.4	25-50%	0.4	>3 - <6	0.50	5-20	0.33	0.33 - 0.66
High	>95%	1.0	<15%	1.0	25-50 ft.	0.7	51-75%	0.7	>6 - <9	0.75	20-30	0.66	0.67 - 0.80
Excellent	>95%	1.0	<15%	1.0	>50 ft.	1.0	76-100%	1.0	>9 - 10	1.00	>30	1.0	> 0.80

[11]Unmanicured (upland) Buffer Width is divided into four categories: Excellent (1.0) = >50 ft, High (0.7) = 25-50 ft, Moderate (0.4) = 10-25 ft, and Low (0.1) = <10 ft.
[12]Estimated Total Vegetative Cover (Percent Range) for upland buffer is the proportion of the ground covered by vegetation within 50 feet of the wetland/upland transition zone. The percent cover is divided into three categories: High and Excellent (1.0) = >95%, Moderate (0.5) = 75 - 95%, and Poor (0.1) = <75%.
[13]The Total Number of Native Plant Species within the unmanicured upland buffer zone is based on two plot locations and a meandering visual survey along the shoreline.
[14](Upland) Buffer Continuity is a measure of the proportion of the water body surrounded by the unmanicured, native upland buffer. This measure is divided into four categories: Excellent (1.0) = 76 - 100%, High (0.7) = 51 - 75%, Medium (0.4) = 26 - 50%, and Low (0.1) = 0 - 25%.
[15]Upland buffer exotic species "Percent of Total Coverage" is the percent cover of exotic species within the unmanicured upland buffer, which is divided into three categories: High and Excellent (1.0) = <15%, Moderate (0.5) = 15 - 40%, and Poor (0.1) = >40%.
[16]The presence of shoreline erosion is determined by the approximate percentage of the shoreline affected and is divided into the following three categories: 0 - 10%, 11 - 25%, 26 - 100%.

Table 1: Kingsley Lake 2011 and 2016 Habitat Assessment Monitoring Results Black Dog Watershed Management Organization

Monitoring Year	Submergent Zone									
	Approximate Proportion of the Water Body Which is Deep Water Habitat (~ > 20 ft. depth)	Overall Submergent Zone Quality[1]	Approximate Proportion of Water Body Typically Dominated By Submergent Vegetation (~ 2 - 20 ft. depth)	Native Species		Mean Coefficient of Conservatism Value	Exotic Species		
				Average Native Plant Density Rating[2,3]	Total Number of Native Species[5]		Total Number of Species	Average Exotic Plant Density Rating[2, 3]	Maximum Exotic Plant Density Rating[4]
2011	0%	**High**	70%	1.4 (Moderate)	18 (Excellent)	5.8 (Moderate)	0	0.0 (Excellent)	0.0 (Excellent)
2016	0%	**High**	70%	1.4 (Moderate)	20 (Excellent)	5.7 (Moderate)	1	<1.0 (High)	<1.0 (High)

Monitoring Year	Emergent Zone						
	Overall Emergent Zone Quality[6]	Approximate Proportion of Emergent Zone (0 - 2 ft. depth) Within The Water Body	Approximate Total Percent Vegetative Cover Within The Entire Emergent Zone[7]	Total Number of Native Wetland Plant Species[8]	Mean Coefficient of Conservatism Value	Exotic Species	
						Number of Species	Total Exotic Emergent Percent Coverage[9]
2011	**High**	30%	51-75% (High)	22 (Excellent)	3.3 (Moderate)	4	26-50% (High)
2016	**High**	30%	51-75% (High)	31 (Excellent)	3.8 (Moderate)	4	26-50% (High)

Monitoring Year	Upland Buffer								Erosion/Sedimentation	
	Overall Upland Buffer Quality[10]	Unmanicured Buffer Width[11]	Estimated Total Vegetative Cover (Percent Range)[12]	Total Number of Native Plant Species[13]	Mean Coefficient of Conservatism Value	Buffer Continuity (Percent Surrounding Water Body)[14]	Exotic Species		Shoreline Erosion (Percent of Shoreline)[16]	Sediment Deltas (Yes/No)
							Number of Species	Percent of Total Coverage[15]		
2011	**High**	25-50 ft. (High)	>95% (High)	45 (Excellent)	2.2 (Poor)	76-100% (Excellent)	25	15-40% (Moderate)	0-10%	No
2016	**High**	25-50 ft. (High)	>95% (High)	59 (Excellent)	2.2 (Poor)	76-100% (Excellent)	26	15-40% (Moderate)	0-10%	No

Table 1: Kingsley Lake 2016 Habitat Assessment Monitoring Results Black Dog Watershed Management Organization

The following changes were made to the 2011 - 2016 monitoring and analysis:

- Monitor one or two water bodies per year. Kingsley Lake in 2011 - Conduct a meandering survey of submergent, emergent, and upland buffer zones rather than monitoring of plot locations. Orchard Lake in 2012, Crystal Lake in 2013, Lac Lavon in 2014, Keller Lake in 2015, Kingsley Lake in 2016 - Conduct a meandering survey of submergent, emergent, and upland buffer zones. In addition, the emergent and upland buffer plot locations were evaluated.
- Changes were made in 2011 through 2016 to the calculations to include floristic quality as part of the assessment. These changes include adding a rating of "High" to the categories to accommodate MPCA ratings for floristic quality. These changes included adding a Rating Code:

Poor	Moderate	High or Excellent

The following footnotes pertain to 2011 through 2016 data:

[1]**Overall Submergent Zone Quality** rating is the average of the rating scores for the following parameters: average exotic plant density, average native plant density, total number of native species, and C-value rating: >0.80 = Excellent, 0.67-0.80 = High, 0.33-0.66 = Moderate, <0.33 = Poor.

Overall Submergent Zone Quality	Avg. Exotic Plant Density	Exotic Plant Density Rating Score	Avg. Native Plant Density	Avg. Native Plant Density Rating Score	Total Number of Native Species In Submergent Zone	Species Richness Rating Score	Mean Coefficient of Conservatism Value (C-Value)	C-Value Rating (using MPCA values, 2007)	Total Overall Submergent Zone Quality Score
Poor	>2.0	0.1	> 1.75	0.1	<7	0.1	0 - <3	0.10	< 0.33
Moderate	>1.0 - 2.0	0.5	1.25 - 1.75	0.5	>7 - <9	0.5	>3 - <6	0.50	0.33 - 0.66
High	>0 - 1.0	0.75			>9 - <14	0.75	>6 - <9	0.75	0.67 - 0.80
Excellent	0	1.0	1.0 to 1.25	1.0	>14	1.0	>9 - 10	1.00	> 0.80

[2]Plant density ratings are a relative measure of the total amount of submergent vegetation covering the submergent zone, with a scale from 1 to 3 utilizing a 6-tined hook; 1 = light density (plant species found on only 1 tine), 2 = moderate density (plant species found on 2 to 4 tines), 3 = heavy density (plant species found on 5 or 6 tines).

[3]Density data for Kingsley Lake were collected by Barr using a meander survey throughout the lake.

[4]Maximum exotic plant density ratings represent the worst case scenario of curlyleaf pondweed density early in the growing season and/or Eurasian watermilfoil when it is most prolific later in the growing season.

[5]The Total Number of Native Species within the submergent zone for Kingsley Lake was collected by Barr using a meander survey.
The additional category of "High" was added in 2011 through 2016 and values were adjusted to: <7 = Poor, 7-9 = Moderate, 9-14 = High, >14 = Excellent.

[6]**Overall Emergent Zone Quality** is the average of the rating scores for the following parameters within the emergent zone: the total percent coverage, the total number of native wetland plant species, the percent coverage of exotic species, and the C-Value Rating: >0.80 = Excellent, 0.67-0.80 = High, 0.33-0.66 = Moderate, <0.33 = Poor.

Overall Emergent Zone Quality	Percent Cover	Percent Cover Rating Score	Total Number of Native Wetland Plant Species	Number of Native Wetland Plant Species Rating Score	Percent Cover of Exotics	Percent Cover of Exotics Rating Score	Mean Coefficient of Conservatism Value (C-Value)	C-Value Rating (using MPCA values, 2007)	Overall Emergent Zone Quality Score
Poor	0-25%	0.1	< or= 5	0.1	76-100%	0.1	0 - <3	0.10	< 0.33
Moderate	76-100% or 26-50%	0.5	6 - 10	0.33	51-75%	0.33	>3 - <6	0.50	0.33 - 0.66
High	51-75%	1.0	11 - 15	0.66	26-50%	0.66	>6 - <9	0.75	0.67 - 0.80
Excellent	51-75%	1.0	> 15	1.0	0-25%	1.0	>9 - 10	1.00	> 0.80

Table 1: Kingsley Lake 2016 Habitat Assessment Monitoring Results Black Dog Watershed Management Organization

[7]Approximate Total Percent Vegetative Cover Within the Entire Emergent Zone (0-2 ft. depth) is estimated based on the three sampling locations and a visual survey during travels around the water body. Estimates are broken into the following categories: 0-25%=Poor, 26-50%=Moderate, 51-75%=High and Excellent, 76-100%=Moderate.
[8]The Total Number of Native Wetland Plant Species within the emergent zone is based on 3 sampling locations, a meandering visual survey during travels on the water body, and walking along the shoreline: 0-5 = Poor, 6-10 = Moderate, 11-15 = High, and >15 = Excellent.
[9]Total Exotic Emergent Percent Coverage, out of the entire emergent zone area, is estimated based on two plot locations, a meandering visual survey during travels on the water body, and walking along the shoreline. Estimates are broken into four categories: 0-25%=Excellent (1.0), 26-50%=High (0.66), 51-75%=Moderate (0.33), 76-100%=Poor (0.1)
[10]**Overall Upland Buffer Quality** is determined based on the average of the six upland buffer quality parameter rating scores: >0.80 = Excellent, 0.67-0.80 = High, 0.33-0.66 = Moderate, <0.33 = Poor.

Overall Upland Buffer Quality	Percent Cover	Percent Cover Rating Score	Exotics Percent Cover Range	Exotics Percent Cover Rating Score	Buffer Width Range	Buffer Width Rating Score	Buffer Continuity Percent Range	Buffer Continuity Rating Score	Mean Coefficient of Conservatism Value (C-Value)	C-Value Rating (using MPCA values, 2007)	Number of Native Species	Number of Native Species Rating Score	Overall Upland Buffer Quality Score
Poor	<75%	0.1	>40%	0.1	<10 ft.	0.1	0-25%	0.1	0 - <3	0.10	<5	0.1	< 0.33
Moderate	75-95%	0.5	15-40%	0.5	10-25 ft.	0.4	25-50%	0.4	>3 - <6	0.50	5-20	0.33	0.33 - 0.66
High	>95%	1.0	<15%	1.0	25-50 ft.	0.7	51-75%	0.7	>6 - <9	0.75	20-30	0.66	0.67 - 0.80
Excellent	>95%	1.0	<15%	1.0	>50 ft.	1.0	76-100%	1.0	>9 - 10	1.00	>30	1.0	> 0.80

[11]Unmanicured (upland) Buffer Width is divided into four categories: Excellent (1.0) = >50 ft, High (0.7) = 25-50 ft, Moderate (0.4) = 10-25 ft, and Low (0.1) = <10 ft.
[12]Estimated Total Vegetative Cover (Percent Range) for upland buffer is the proportion of the ground covered by vegetation within 50 feet of the wetland/upland transition zone. The percent cover is divided into three categories: High and Excellent (1.0) = >95%, Moderate (0.5) = 75 - 95%, and Poor (0.1) = <75%.
[13]The Total Number of Native Plant Species within the unmanicured upland buffer zone is based on two plot locations and a meandering visual survey along the shoreline.
[14](Upland) Buffer Continuity is a measure of the proportion of the water body surrounded by the unmanicured, native upland buffer. This measure is divided into four categories: Excellent (1.0) = 76 - 100%, High (0.7) = 51 - 75%, Medium (0.4) = 26 - 50%, and Low (0.1) = 0 - 25%.
[15]Upland buffer exotic species "Percent of Total Coverage" is the percent cover of exotic species within the unmanicured upland buffer, which is divided into three categories: High and Excellent (1.0) = <15%, Moderate (0.5) = 15 - 40%, and Poor (0.1) = >40%.
[16]The presence of shoreline erosion is determined by the approximate percentage of the shoreline affected and is divided into the following three categories: 0 - 10%, 11 - 25%, 26 - 100%.

Appendix D

2003–2016 Recommended and Completed Management Actions

Table D-1: 2009 Recommended and Completed Management Actions
Black Dog Watershed Management Organization Habitat Monitoring

Strategic Water Body	Problem Identified	Recommendation	Proposed Action	Benefits	Implementation Period	Completed 2004-2009 Actions Which May Improve Wildlife Habitat and/or Water Quality
Crystal	Unmanicured, native vegetation in adjacent upland and emergent zone is narrow and not continuous, limiting wildlife benefits.	1. Increase width and continuity of native upland buffer and emergent zone.	Conduct an educational workshop and lakescaping demonstration project. Assist lakeshore owners with funding and obtaining any needed MnDNR permits for potential upland buffer and emergent zone enhancements.	Inform/show lakeshore property owners how a native upland buffer and native emergent zone can improve functions and values of the lake and improve aesthetics.	Spring - Fall	2009: Operation of the ferric chloride treatment system halted due to low water levels. The City of Burnsville harvested curlyleaf pondweed. In late 2009, the City of Burnsville treated 14 acres of buckthorn within Crystal West Park. In 2009 and 2008, garlic mustard within the upland buffer was removed/pulled. 2004-2008: The BDWMO resumed and continued operation of the ferric chloride treatment system. The City of Burnsville: 1) excavated/enhanced four stormwater treatment ponds (including West Buck Hill Park), which reduced the phosphorus loading into the lake, and 2) conducted annual harvesting of Eurasian watermilfoil and curlyleaf pondweed. The City of Lakeville excavated/enhanced the Bluebill stormwater treatment pond.
			Restore sustainable native communities	Increase wildlife habitat.	Spring - Fall	
	Purple loosestrife is present.	2. Continue to control and manage purple loosestrife.	Control and manage. For large stands of purple loosestrife, contact the MnDNR to request a release of purple loosestrife-controlling beetles. For a few small colonies of purple loosestrife, hand pull or dig the plants out before they go to seed.	Increase/maintain wildlife habitat.	Spring - Fall	
	Curlyleaf pondweed is present.	3. Control curlyleaf pondweed	Control by harvesting or chemical treatment.	Maintain wildlife habitat.	Late Spring	
	Eurasian watermilfoil is present.	4. Control Eurasian watermilfoil.	Control by chemical treatment.	Maintain wildlife habitat.	Summer	
Keller Lake	Unmanicured, native vegetation in adjacent upland is narrow and not continuous, limiting wildlife benefits.	1. Increase width and continuity of native upland buffer.	Conduct an educational workshop and lakescaping demonstration project. Assist lakeshore owners with funding of potential upland buffer enhancements.	Inform/show lakeshore property owners how a native upland buffer can improve functions and values of the lake and improve aesthetics.	Spring - Fall	In 2010 the City of Apple Valley may construct Whitney Pond for stormwater treatment within the Keller Lake watershed. 2009: Due to low water levels, operation of the ferric chloride treatment system halted and no harvesting of curlyleaf pondweed was conducted. The City of Burnsville stabilized approximately one hundred feet of shoreline on the southeast edge of the lake. Logs were interlaced and secured along the shoreline and red-osier dogwood live stakes were installed along the eroding banks. 2004 - 2008: The Cities of Apple Valley and Burnsville partnered to conduct annual harvesting of curlyleaf pondweed. 2005: The City of Apple Valley excavated and enhanced Redwood Pond, which will decrease phosphorus loading into Keller Lake. Also, In 2010 the City of Apple Valley may construct Whitney Pond for stormwater treatment within the Keller Lake watershed.
			Restore sustainable native communities	Increase wildlife habitat.	Spring - Fall	
	Purple loosestrife is present.	2. Continue to control and manage purple loosestrife.	Control and manage. For large stands of purple loosestrife, contact the MnDNR to request a release of purple loosestrife-controlling beetles. For a few small colonies of purple loosestrife, hand pull or dig the plants out before they go to seed.	Increase/maintain wildlife habitat.	Spring - Fall	
	Curlyleaf pondweed dominates the lake in late spring-early summer.	3. Continue control of curlyleaf pondweed.	Control as recommended by the MnDNR. Since the MnDNR designates Keller Lake as a "Natural Environment", a special permit is needed to chemically treat the lake.	Maintain wildlife habitat.	Summer	
	Eurasian watermilfoil is present.	4. Control Eurasian watermilfoil.	Control as recommended by the MnDNR. Since the MnDNR designates Keller Lake as a "Natural Environment", a special permit is needed to chemically treat the lake.	Maintain wildlife habitat.	Summer	
Kingsley Lake	Curlyleaf pondweed is present.	1. Conduct a detailed late spring macrophyte survey to ascertain densities and extent of coverage.	Consider control measures, dependent on results of an detailed early growing season survey.	Maintain wildlife habitat.	Late Spring	2005 - 2008: Annually, the City of Lakeville and members of the Kingsley Lake Homeowner's Association removed purple loosestrife plants and common buckthorn from portions of the lake and the upland buffer surrounding the lake. On March 6, 2008, soil sediment samples were collected on Kingsley Lake by Blue Water Science (BWS) and the City of Lakeville. Based on the results of the soil analysis, the BWS report stated that "curlyleaf pondweed is not expected to produce heavy growth conditions (where plants top out in a solid canopy) in Kingsley Lake." However, since curlyleaf pondweed may typically die-off prior to the early-June habitat assessment, the peak density and percent total coverage of curlyleaf pondweed is uncertain. To date, it is unclear if curlyleaf pondweed densities and percent coverage have been relatively consistent or increasing within the lake over the last few years. In 2008, a Kingsley lakeshore resident, inspired by the Blue Thumb program, commenced shoreline stabilization utilizing native plants.
	Common buckthorn dominates portions of the upland buffer.	2. Conduct an evaluation of common buckthorn, followed by removal.	Remove buckthorn. Volunteer groups and contractors can effectively remove buckthorn by pulling, cutting, and treating stumps with herbicide.	Increase wildlife habitat.	Open	
	Purple loosestrife is present.	3. Continue to control and manage purple loosestrife.	Control and manage. For large stands of purple loosestrife, contact the MnDNR to request a release of purple loosestrife-controlling beetles. For a few small colonies of purple loosestrife, hand pull or dig the plants out before they go to seed.	Increase/maintain wildlife habitat.	Spring - Fall	
	Hybrid cattail and reed canary grass are present.	4. Control hybrid cattail and reed canary grass.	Control hybrid cattail and reed canary grass now before colonies become more abundant. The herbicide Rodeo™ can be used to effectively control both invasive emergent species.	Increase/maintain wildlife habitat.	Spring-Summer	
Lac Lavon	Eurasian watermilfoil dominates portions of the lake.	1. Continue to manage Eurasian watermilfoil.	Control by chemical treatment as recommended by MnDNR.	Increase/maintain wildlife habitat and water quality	Spring-Summer	2006: The Cities of Burnsville and Apple Valley and the lake homeowners partnered to fund a fluridone treatment for control of Eurasian watermilfoil. The treatment is expected to provide control of Eurasian watermilfoil for three years, while allowing native plant species to rebound. The cities have continued to inform the MnDNR of the ongoing treatments and the MnDNR proposes to continue aquatic plant surveys to study the effects of whole-lake fluridone treatments. However, no MnDNR macrophyte survey was conducted in 2008.
	Curlyleaf pondweed is present.	2. Monitor presence of curlyleaf pondweed.	Control if increased occurrence and subsequent midsummer die off threatens water quality)	Identify the problem before it becomes difficult to treat.	Spring	
	Unmanicured, native vegetation in adjacent upland is narrow and not continuous, limiting wildlife benefits.	3. Increase width/creation of native upland buffer.	Conduct an educational workshop and lakescaping demonstration project. Assist lakeshore owners with funding of potential upland buffer enhancements.	Inform/show lakeshore property owners of how a native upland buffer can improve functions and values of the lake and improve aesthetics.	Spring - Fall	
			Restore sustainable native communities	Increase wildlife habitat.	Spring - Fall	
Orchard Lake	Curlyleaf pondweed dominates the lake in late spring-early summer.	1. Continue curlyleaf pondweed control measures.	Control and manage	Increase/maintain wildlife habitat and water quality.	Late Spring - Early summer	2009: The City of Lakeville conducted herbicide treatment for curlyleaf pondweed within the northeast bay (~20 acres). The herbicide treatment resulted in lake-wide control of curlyleaf pondweed. 2004-2008: The City of Lakeville provided lakeshore owners with shoreline restoration information. However, to date, no plans have been made for potential future shoreline restoration projects. Annually, the City of Lakeville harvested approximately 70 acres of curlyleaf pondweed. 2007: A small area of lakeshore, near the boat launch, was restored using native plants.
	Unmanicured, native vegetation in adjacent upland is narrow and not continuous, limiting wildlife benefits.	2. Increase width and continuity of native upland buffer.	Conduct an educational workshop and lakescaping demonstration project. Assist lakeshore owners with funding of potential upland buffer enhancements.	Inform/show lakeshore property owners how a native upland buffer can improve functions and values of the lake and improve aesthetics.	Spring - Fall	
			Restore sustainable native communities	Increase wildlife habitat.	Spring - Fall	
	Purple loosestrife is present.	3. Conduct a detailed evaluation of purple loosestrife, followed by removal/control.	Control and manage by hand-pulling if only a few plants are present or introduce beetles if numerous plants are present.	Increase/maintain wildlife habitat.	Spring - Summer	
Sunset Pond	Extensive algal bloom	1. Reduce phosphorus loading into the pond.	Construct/install: catch basin sumps, prefabricated treatment devices (e.g. Stormceptor), infiltration facilities within the watershed, or other more conventional methods. Conduct more frequent street sweepings.	Improve wildlife habitat, fishery habitat, and aesthetics/recreation.	Open	In 2009, as in past years, the City of Burnsville actively managed the restored native buffer adjacent to the pond, the surrounding prairie restoration area, and portions of the emergent zone. Specifically, in 2007 through 2009 the City of Burnsville conducted spot spraying of invasive vegetation, such as reed canary grass, thistle, and purple loosestrife. A prescription burn, inter-seeding of prairie species, and buckthorn removal were conducted in 2008 to increase the plant diversity in the upland area.
	Maintained turf grass remains within portions of the upland buffer.	2. Enhance/maintain upland buffer.	Continue restoring sustainable native communities	Improve wildlife habitat and water quality.	Spring - Fall	
	Exotic species are dominant in emergent zone, and include narrow-leaf cattail, hybrid cattail, and reed canary grass.	3. Manage exotic species within emergent zone.	Selective herbicide treatments to reduce presence of exotic species	Allow for the establishment of more diverse native species that provide better wildlife values.	Spring - Fall	
	Presence of curlyleaf pondweed observed in 2003 and 2005 through 2008.	4. Conduct a late spring macrophyte survey to ascertain densities and extent of coverage.	consider control measures dependent on the results of an early growing season survey.	Maintain wildlife habitat. Reduce down-stream phosphorus loading.	Late Spring	
	The southern portion of the pond is shallow (1 to 3 feet deep).	5. Create a "navigation channel".	Excavate and remove sediment.	Improve wildlife habitat, fishery habitat, and aesthetics/recreation.	Winter	

Table 2: 2011 Recommended and Completed Management Actions for Kingsley Lake
Black Dog Watershed Management Organization Habitat Monitoring

Problem Identified	Recommendation	Proposed Action	Benefits	Implementation Period	Completed 2004-2009 Actions Which May Improve Wildlife Habitat and/or Water Quality
Curlyleaf pondweed is present in some years.	Conduct a detailed late spring macrophyte survey to ascertain densities and extent of coverage.	Consider control measures, dependent on results of a detailed early growing season survey.	Maintain wildlife habitat.	Late Spring	2005 - 2008: Annually, the City of Lakeville and members of the Kingsley Lake Homeowner's Association removed purple loosestrife plants and common buckthorn from portions of the lake and the upland buffer surrounding the lake. Purple loosestrife beetles were released by the MnDNR prior to 2002. Follow up monitoring by the MnDNR indicates that beetles are present at a population that the MnDNR feels is appropriate for biological control. On March 6, 2008, soil sediment samples were collected on Kingsley Lake by Blue Water Science (BWS) and the City of Lakeville. Based on the results of the soil analysis, the BWS report stated that "curlyleaf pondweed is not expected to produce heavy growth conditions (where plants top out in a solid canopy) in Kingsley Lake." However, since curlyleaf pondweed may typically die-off prior to the early-June habitat assessment, the peak density and percent total coverage of curlyleaf pondweed is uncertain. To date, it is unclear if curlyleaf pondweed densities and percent coverage have been relatively consistent or increasing within the lake over the last few years. In 2008, a Kingsley Lake lakeshore resident, inspired by the Blue Thumb program, commenced shoreline stabilization utilizing native plants.
Common buckthorn dominates portions of the upland buffer.	Conduct an evaluation of common buckthorn, followed by removal.	Remove buckthorn. Volunteer groups and contractors can effectively remove buckthorn by pulling, cutting, and treating stumps with herbicide.	Increase wildlife habitat.	Open	
Purple loosestrife is present.	Continue to control and manage purple loosestrife.	Control and manage. For a few small colonies of purple loosestrife, hand pull or dig the plants out before they go to seed. Continue to request monitoring from the MnDNR to assure beetles are present and at appropriate populations for biological control.	Increase/maintain wildlife habitat.	Spring - Fall	
Hybrid cattail and reed canary grass are present.	Control hybrid cattail and reed canary grass.	Control hybrid cattail and reed canary grass now before colonies become more abundant. The herbicide Rodeo ^{TM} can be used to effectively control both invasive emergent species.	Increase/maintain wildlife habitat.	Spring-Summer	
Stormwater drainage from impervious surfaces is directed into the lake.	Redirect stormwater for infiltration prior to discharge.	Install a rainwater garden or other suitable method for infiltration.	Improve water quality	Open	
Bare soil on steep slope could cause erosion and sedimentation into lake.	Vegetate hillslope.	Plant vegetation suited for steep slopes along hillside to prevent erosion.	Improve water quality	Open	
Upland buffer areas lacking naturalized vegetation.	Improve the shoreline with a naturalized upland buffer.	Rather than manicured turf grass, gravel, and managed plantings with bare soil, the shoreline could be vegetated with native grasses and wildflowers. A landscape architect could create inviting spaces and views for restaurant customers to enjoy.	Increase wildlife habitat and Improve water quality	Open	
Emergent and upland buffer areas contain non-native invasive vegetation.	Replace non-native invasive vegetation with native vegetation.	Treat non-native invasive vegeation and then seed with an appropriate BWSR seed mix.	Increase/maintain wildlife habitat.	Spring-Summer	

Table 2: 2012 Recommended and Completed Management Actions for Orchard Lake
Black Dog Watershed Management Organization Habitat Monitoring

Problem Identified	Recommendation	Proposed Action	Benefits	Implementation Period	Completed 2004-2012 Actions Which May Improve Wildlife Habitat and/or Water Quality
Curlyleaf pondweed dominates the lake in late spring-early summer.	Continue curlyleaf pondweed control measures.	Continue to control and manage. See Figure 3 for locations of curlyleaf pondweed.	Increase wildlife habitat, improve water quality, vegetative diversity, aesthetics, and recreation.	Late Spring - Early summer	**1999 through 2012:** The City of Lakeville conducts aquatic vegetation monitoring twice/year. **2009 through 2012**: The City of Lakeville conducted annual herbicide treatment for curlyleaf pondweed. **2004 through 2008:** Annually, the City of Lakeville harvested approximately 70 acres of curlyleaf pondweed. **2010**: Adjacent to the southwest end of the lake, an aeration system was installed in Orchard Pond to precipitate out phosphorus and improve water quality flowing into Orchard Lake. **2004 through 2012**: The City of Lakeville annually provides lakeshore owners with shoreline restoration information and encourages homeowners to take advantage of the Blue Thumb restoration program. One shoreline resident started a restoration project in **2012**. **2007**: A small area of lakeshore, near the boat launch, was restored using native plants. **2002**: Purple loosestrife beetles were released by the MNDNR. Follow up monitoring indicates that beetles are present at a popoulation that the MNDNR feels is appropriate for biological control of purple loosestrife plants.
Upland buffer areas lacking naturalized vegetation within publicly owned properties.	Increase width and continuity of native upland buffer.	To expand on the shoreline restoration that was done near the boat launch in 2007, the adjacent upland buffer could also be restored to naturalized native vegetation and not mowed (Potential Restoration Area #1 as shown in Appendix A and Figure 5). In the Wayside Park Area, non-native invasive vegetation including common buckthorn, vetch, spotted knapweed, and cattails could be removed and replaced with native vegetation. The naturalized upland buffer could be widened (Potential Restoration Area #2 as shown in Appendix A and Figure 5). At the beach area, there is a timber wall which is currently being used for fishing. A shoreline restoration could be done in this area (Potential Resotration Area #3 as shown in Appendix A and Figure 5). On the northwest side of the lake, one property owned by the City of Lakeville (adjacent to residential shoreline properties) could be restored to naturalized vegetation and provide an example for adjacent residential landowners for shoreline and upland buffer restoration (Potential Restoration Area #4 as shown in Appendix A and Figure 5).	Increase wildlife habitat. Improve water quality. Improve vegetative diversity and aesthetics.	Spring - Fall	
Upland buffer areas lacking naturalized vegetation. Most of the residential properties have turf grass up the the lakeshore edge.	Increase width and continuity of native upland buffer.	Restore sustainable native communities. Rather than manicured turf grass, sand, and bare soil, the shoreline could be vegetated with native grasses and wildflowers. A native upland buffer can improve functions and values of the lake and improve aesthetics (Potential Restoration Area #5 as shown in Appendix A and Figure 5).	Increase wildlife habitat. Improve water quality. Improve vegetative diversity and aesthetics.	Spring - Fall	
Purple loosestrife is present.	Continue to control and manage purple loosestrife.	Control and manage. For a few small colonies of purple loosestrife, hand pull or dig the plants out before they go to seed. Continue to request monitoring from the MNDNR to assure beetles are present and at appropriate populations for biological control (See Figures 3 and 5 for location of purple loosestrife).	Increase wildlife habitat. Improve vegetative diversity.	Spring - Fall	

Table 2: 2013 Recommended and Completed Management Actions for Crystal Lake
Black Dog Watershed Management Organization Habitat Monitoring

Problem Identified	Recommendation	Proposed Action	Benefits	Implementation Period	Completed Actions Which May Improve Wildlife Habitat and/or Water Quality
Curlyleaf pondweed dominates the lake in late spring-early summer.	Continue curlyleaf pondweed control measures.	Continue to control and manage. See Blue Water Science report for locations of curlyleaf pondweed.	Increase wildlife habitat, improve water quality, vegetative diversity, aesthetics, and recreation.	Late Spring - Early summer	**1999 through 2013:** The City of Burnsville conducts aquatic vegetation monitoring twice/year. **2003 through 2013**: The City of Burnsville conducted annual harvesting of curlyleaf pondweed. **2004-2008**: -The BDWMO operated the ferric chloride treatment system. -The City of Burnsville: 1) excavated/enhanced four stormwater treatment ponds (including West Buck Hill Park), which reduced the phosphorus loading into the lake, and 2) conducted annual harvesting of Eurasian watermilfoil and curlyleaf pondweed. -The City of Lakeville excavated/enhanced the Bluebill stormwater treatment pond. In **2009 and 2008**, garlic mustard within the upland buffer was removed/pulled. In late **2009**, the City of Burnsville treated 14 acres of buckthorn within Crystal West Park.
Upland buffer areas lacking naturalized vegetation within publicly owned properties.	Increase width and continuity of native upland buffer.	The width and density of naturalized shoreline buffer at the location of Emergent Plot #1 near the swimming area has improved significantly since 2009. The adjacent upland buffer could also be restored to naturalized native vegetation and not mowed (Potential Restoration Areas #1 through 4 as shown in Figure 4 and photos).	Increase wildlife habitat. Improve water quality. Improve vegetative diversity and aesthetics.	Spring - Fall	
Upland buffer areas lacking naturalized vegetation. Most of the residential properties have turf grass up the the lakeshore edge.	Increase width and continuity of native upland buffer.	Restore sustainable native communities. Rather than manicured turf grass, sand, and bare soil, the shoreline could be vegetated with native grasses and wildflowers. A native upland buffer can improve functions and values of the lake and improve aesthetics (Potential Restoration Area #5 as shown in Figure 4 and photos).	Increase wildlife habitat. Improve water quality. Improve vegetative diversity and aesthetics.	Spring - Fall	
Purple loosestrife is present.	Continue to control and manage purple loosestrife.	Continue to control. For a few small colonies of purple loosestrife, hand pull or dig the plants out before they go to seed.	Increase wildlife habitat. Improve vegetative diversity.	Spring - Fall	
Eurasian watermilfoil is present.	Control Eurasian watermilfoil.	Control by chemical treatment.	Maintain wildlife habitat.	Summer	

Table 2: 2014 Recommended and Completed Management Actions for Lac Lavon
Black Dog Watershed Management Organization Habitat Monitoring

Problem Identified	Recommendation	Proposed Action	Benefits	Implementation Period	Completed Actions Which May Improve Wildlife Habitat and/or Water Quality
Curlyleaf pondweed dominates the lake in late spring-early summer.	Continue curlyleaf pondweed control measures.	Continue to control and manage. **See Macrophyte Survey Results for locations of curlyleaf pondweed**.	Increase wildlife habitat, improve water quality, vegetative diversity, aesthetics, and recreation.	Late Spring - Early summer	Aquatic plant surveys were conducted by Barr in 2013 and 2014.
Eurasian watermilfoil is present.	Control Eurasian watermilfoil.	Control by chemical treatment. **See Macrophyte Survey Results for locations of Eurasian watermilfoil**	Maintain wildlife habitat.	Summer	In 2006, the cities of Burnsville and Apple Valley and the lake homeowners partnered to fund a fluridone treatment for control of Eurasian watermilfoil. Aquatic plant surveys were conducted by Barr in 2013 and 2014.
Purple loosestrife is present.	Continue to control and manage purple loosestrife.	Continue to control. For a few small colonies of purple loosestrife, hand pull or dig the plants out before they go to seed. **See Macrophyte Survey Results for locations of purple loosestrife**	Increase wildlife habitat. Improve vegetative diversity.	Spring - Fall	Purple loosestrife removal on shallow island areas was completed by the cities of Apple Valley and Burnsville in 2011.
Upland buffer areas lacking naturalized vegetation within publicly owned properties.	Increase width and continuity of native upland buffer.	Expand native prairie planting to include area to the east, which is dominated by knapweed. This could become a tall grass prairie. **Potential Restoration Area #1**	Increase wildlife habitat. Improve water quality. Improve vegetative diversity and aesthetics.	Spring - Fall	In 2013, the city of Burnsville installed a native prairie planting converting a sand beach and turf grass to prairie and wetland vegetation.
Upland buffer areas in city parks contain non-native invasive vegetation such as buckthorn, Siberian elm, leafy spurge, and spotted kanpweed.	Continue to control and manage non-native invasive vegetation	Continue to control and manage non-native invasive vegetation **Potential Restoration Area #2**	Increase wildlife habitat. Improve vegetative diversity and aesthetics	Spring - Fall	Some invasive species control for Canada thistle and knapweed was conducted on the new native planting area in 2014. In 2010, the city of Apple Valley released about 150 spotted knapweed seedhead boring weevils in Lac Lavon Park in Apple Valley. Continued management of the vegetation communities and shoreline restoration activities will help to maintain and improve wildlife habitat, vegetation diversity, aesthetics, and recreation
Impervious surfaces and turf grass in the Apple Valley park near the fishing pier can collect pollutants in stormwater and flow directly into the lake, decreasing water quality.	Increase areas of naturalized vegetation to slow down and pretreat stormwater prior to entering the lake.	Strategically create buffer strips with naturalized vegetation adjacent to impervious surfaces to slow down and pretreat stormwater prior to entering the lake. **Potential Restoration Area #3**	Improve water quality	Spring - Fall	
Upland buffer areas lacking naturalized vegetation. Most of the residential properties have turf grass or sand up to the lakeshore edge.	Increase width and continuity of native upland buffer.	Restore sustainable native communities. Rather than manicured turf grass, sand, and bare soil, the shoreline could be vegetated with native grasses and wildflowers. A native upland buffer can improve functions and values of the lake and improve aesthetics. **Potential Restoration Area #4**	Increase wildlife habitat. Improve water quality. Improve vegetative diversity and aesthetics.	Spring - Fall	One raingarden was installed in the backyard of a shoreline property owner on Highview Drive in Apple Valley through the Blue Thumb program. The establishment of shoreline restoration projects (especially contiguous) on residential properties in the future will help balance out the differences in upland buffer habitat between city owned property and residential property.

Table 2: 2015 Recommended and Completed Management Actions for Keller Lake
Black Dog Watershed Management Organization Habitat Monitoring

Problem Identified	Recommendation	Proposed Action	Benefits	Implementation Period	Completed Actions Which May Improve Wildlife Habitat and/or Water Quality
Curlyleaf pondweed dominates the lake in late spring-early summer.	Continue curlyleaf pondweed control measures.	Continue to control and manage. **See Appendix A Aquatic Plant Survey for locations of curlyleaf pondweed**.	Increase wildlife habitat, improve water quality, vegetative diversity, aesthetics, and recreation.	Late Spring - Early summer	Aquatic plant surveys have been conducted by Blue Water Science 1998-2015. Iron dosing occurred from 1999 through 2008. Mechanical harvesting is conducted each year since 2004.
Eurasian watermilfoil is present.	Control Eurasian watermilfoil.	Continue to monitor. Control as recommended by the MnDNR. Since the MnDNR designates Keller Lake as a "Natural Environment Lake", chemical treatment is not allowed.	Maintain wildlife habitat.	Summer	Aquatic plant surveys have been conducted by Blue Water Science 1998-2015.
The inlet coming from the stormwater pond at the south end of Keller Lake is surrounded by bare soil or sparse vegetation.	Re-vegetated bare areas to prevent soil erosion into Keller Lake.	Seed or plant bare areas with native vegetation. **Potential Restoration Area #1**	Improve water quality and vegetative diversity.	Spring or Fall	
Shoreline fishing traffic is causing bare soil areas along the shoreline.	Re-vegetated bare areas to prevent soil erosion into Keller Lake.	Create designated stone walkways for fishing access. **Potential Restoration Area #2**	Improve water quality, vegetative diversity, and aesthetics.	Spring - Fall	
The southern public park is littered with trash and other dumped items especially near the shoreline.	Clean up the litter.	Organize a neighborhood clean-up project to pick up trash and other dumped items along the south shoreline of the lake. **Potential Restoration Area #3**	Improve aesthetics. Potentially prevent harm to wildlife. Prevent migration of trash into lake.	Spring - Fall	
Upland buffer areas in city parks contain non-native invasive vegetation such as buckthorn and garlic mustard.	Continue to control and manage non-native invasive vegetation	Continue to control and manage non-native invasive vegetation. Pull garlic mustard within the City of Burnsville property at the north end of the lake. Continue to remove and treat new growth of buckthorn in city parks. **Potential Restoration Area #4**	Increase wildlife habitat. Improve vegetative diversity and aesthetics	Spring - Fall	Buckthorn appears to have been previously removed in the park along the southern shoreline.
Upland buffer areas lacking naturalized vegetation. Some of the residential properties have narrow buffers with turf grass close to the lakeshore edge.	Increase width and continuity of native upland buffer.	Restore sustainable native communities. Manicured turf grass near the shoreline could be vegetated with native grasses and wildflowers. A native upland buffer can improve functions and values of the lake and improve aesthetics. **Potential Restoration Area #5**	Increase wildlife habitat. Improve water quality. Improve vegetative diversity and aesthetics.	Spring - Fall	Most residential properties allow a narrow width of naturalized vegetation to prevent soil erosion, however a wider buffer of native vegetation could help improve wildlife habitat, vegetative diversity, and aesthetics.

Table 2: 2016 Recommended and Completed Management Actions for Kingsley Lake
Black Dog Watershed Management Organization Habitat Monitoring

Problem Identified	Recommendation	Proposed Action	Benefits	Implementation Period	Completed Actions Which May Improve Wildlife Habitat and/or Water Quality
Curlyleaf pondweed is present in some years.	Continue to monitor	Consider control measures, if densities and locations increase to an extent of concern.**See Appendix A Aquatic Plant Survey for locations of curlyleaf pondweed**.	Increase wildlife habitat, improve water quality, vegetative diversity, aesthetics, and recreation.	Late Spring - Early summer	On March 6, 2008, soil sediment samples were collected on Kingsley Lake by Blue Water Science (BWS) and the City of Lakeville. Based on the results of the soil analysis, the BWS report stated that "curlyleaf pondweed is not expected to produce heavy growth conditions (where plants top out in a solid canopy) in Kingsley Lake."
Common buckthorn dominates portions of the upland buffer.	Conduct an evaluation of common buckthorn, followed by removal.	Remove buckthorn. Volunteer groups and contractors can effectively remove buckthorn by pulling, cutting, and treating stumps with herbicide. **See Figure 4, Potential Restoration Area #1**	Increase wildlife habitat. Improve vegetative diversity and aesthetics	Spring - Fall	From 2005-2008, the City of Lakeville and members of the Kingsley Lake Association removed common buckthorn from portions of the lake and the upland buffer surrounding the lake.
Purple loosestrife is present.	Continue to control and manage purple loosestrife.	Control and manage. For a few small colonies of purple loosestrife, hand pull or dig the plants out before they go to seed. **See Figure 4 for purple loosestrife locations.**	Increase/maintain wildlife habitat.	Spring - Fall	From 2005-2008, the City of Lakeville and members of the Kingsley Lake Association removed purple loosestrife plants from portions of the lake and the upland buffer surrounding the lake. Purple loosestrife beetles were released by the MnDNR prior to 2002. Follow up monitoring by the MnDNR indicates that beetles are present at a population that the MnDNR feels is appropriate for biological control.
Stormwater drainage from impervious surfaces is directed into the lake.	Redirect stormwater for infiltration prior to discharge.	Install a rainwater garden, pervious pavement, or other suitable method for infiltration. **See Figure 4, Potential Restoration Area #2.**	Improve water quality	Open	
Bare soil on steep slope could cause erosion and sedimentation into lake.	Re-vegetate bare areas to prevent soil erosion into Kingsley Lake.	Plant vegetation suited for steep slopes along hillside to prevent erosion. **See Figure 4, Potential Restoration Area #3**	Improve water quality	Spring - Fall	
Upland buffer areas lacking naturalized vegetation.	Increase width and continuity of native upland buffer.	Rather than manicured turf grass, gravel, and managed plantings with bare soil, the shoreline could be vegetated with native grasses and wildflowers. **See Figure 4, Potential Restoration Areas #4 through 7**. See **Appendix G** for examples of improvements. See also island shoreline areas becoming bare from YMCA camper overuse (**Figure 4, Potential Restoration Areas 10 and 11)**.	Improve water quality, increase wildlife habitat. Improve vegetative diversity and aesthetics.	Spring - Fall	In 2008, a Kingsley Lake lakeshore resident, inspired by the Blue Thumb program, commenced shoreline stabilization utilizing native plants.
Emergent zone and upland buffer areas contain non-native invasive vegetation.	Continue to control and manage non-native invasive vegetation, including, but not limited to reed canary grass, hybrid cattail, and yellow iris.	Treat non-native invasive vegeation and then seed with an appropriate BWSR seed mix. **See Figure 4, Potential Restoration Areas #8 and 9.** Remove yellow iris **(See Appendix A for locations of yellow iris).** The MN DNR may require a permit for cattail treatment and yellow iris removal if below the OHW. Dense reed canary grass is located at **Plot 2b as shown of Figure 3**. Dense hybrid cattail is located at **Plot 1b as shown on Figure 3**.	Increase/maintain wildlife habitat.	Spring-Summer	

Appendix E

2012 Orchard Lake MNRAM 3.4 Wetland Functional Assessment Results

Wetland Functional Assessment Summary

Wetland Name	Hydrogeomorphology	Maintenance of Hydrologic Regime	Flood/ Stormwater/ Attenuation	Downstream Water Quality	Maintenance of Wetland Water Quality	Shoreline Protection
Orchard Lake	Depressional/Flow-through (apparent inlet and outlet), Depressional/Flow-through (apparent inlet and outlet)	0.75	0.53	0.58	0.37	0.46
		High	Moderate	Moderate	Moderate	Moderate

Wetland Name	Maintenance of Characteristic Wildlife Habitat Structure	Maintenance of Characteristic Fish Habitat	Maintenance of Characteristic Amphibian Habitat	Aesthetics/ Recreation/ Education/ Cultural	Commercial Uses	Ground-Water Interaction	Additional Information: Wetland Restoration Potential	Additional Information: Wetland Sensitivity to Stormwater and Urban Development	Additional Information: Additional Stormwater Treatment Needs
Orchard Lake	0.37	0.49	0.05	0.76	0.00	Combination Discharge, Recharge	0.00	0.50	0.37
	Moderate	Moderate	Low	High	Not Applicable		Not Applicable	Moderate	Moderate

Wetland Community Summary

Wetland Name	Location	Vegetative Diversity/Integrity: Community: Cowardin Classification	Community: Circular 39	Community: Plant Community	Wetland Proportion	Individual Community Rating	Highest Wetland Rating	Average Wetland Rating	Weighted Average Wetland Rating	
Orchard Lake	19-114-21-11-001	L2UBGh	Type 5	Shallow, Open Water Communities	95	0.1	0.50	0.30	0.12	
							Moderate	Low	Low	
		PEM1C	Type 3	Shallow Marsh	5	0.5	0.50	0.30	0.12	
							Moderate	Low	Low	
					100		0.50	0.30	0.12	☐

☑ *Denotes incomplete calculation data.*

Appendix F

Descriptions of MNRAM Wetland Functions

6.0 Functional Rating Formulas

GENERAL NOTE: Some questions are not applicable to particular wetlands and will be scored N/A. In these cases, rather than count N/A as zero, an alternate equation is provided that eliminates the question from the formula altogether. Because not every question has N/A as an option, formulas that do not include N/A-option questions have only one configuration.

Formulas with a "reverse rating" (marked as "R") take the actual response and "flip" its value for the calculation, so that a question response of "A" high (value of 1.0) will be calculated as low (value of 0.1). In such a formula, medium ratings stay medium.

6.1 VEGETATIVE DIVERSITY/INTEGRITY

Table 3: Vegetative Diversity/Integrity Summary

The functional rating is based primarily on the diversity of vegetation within the wetland in comparison to an undisturbed condition for that wetland type. An exceptional rating results from one of the following conditions: 1) highly diverse wetlands with virtually no non-native species, 2) rare or critically impaired wetland communities in the watershed, or 3) the presence or previous siting of rare, threatened, or endangered plant species. A high rating indicates the presence of diverse, native wetland species and a lack of non-native or invasive species. Wetlands that rate low are primarily dominated by non-native and/or invasive species.

This table may be used when calculating Vegetative Diversity/Integrity Functional Index manually. It shows four options for calculating and presenting floristic data. If you are entering data directly into the MnRAM 3.0 database, this table does not apply.

	3A Proportion of Wetland	3B Individual Community Scores	3C Highest Quality	3D Non-Weighted Average	3E Weighted Average
Community #1	**T**	**A**		**A**	**A**
Community #2	**U**	**B**		**B**	**B**
Community #3	**V**	**C**		**C**	**C**
Community #4	**W**	**D**		**D**	**D**
Community #5	**X**	**E**		**E**	**E**
Community #6	**Y**	**F**		**F**	**F**
Community #7	**Z**	**G**		**G**	**G**
Wetland Rating Value	**1.0**		**Highest Value**	**(A+B+C+D+E+F+G)/7 = Ave.**	**(A*T)+(B*U)+(C*V)+(D*W)+(E*X)+(F*Y)+(G*Z) = Wt. Ave.**

If any questions #4-6 are answered yes and/or if any of the Special Features b, d, or i have been selected, enter Exceptional for the functional index. If not, compute the contribution to vegetative diversity and integrity by each plant community by doing the following: multiply the ranking for each community (Question #3b) by its total proportion in Question 3a (percent of total). Then, the functional index for the entire wetland can be calculated four ways (as follows) and should be utilized according to the scope of the project:

3b) Individual Community Scores: maintain raw data as recorded.

3c) Highest Quality Community: report the highest-functioning community.

3d) Non-Weighted Average Quality of all Communities: straight average

3e) Weighted Average Quality Based on Percentage of Each Community: multiply each community rating by its percentage, then add all together.

Vegetative Diversity/ Integrity					
	3a. Proportion of Wetland	**3b. Individual Community Scores**	**3c. Highest Rated Community Quality**	**3d. Non-Weighted Average**	**3e. Weighted Average**
Community #1	**T**	**A**	**If Spec. Features b, d or i are checked then rate Exceptional (2); if either question 4, 5, or 6 are Yes, then rate Exceptional (2); else:**		
Community #2	**U**	**B**			
Community #3	**V**	**C**			
Community #4	**W**	**D**			
Community #5	**X**	**E**			
Community #6	**Y**	**F**			
Community #7	**Z**	**G**			
Overall Wetland Value Rating	**1.0**		**: Highest Value of A-G**	**: (A+B+C+ D+E+F+G)/7 = Ave.**	**:(A*T)+(B* U)+(C*V)+ (D*W)+(E* X)+(F*Y)+(G*Z) = Wt. Ave.**

6.2 MAINTENANCE OF CHARACTERISTIC HYDROLOGIC REGIME

A wetland's hydrologic regime or hydroperiod is the seasonal pattern of the wetland water level that is like a hydrologic signature of each wetland type. It defines the rise and fall of a wetland's surface and subsurface water. The constancy of the seasonal patterns from year to year ensures a reasonable stability for the wetland[23]. The ability of the wetland to maintain a hydrologic regime characteristic of the wetland type is evaluated based upon wetland soil and vegetation characteristics, land use within the wetland, land use within the upland watershed contributing to the wetland, and wetland outlet configuration. Maintenance of the hydrologic regime is important for maintaining a characteristic vegetative community, and is closely associated with other functions including flood attenuation, water quality and groundwater interaction.

Measures the degree of human alteration of the wetland hydrology, either by outlet control or by altering immediate watershed conditions. Each parameter is weighted equally.

MnRAM #	Excel #	Variable Description	Type of Interaction
13	E17	Outlet—natural hydrologic regime	Controlling
14	E18	Dominant upland land use	Compensatory
15	E19	Soil condition/wetland	Compensatory
20	F24	Stormwater runoff/pretreatment-Reverse	Compensatory

Hydrologic Regime Index = (13+14+15+20)/4

6.3 FLOOD AND STORMWATER STORAGE/ATTENUATION

A wetland's ability to provide flood storage and/or flood wave attenuation is dependent on many characteristics of the wetland and contributing watershed. Characteristics of the subwatershed that affect the wetlands ability to provide flood storage and attenuation include: soil types, land use and resulting stormwater runoff volume, sediment delivery from the subwatershed, and the abundance of wetlands and waterbodies in the subwatershed. Wetland characteristics which affect the wetland's ability to store and or attenuate stormwater include: condition of wetland soils; presence, extent, and type of wetland vegetation; presence and connectivity of channels; and most importantly outlet configuration. Higher rated wetlands will have an unaltered or restricted outlet, undisturbed wetland soils, dense emergent vegetation without channels, a high proportion of impervious surfaces in the subwatershed, large runoff volumes, clayey upland soils, and few wetlands present within the subwatershed.

This formula is based on the Surface Water Storage Functional Capacity Index scoring concept and equation[24]. The formula was altered with the addition of three surface flow characteristics and two stormwater runoff parameters (Stormwater Runoff Quality/Quantity and Subwatershed Wetland Density) along with the removal of two parameters (Soil Porosity and Subsurface Outlet,

[23] Mitsch and Gosselink, 2000
[24] Lee et al., 1997

which is already characterized in another parameter). This index is comprised of 5 primary processes, which are weighted equally; included in each major process are one to three characteristics that equally contribute to that process.

1. **Outlet Characteristics**: Outlet characteristics
2. **Upland Watershed**: Upland land use, Upland soils,
3. **Wetland Condition/Land Use**: Wetland land use, sediment delivery
4. **Runoff Characteristics:** Stormwater runoff quality/quantity, subwatershed wetland density
5. **Surface Flow Characteristics**: Flow-through emergent vegetation density, surface flow characteristics

Flood and Stormwater Storage Index Computation:

Entire Formula: Outlet for flood retention{12} + (Dominant upland use-RR{14}+ Upland soils{19})/2 + (Soil condition{15} + Sediment delivery{18})/2 + Stormwater runoff pretreat&det{20} + Subwatershed wetland density{21})/2 + (Percent emergent vegetative cover{16} + Flow-through emergent vegetative roughness{17} + Channels/sheet flow{22})/3)/5.

1. If 12=0, then: ((14+19)/2+(15+18)/2+(20+21)/2+(16+17+22)/3)/4

2. If 12>0, then: (12+(14+19)/2+(15+18)/2+(20+21)/2+(16+17+22)/3)/5

No changes to the formula are necessary if 16=0.

Flood and Stormwater Storage/Attenuation Variables

MnRAM #	Excel #	Variable Description	Type of Interaction
12	E16	Outlet—flood attenuation	Controlling—optional
14	F18	Dominant upland land use-RR	Compensatory
19	E23	Upland soils	Compensatory
15	E19	Soil condition	Compensatory
18	E22	Sediment delivery	Compensatory
20	E24	Stormwater pretreatment &detention	Compensatory
21	E25	Subwatershed wetland density	Compensatory
16	F20	Emergent vegetation % cover	Comp.—optional
17	E21	Emergent vegetation flood resistance	Comp.—optional
22	E26	Channels/sheet flow	Compensatory

6.4 DOWNSTREAM WATER QUALITY PROTECTION

This rates the wetland's ability and opportunity to protect valuable downstream resources. Valuable downstream resources include recreational waters (i.e. lakes, streams, rivers, creeks, etc) and potable water supplies. The level of functioning is determined based on runoff characteristics, sedimentation processes, nutrient cycling, and the presence and location of significant downstream water resources. Runoff characteristics that are evaluated include: land use and soils in the upstream watershed, the stormwater delivery system to the wetland, and sediment delivery characteristics. The ability of the wetland to remove sediment from stormwater is determined by emergent vegetation and overland flow characteristics. A high nutrient removal rating indicates dense vegetation and sheet flow to maximize nutrient uptake and residence time within the wetland. The opportunity for a wetland to protect a valuable water resource diminishes with distance from the wetland so wetlands with valuable waters within 0.5 miles downstream have the greatest opportunity to provide protection.

Compute Functional Index for Downstream Water Quality Protection
This functional index computation was derived from a combination of Nutrient Cycling and Retention of Particulates functions in the HGM Prairie Pothole draft guidebook[54] with the downstream sensitivity concept from *The Minnesota Wetland Evaluation Methodology.* Three major processes make up equal portions of the Downstream Water Quality Protection function[25] with a measure of opportunity to protect downstream resources; each process is comprised of two to four observable parameters.

1. **Rate, Quantity, and Quality of Runoff to the Wetland**: this is characterized by the conditions in the upstream watershed; both land use and soils, that affect the sediment and nutrient loads to the wetland, and by the existing storm water delivery system to the wetland (Upland watershed conditions, storm water runoff, evidence of sediment delivery, and upland buffer each comprise 1/16 of the entire downstream water quality functional index based on their contribution to sediment removal).
2. **Sedimentation**: this is characterized by the presence of flow-through emergent vegetation density and by the overland flow characteristics within the wetland. A wetland with primarily sheet flow through the wetland and dense emergent vegetation density will allow sediment to drop out more effectively than a wetland with channel flow and no vegetation (When all parameters are applicable; emergent vegetative density and overland flow characteristics each make up 1/8 of the total downstream water quality functional index based on their contribution to sediment removal).
3. **Nutrient Uptake**: this is characterized by the outlet configuration and vegetative characteristics. A wetland with long water retention times has more capacity to remove nutrients from the water column via physical and biological processes. Vegetation slows floodwaters by creating frictional drag in proportion to stem density which allows sediment particles to settle out, thereby improving the water quality for downstream uses (Outlet characteristics and vegetative density each make up 1/8 of the total downstream water quality functional index based on their contribution to nutrient uptake).

[25] Derived from a combination of Nutrient Cycling and Retention of Particulates functions in the HGM Prairie Pothole draft guidebook (Lee et al., 1997) with the downstream sensitivity concept from *The Minnesota Wetland Evaluation Methodology.*

4. **Downstream Sensitivity**: if the wetland contributes to the maintenance of water quality within one-half mile of a recreational water body or potable water supply source downstream, it operates at a higher functioning level than a similar wetland farther from or without significant downstream water resources (This factor accounts for ¼ of the total downstream water quality functional index).

Downstream Water Quality Functional Index Computations:

1. If 12=0, then: $(14+20_{reversed}+18+(\mathbf{23+24+26})/3+(\mathbf{16}+17)/2+27)/6$

2. If 12>0, then: $(14+20_{reversed}+18+(\mathbf{23+24+26})/3+(\mathbf{16}+17)/2+27+12)/7$

No changes to the formula are necessary if 16=0.

Entire Formula:
(Dominant upland land use{14} + Stormwater runoff pretreatment & detention{$20_{reversed}$ } + Sediment delivery {18} + (Upland buffer width{23}WQ + Upland buffer vegetative cover{24} + Upland buffer slope {26})/3 + (Flow-through %emergent vegetative cover{16} + Flow-through emergent vegetative roughness{17})/2 + Downstream sensitivity{27}+ Outlet for flood{12})/7

Downstream Water Quality Variables

MnRAM #	Excel #	Variable Description	Type of Interaction
14	E18	Dominant upland land use	Controlling
20	E24	Stormwater runoff pretreatment &detention	Controlling
18	E22	Sediment delivery	Controlling
23	G27	Upland buffer width	Comp.
24	G28	Upland area management	Comp.
26	G34	Upland area slope	Comp.
16	F20	Emergent vegetation (% cover)	Comp.—optional
17	E21	Emergent vegetation (roughness coefficient)	Comp.—optional
27	E39	Downstream sensitivity	Comp.
12	E16	Outlet for flood	Controlling--optional

6.5 MAINTENANCE OF WETLAND WATER QUALITY

The sustainability of a wetland is partially driven by the quality and quantity of stormwater runoff entering the wetland. The ability of the wetland to sustain its characteristics is evaluated based on characteristics of the contributing subwatershed and indicators within the wetland. Subwatershed conditions which affect the wetland's sustainability in relation to water quality impacts include: upland land use; sediment delivery characteristics to the wetland; stormwater runoff volumes and rates; and the extent, condition, and width of upland buffer. Indicators of nutrient loading to the wetland indicate that a diverse wetland may not be sustainable. Indicators that a wetland has been affected by nutrient loading include the presence of monotypic vegetation and/or algal blooms.

This functional index was derived from a combination of sources including MNRAM, HGM, WEM, WET, and experiences of the project team. The sustainability of a wetland

is partially driven by the quality and quantity of stormwater runoff entering the wetland. The ability of the wetland to sustain its characteristics is evaluated based on characteristics of the contributing subwatershed and indicators within the wetland. Subwatershed conditions which affect the wetland's sustainability in relation to water quality impacts include: upland land use; sediment delivery characteristics to the wetland; stormwater runoff volumes and rates; and the extent, condition, and width of upland buffer. Indicators of nutrient loading to the wetland indicate that a diverse wetland may not be sustainable. Indicators that a wetland has been affected by nutrient loading include the presence of monotypic vegetation and/or algal blooms.

Wetland Water Quality Functional Index Computation:

(3e*2+14+$20_{reversed}$ +**(23**+**24**+**26)**/3+18+28)/7

Entire Formula:
(Vegetative Diversity/Integrity{3e*2} + Dominant upland land use{14} + Stormwater runoff pretreatment & detention{$20_{reversed}$ } + (Upland buffer width{23}WQ + Upland buffer vegetative cover {24} + Upland buffer slope {26})/3 + Sediment delivery {18})/2 + Nutrient loading {28})/7

Wetland Water Quality Variables

MnRAM #	Excel #	Variable Description	Type of Interaction
3e	D6*2	Vegetative Diversity/Integrity	Contributing
14	E18	Dominant upland land use	Contributing
20	F24	Stormwater runoff pretreatment and detention—RR	Contributing
23	G27	Upland buffer width	Contributing
24	G28	Upland area management	Contributing
26	G34	Upland area slope	Contributing
18	E22	Sediment delivery	Contributing
28	E40	Nutrient loading	Contributing

This functional index was derived from a combination of sources including MNRAM, HGM, WEM, WET, and experiences of the project team. The sustainability of a wetland is partially driven by the quality and quantity of stormwater runoff entering the wetland. The ability of the wetland to sustain its characteristics is evaluated based on characteristics of the contributing subwatershed and indicators within the wetland. Subwatershed conditions which affect the wetland's sustainability in relation to water quality impacts include: upland land use; sediment delivery characteristics to the wetland; stormwater runoff volumes and rates; and the extent, condition, and width of upland buffer. Indicators of nutrient loading to the wetland indicate that a diverse wetland may not be sustainable. Indicators that a wetland has been affected by nutrient loading include the presence of monotypic vegetation and/or algal blooms.

6.6 SHORELINE PROTECTION

Shoreline protection is evaluated only for those wetlands adjacent to lakes, streams, or deepwater habitats. The function is rated based on the wetlands opportunity to protect the shoreline; i.e. wetlands located in areas frequently experiencing large waves and high

currents have the best opportunity to protect the shore. In addition, shore areas composed of sands and loams with little vegetation or shallow-rooted vegetation will benefit the most from shoreline wetlands. The wetland width, vegetative cover, and resistance of the vegetation to erosive forces determine the wetland's ability to protect the shoreline.

Each of the five parameters contributes equally[26]: based primarily on the characteristics presented in WEM with a simple, straightforward computation of the index assuming all characteristics contribute equally.

MnRAM #	Excel #	Variable Description	Type of Interaction
29	E41	Shoreline?	Controlling
30	E42	Rooted shoreline vegetation (% cover)	Contributing
31	E43	Wetland width (average)	Contributing
32	E44	Emergent vegetation erosion resistance	Contributing
33	E45	Shoreline erosion potential	Contributing
34	E46	Bank protection ability	Contributing

Shoreline Protection Functional Index Computation:

If 29=1, then:
Shoreline Protection Index = (30+31+32+33+34)/5

Entire Formula:
(Rooted shoreline vegetation {30} + Average shoreline wetland width {31} + Emergent vegetation erosion resistance {32} + (Shoreline erosion potential {33} + Bank protection ability {34})/5

6.7 MAINTENANCE OF CHARACTERISTIC WILDLIFE HABITAT STRUCTURE

The ability of a wetland to support various wildlife species is difficult to determine due to the specific requirements of the many wildlife species that utilize wetlands. This function determines the value of a wetland for wildlife in a more general sense, and not based on any specific species. The characteristics evaluated to determine the wildlife habitat function include: vegetative quality, outlet characteristics (which control hydrologic regime), upland land use, wetland soil type and conditions, water quality of storm water runoff entering the wetland, upland buffer extent, condition, and diversity; the interspersion of wetlands in the area; barriers to wildlife movement; wetland size; vegetative and community interspersion within the wetland; and amphibian breeding potential and overwintering habitat.

Thirteen parameters are weighed equally as described below; vegetative quality weighted double the other factors. The questions are borrowed or modified from MNRAM, WET, WEM, and HGM methodologies, combined to provide a measure of wildlife habitat in general, not focusing on any particular species.

If Rare Wildlife (35) or Rare Natural Community (36) are true, then this Index is Exceptional.

[26] Based primarily on the characteristics presented in WEM.

If Special Features d, g, or j are checked, then this Index is Exceptional, otherwise, follow conditions below:

If 37=0 and 38=0 and 39=0, then:
(3e*2+40+41+(**23**+**24**+**25)**/3+13+ 20)/7

If 38=0 and 39=0, then:
(3e*2+37+40+41+(**23**+**24**+**25)**/3+ 13+20)/8

If 37=0 and 39=0, then:
(3e*2+38+40+41+(**23**+**24**+**25)**/3+ 13+20)/8

If 37=0 and 38=0, then:
(3e*2+39+40+41+(**23**+**24**+**25)**/3+ 13+20)/8

If 39=0, then:
(3e*2+37+38+40+41+(**23**+**24**+**25)**/3+13+20)/9

If 38=0, then:
(3e*2+39+37+40+41+(**23**+**24**+**25)**/3+13+20)/9

If 37=0, then:
(3e*2+39+38+40+41+(**23**+**24**+**25)**/3+13+20)/9

If 37>0 and 38>0 and 39>0, then:
(3e*2+39+37+38+40+41+(**23+24+25**)/3+13+20)/10

Entire Equation:
(Vegetative Diversity/Integrity{3e*2} + Wetland Detritus {39} + Vegetation Interspersion {37} + Community Interspersion {38} + Wetland Interspersion {40} + Wildlife Barriers {41} + (Upland buffer width {23}WQ + Upland Area Management{24} + Upland area diversity {25})/3 + Outlet natural hydrologic regime {13}+ Stormwater runoff pretreatment and detention 20)/11

MnRAM #	Excel #	Variable Description	Type of Interaction
41	E53	Wildlife barriers	Controlling
3e	D6	Vegetative Ranking (communities' weighted average)	Compensatory
39	E51	Wetland detritus (n/a)	
23	I27	Upland buffer average width	
24	G28	Upland area management	
25	G31	Upland area diversity	
13	E17	Outlet natural hydrologic regime	
20	F24	Stormwater runoff pretreatment & detention—RR	
37	F49	Vegetation interspersion (n/a)	
38	F50	Community interspersion (n/a)	
40	E52	Wetland interspersion	

6.8 MAINTENANCE OF CHARACTERISTIC FISH HABITAT

The ability of the wetland to support native fish populations is determined by structural factors within the wetland as well as water quality contributions from upland factors. Wetlands rated High are lacustrine or riverine and provide spawning/nursery habitat, or

refuge for native species (included but not limited to game fish). Wetlands rated Low for fish habitat do not have a direct hydrologic connection to a waterbody with a native fishery or have poor water quality.

MnRAM #	Excel #	Variable Description	Type of Interaction
46	E58*2	Fish habitat quality	Controlling
29	D41	Fringe wetland?	Contributing
24	G28	Adjacent area management	Compensatory
18	E22	Sediment delivery	Compensatory
20 (R)	F24	Storm water runoff	Compensatory
28	E40	Nutrient load	Compensatory
30	E42	Percent cover	Compensatory
31	E43	Wetland shoreline width	Compensatory
33 (R)	F45	Shoreline erosion potential	Compensatory

Fish Habitat Functional Index Computation:

If Special Features a or g are checked, then Fishery Habitat Index = Exceptional.

If 46=0, then Fishery Habitat = N/A

If 29=0, Fishery Habitat Index = [(46*2)+24+18+20(R) +28]/6

If 29>0, Fishery Habitat Index = [(46*2)+24+18+20(R) +28+**30**+**31**+**33(R)**]/9

6.9 MAINTENANCE OF CHARACT. AMPHIBIAN HABITAT FOR BREEDING/OVERWINTERING

The ability of a wetland to support various amphibian species is difficult to determine due to the specific requirements of the many amphibian species that depend on wetlands. This function determines the value of a wetland for amphibians in general, not based on specific species. An adequate wetland hydroperiod and the presence or absence of predatory fish are considered to be limiting variables for this function. In general, wetlands must remain inundated until early to mid-June to allow the larval stages to metamorphose into adults. Because many amphibians are partly terrestrial, the characteristics evaluated to determine the amphibian habitat function include numerous hydrology and terrestrial measures. The characteristics evaluated include: upland land use, upland buffer width, water quality of storm water runoff entering the wetland, barriers to wildlife movement, and amphibian breeding potential and overwintering habitat.

An adequate wetland hydroperiod (Question 42) is considered to be the primary limiting variable for this functional index. If the hydroperiod is insufficient for breeding, the wetland rating for amphibian use will be Not Sufficient. The status of predatory fish in the wetland (Q.43) is a secondary limiting factor to the final rating; the lowest rating for this variable, however, is 0.1 (Low), rather than zero (Not Sufficient).

Amphibians' ability to use a particular wetland for over wintering is a contributing factor in rating the wetland's functional index (Q.44). Because most amphibians are partly terrestrial, the extent of upland buffer habitat surrounding the wetland (Q.23) is an

important habitat component[27] and is weighted by a factor of two. Question 14 (Upland Land Use) is also included as an indicator of the quality of the surrounding upland habitat[56]. Unnatural fluctuations in water depth in wetlands from conducted storm water runoff can impair reproductive success in amphibians, which often attach their eggs to stems of wetland vegetation, e.g., salamanders, tree frogs, green frogs, and wood frogs[28]. Extreme water level fluctuations during winter may also cause mortality in overwintering reptiles and amphibians[29]. Thus, Question 20 is included in the formula, with a reverse rating. Question 41 (Barriers) is included because access to and from the wetland by amphibians is an important factor in habitat quality[30].

Amphibian Habitat Functional Index Computation:

If 42=0, then N/A

Otherwise: Amphibian Habitat Index = (43) * [(44 + 2*$23_{wildlife}$ + 14 + 41 + $20_{reversed}$)/6]

Entire Formula:

If Amphibian Breeding Potential-Hydroperiod {42} is applicable, then: (Amphibian Breeding Potential-Predator Fish {43}) * {[(Amphibian Overwintering Habitat {44}+ 2*Upland Buffer Width $(23)_{Wildlife}$ + Dominant Upland Land Use {14} + Barriers {41} + Stormwater Input $\{20_{reverse}\}$]/6}

Amphibian Habitat Variables

MnRAM #	Excel #	Variable Description	Type of Interaction
42	D54	Amphibian breeding potential—hydroperiod	Controlling
43	D55	Amphibian breeding potential—fish presence	Controlling
44	E56	Amphibian overwintering habitat	Compensatory
23	I27	Upland buffer width	Compensatory
41	E53	Wildlife barriers	Compensatory
14	E18	Dominant upland land use	Compensatory
20	F24	Stormwater runoff pretreatment & detention—RR	Compensatory

6.10 AESTHETICS/RECREATION/EDUCATION/CULTURAL/SCIENCE

The aesthetics/recreation/education/cultural and science function and value of each wetland is evaluated based on the wetland's visibility, accessibility, evidence of recreational uses, evidence of human influences (e.g. noise and air pollution) and any known educational or cultural purposes. Accessibility of the wetland is key to its aesthetic or educational appreciation. While dependent on accessibility, a wetland's functional level could be evaluated by the view it provides observers. Distinct contrast

[27] Knutson et al., 2000
[28] Richter and Azous, 1995
[29] Hall and Cuthbert, 2000
[30] Knutson, et al., 1999; Findlay and Bourdages, 2000; Semlitsch, 2000.

between the wetland and surrounding upland may increase its perceived importance. Also, diversity of wetland types or vegetation communities may increase its functional level as compared to monotypic open water or vegetation. Excess negative human influence on the wetland is counted double in the formula.

All questions contribute equally to the overall index.

MnRAM #	Excel #	Variable Description	Type of Interaction
48	E60	Rare educational opportunity	Controlling
49	E61	Wetland visibility	Compensatory
50	E62	Proximity to population	Compensatory
51	E63	Public ownership	Compensatory
52	E64	Public access	Compensatory
53	E65	Human influence—wetland	Compensatory
54	E66	Human influence—viewshed	Compensatory
55	E67	Spatial buffer	Compensatory
56	E68	Recreational activities in wetland	Compensatory

Aesthetics/Recreation/Education/Cultural/Science Functional Index Computations:

If Special Features c, h, or u is checked[31], or

If 48=1, then Index = Exceptional;

If 53=0.1 (Low), then = (50+51+52+2*53+54+55+56)/8

If 53>0.1, then = (49+50+51+52+53+54+55+56)/8

Entire Formula

(Wetland Visibility {49} + Proximity to Population {50} + Public Ownership {51} + Public Access {52} + Human Influence - Wetland {53} + Human Influence - Viewshed {54} + Spatial Buffer {55} + Recreational Activities in Wetland {56})/8

6.11 COMMERCIAL USES

This question considers the nature of any commercially-valuable use of the wetland and requires the assessor to consider how such use may be a detriment to the sustainability of the wetland. Some row crops can be planted in Type 1 wetlands after spring flooding has ceased and still have adequate time to grow to maturity. This non-wetland-dependent agricultural use of wetlands may include hay, pasture/grazing, or row crops such as soybeans or corn. Wetland-dependent crops include wild rice and cranberries, which rely on the wetland hydrology for part of their life cycle.

[31] c = Designated scientific and natural area; h = Archeologic or historic site designated by the State Historic Preservation Office; u = State or Federal designated wilderness area.

Sustainable uses of the wetland would not require modifying a natural wetland. Products in this category would include collection of botanical products, wet native grass seed, floral decorations, wild rice, black spruce, white cedar, and tamarack. Sustainable uses may require modification of the natural hydrology, such as for wetland-dependent crops (rice, cranberries). Haying and grazing can be less intrusive agricultural activities utilized more or less casually when hydrologic conditions permit; light pasture and occasional haying would be considered more or less sustainable. Like peat-mining, cropping is an unsustainable use of the wetland as it is results in severe alterations of wetland characteristics (soil, vegetation, hydrology).

MnRAM #	Excel #	Variable Description	Type of Interaction
57	E69	Commercial crop—hydrologic impact	Controlling

Commercial Uses Functional Index = 57

6.12 GROUND-WATER INTERACTION

The ground water interaction function is the most difficult to assess. Here the most likely type of ground water interaction is determined, i.e. recharge or discharge, or a combination. In many cases, a wetland will exhibit both recharge and discharge characteristics, however one is usually more dominant. Several wetland and watershed characteristics are evaluated to determine the likely interaction including: wetland soil type, upland land use, upland soil types and wetland size, wetland hydroperiod, wetland outlet characteristics, and topographic relief.

The purpose of this function is strictly to determine the likelihood of the appropriate ground-water interaction based on observable characteristics of the wetland and watershed. The significance of ground water as a component of the wetland water budget is the most difficult functional characteristic to determine without large quantities of detailed hydrologic and geologic information. The following methodology takes the most easily observable and distinct measures of recharge/discharge relationships from the *Wetland Evaluation Technique*[32] and the *Hydrogeomorphic Assessment Methodology*[33]. In many wetlands, surface water and ground water both make significant contributions to the water budget, but occasionally recharge or discharge is dominant. The goal here is to identify the dominant ground-water interaction (if there is one) to help guide future management and provide an indication when additional information may be warranted.

[32] Adamus, et al., 1987
[33] Magee and Hollands, 1998

- If 5 or 6 of questions 58-63 are answered the same, this indicates a strong likelihood that the most frequently stated interaction exerts the primary influence on the wetland.
- If 3-4 questions are answered the same, then the wetland is likely influenced by a combination of both recharge and discharge interactions (i.e. both types of ground water interaction are likely to be present at some point during most years).

58. Wetland Soils – from HGM system functional assessments and Novitzki
59. Subwatershed Land Use/Imperviousness – taken from WET Volume I
60. Wetland Size and Upland Soils – taken from WET Volume I and HGM
61. Wetland Hydrologic Regime– taken from WET Volume I and HGM
62. Inlet/Outlet Configuration – taken from WET Volume I and HGM
63. Upland Topographic Relief – taken from WET Volume I

Special Concerns for Recharge Wetlands

Wherever ground water recharge is indicated as the **primary** interaction and the wetland lies within a sensitive ground water area (**Special Feature Question q**), a contribution area to a public water supply, or a wellhead protection area (**Special Feature Question r**), it should be recorded as Exceptional for the ground water/wetland function.

6.13 WETLAND RESTORATION POTENTIAL

The potential for wetland restoration is determined based on the ease with which the wetland could be restored, the number of landowners within the historic wetland basin, the size of the potential restoration area, the potential for establishing buffer areas or water quality ponding, and the extent and type of hydrologic alteration. Each variable uses the High, Medium, Low rating rather than raw numbers—see MnRAM for individual ranges.

MnRAM #	Excel #	Variable Description	Type of Interaction
64	D79	Wetland Restoration Potential	Controlling
65	F80	Number of Landowners Affected	Contributing
21	E25	Subwatershed Wetland Density	Contributing
66b	F82	Total Wetland Restored Size (Potential)	Contributing
66c	F83	Calculated potential new wetland area	Contributing
67	F84	Potential Buffer Width	Contributing
68	F85	Likelihood of Restoration Success	Contributing

If 64="Yes", then Wetland Restoration Potential = (65+21+66b+66c+67+68)/6,

Otherwise, if 64="No" then "N/A"

Entire Formula

(Landowners Affected by Restoration (65)+Subwatershed Wetland Density (21)+ Wetland Restoration Size (66b)+Proportion of Wetland Drained (66c)+Potential Buffer Width (67)+Likelihood of Restoration Success (68))/6

6.14 WETLAND SENSITIVITY TO STORMWATER INPUT AND URBAN DEVELOPMENT

The sensitivity of the wetland to stormwater and urban development is determined based on guidance within the *Storm-Water and Wetlands: Planning and Evaluation Guidelines for Addressing Potential Impacts of Urban Storm-Water and Snow-Melt Runoff on Wetlands,* State of Minnesota Storm-Water Advisory Group, June, 1997.

Use habitat proportions from Vegetative Integrity section and enter into a formula to compute answer according to the following criteria[34].

Exceptional = Sedge meadows, open and coniferous bogs, calcareous fens, low prairies, wet to wet-mesic prairies, coniferous swamps, lowland hardwood swamps, or seasonally flooded basins.

A = Shrub-carrs, alder thickets, diverse fresh wet meadows dominated by native species, diverse shallow and deep marshes, and diverse shallow, open water communities.

B = Floodplain forests, fresh wet meadows dominated by reed canary grass, shallow and deep marshes dominated by cattail, reed canary grass, giant reed or purple loosestrife, and shallow, open water communities with low to moderate vegetative diversity.

C = Gravel pits, cultivated hydric soils, or dredge/fill disposal sites.

6.15 ADDITIONAL STORMWATER TREATMENT NEEDS

This rates the sustainability of the wetland with regard to stormwater discharges to the wetland. The need for additional stormwater treatment prior to discharge to the wetland is rated based on the overall rating for Maintenance of Wetland Water Quality. If a wetland is severely degraded by stormwater inputs, the rating will be low, since a diverse, high quality wetland will not be sustainable.

Use functional rating for Maintenance of Wetland Water Quality (MWWQ) as follows (this index is rated strictly from the measure of the water quality in the wetland and the sustainability, i.e. if the water quality in the wetland is low, additional stormwater treatment is needed to protect the wetland and the rating is low):

Use Value for Maintenance of Wetland Water Quality Index (D76, Excel spreadsheet) and apply to criteria below.

A = Maintenance of Wetland Water Quality Index >0.66 (no additional treatment needed)

B = 0.33 < Maintenance of Wetland Water Quality Index $\leq$ < 0.66 (sediment removal needed)

[34] Taken directly from State of Minnesota Storm-Water Advisory Group, 1997.

C = Maintenance of Wetland Water Quality Index < 0.33 (sediment and nutrient removal needed)

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Appendix G

Vegetation Shoreline Buffer Brochure Examples

PROJECT FACTSHEET

MCCRUM
RESIDENTIAL SHORELINE PLANTING

DAKOTA COUNTY
SOIL & WATER
CONSERVATION DISTRICT

Shoreline planting is the use of native vegetation to protect a shoreline from existing or potential erosion

PROJECT: Installation of a 1000 square foot residential shoreline planting

COST: Project materials cost estimated at $3,000

FUNDING: Landowners receive a $250 Blue Thumb grant as well as technical assistance provided by the Dakota County Soil and Water Conservation District

Black Dog
Watershed Management Organization

LOCATION:

Burnsville, MN

132nd Street East

PRACTICE:

- Residential shoreline planting

BENEFITS:

- Shoreline stabilization and erosion reduction
- Improved water quality
- Improved wildlife habitat
- Opportunity for public education and outreach
- Improved aesthetics

PARTNERS:

- Black Dog Watershed Management Organization

WATERSHED:

- Minnesota River

RECEIVING WATERS:

- Minnesota River

INSTALLATION:

- Summer 2015

4100 220th Street W, Suite 102, Farmington, MN 55024 Tel: (651) 480-7777 Fax: (651) 480-7775 www.dakotacountyswcd.org Revised: 9/10/2015

PROJECT FACTSHEET

GILBERTSON

RESIDENTIAL RAINGARDEN

DAKOTA COUNTY
SOIL & WATER
CONSERVATION DISTRICT

A raingarden is a shallow depression that captures rainwater, removes pollutants, and soaks the water into the ground

PROJECT: Installation of a 275 square foot residential raingarden

COST: Project materials cost estimated at $706

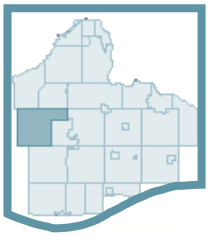
FUNDING: Landowners receive a $250 Landscaping for Clean Water grant as well as technical assistance provided by the Dakota County Soil and Water Conservation District

Black Dog
Watershed Management Organization

LOCATION:

Lakeville, MN

170th Street West



PRACTICE:

- Residential raingarden

BENEFITS:

- Runoff volume reduction
- Improved water quality
- Improved wildlife habitat
- Opportunity for public outreach and education
- Improved aesthetics

PARTNERS:

- Black Dog Watershed Management Organization

WATERSHED:

- Minnesota River

RECEIVING WATERS:

- Crystal Lake

INSTALLATION:

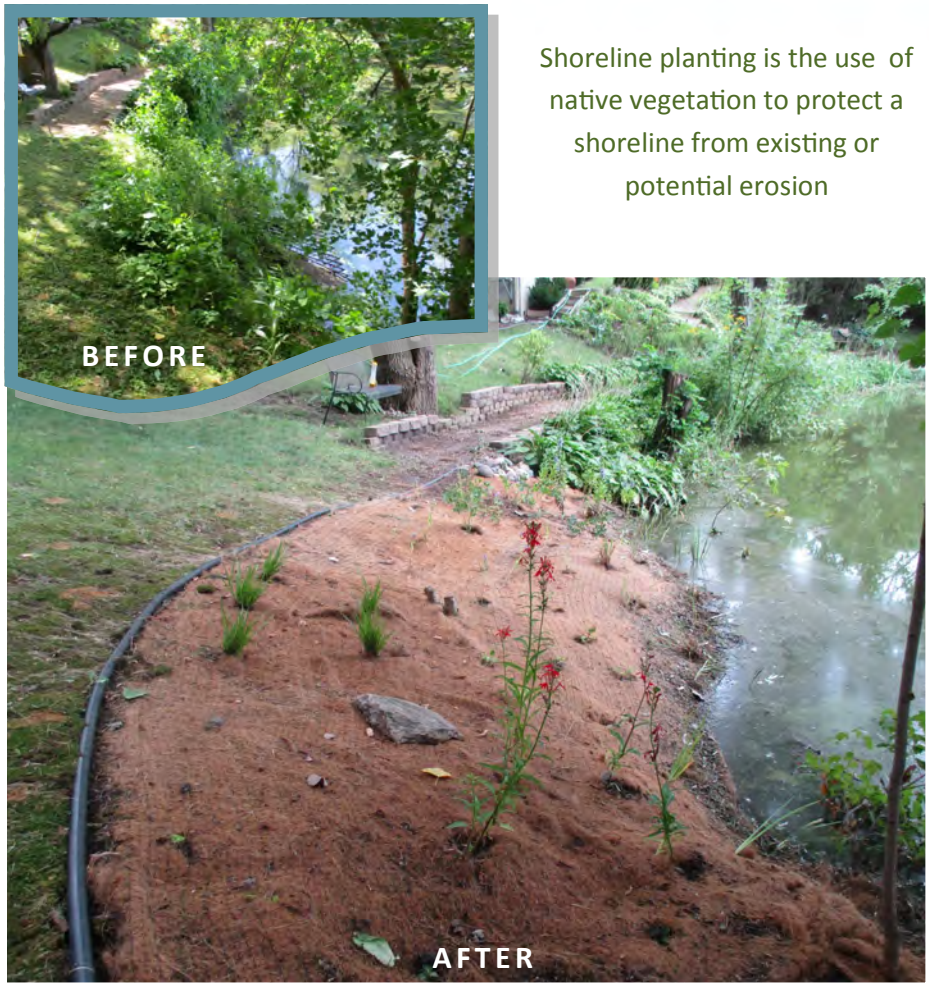
- Summer 2015

4100 220th Street W, Suite 102, Farmington, MN 55024 Tel: (651) 480-7777 Fax: (651) 480-7775 www.dakotacountyswcd.org Revised: 6/26/2015

PROJECT FACTSHEET

ASHENBRENER RESIDENTIAL SHORELINE PLANTING

DAKOTA COUNTY SOIL & WATER CONSERVATION DISTRICT



Shoreline planting is the use of native vegetation to protect a shoreline from existing or potential erosion

PROJECT: Installation of a 280 square foot residential shoreline planting

COST: Project materials cost estimated at $1,410

FUNDING: Landowners receive a $250 Landscaping for Clean Water grant as well as technical assistance provided by the Dakota County Soil and Water Conservation District

Black Dog
Watershed Management Organization

LOCATION:

Burnsville, MN

Baypoint Drive

PRACTICE:

- Residential shoreline planting

BENEFITS:

- Shoreline stabilization and erosion reduction
- Improved water quality
- Improved wildlife habitat
- Opportunity for public education and outreach
- Improved aesthetics

PARTNERS:

- Black Dog Watershed Management Organization

WATERSHED:

- Minnesota River

RECEIVING WATERS:

- Unnamed pond

INSTALLATION:

- Summer 2016

4100 220th Street W, Suite 102, Farmington, MN 55024 Tel: (651) 480-7777 Fax: (651) 480-7775 www.dakotacountyswcd.org Revised: 8/31/2016

PROJECT FACTSHEET

DELONG

RESIDENTIAL SHORELINE

DAKOTA COUNTY
SOIL & WATER
CONSERVATION DISTRICT

A native shoreline planting is the use of native vegetation to protect a shoreline from existing or potential erosion

PROJECT: Installation of a 1,300 square foot native shoreline planting

COST: Project materials cost estimated at $2,300

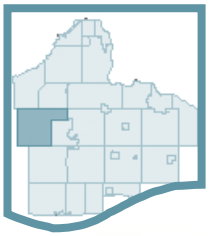
FUNDING: Landowners receive a $250 Blue Thumb grant as well as technical assistance provided by the Dakota County Soil and Water Conservation District

Black Dog
Watershed Management Organization

LOCATION:

Lakeville, MN

166th Street W.



PRACTICE:

- Residential Native Shoreline Planting

BENEFITS:

- Shoreline stabilization and erosion reduction
- Improved water quality
- Improved wildlife habitat
- Opportunity for public education and outreach
- Improved aesthetics

PARTNERS:

- Black Dog Watershed Management Organization

WATERSHED:

- Minnesota River

RECEIVING WATERS:

- Lee Lake

INSTALLATION:

- Summer 2016

4100 220th Street W, Suite 102, Farmington, MN 55024 Tel: (651) 480-7777 Fax: (651) 480-7775 www.dakotacountyswcd.org Revised: 8/4/2016

Appendix H

Buckthorn Management Guidelines

Buckthorn Management Guidelines

Goal: Restore native plant communities in designated natural areas and other park locations by controlling and removing non-native invasive species.

Buckthorn belongs to the *Rhamnaceae* family. It is native to Europe and Asia, first appearing in the U.S. in the late 1700s. Buckthorn quickly naturalized in the woodlands of the northeastern states. Today buckthorn flourishes in the understory of Minnesota woodlands and in brushy thickets along roadsides and fields. It has become a major plant pest in natural woodlands and wetlands.

Buckthorn can grow to 15-20 feet and has dark green elliptical or oval leaves. In the fall its leaves hang on late into the season and without much color change. It starts easily from seed and will tolerate almost any soil condition or location. In partial shade it will outstretch its neighbors toward the light.

Buckthorn removal is recommended for those areas where the native plant community has been displaced by buckthorn species and where there is a high likelihood that the native plant community can be enhanced and restored.

Restoration of the native communities is the overall intent of non-native eradication efforts.

Volunteer Considerations

Volunteers must be trained in species identification, removal techniques and other aspects related to the eradication/restoration efforts.

Identification of buckthorn by volunteers is best performed during the month of October.

Process

Buckthorn removal is a long-term process requiring several steps over a three- to four-year period. Pulling seedlings, cutting and removing mature plants, chemically treating stumps and replanting the site with native species are critical to the long-term success of restoration efforts.

Staff are responsible for cutting mature plants and chemically treating the stumps in areas designated for restoration. A 20%-25% solution of glyphosate (Roundup) with a dye is used to paint, chemically treat, and mark the stumps.

Volunteer procedures

1. Hand pulling allowed by volunteers with training or under the supervision of a "trained" volunteer supervisor.
2. Use of loppers allowed by volunteers.
3. No use of power tools or chemicals by volunteers; chemicals and power tool use only by staff or contractor.
4. Volunteers must sign waiver form.

Recommended chronology of restoration activities with volunteers

Year one

- Seedlings cut or pulled (September-November)
- Mature trees cut by staff and/or volunteers in late fall (October-December)
- Stumps or stems chemically treated by staff immediately after cutting
- Removal of brush to a chipping location (or pile on site for burning)

Year two

- Remove seedlings by hand pulling or cutting and treating (June-November)
- Follow-up cutting by staff and/or volunteers in late fall (October-December) and chemically treat stump and stems.

Year three

- Seedling removal by hand pulling or cutting and treating as necessary
- Plant native understory shrubs, trees, ferns, wildflowers and grasses to approximate prior native plant community.

Year four

- Continued monitoring and buckthorn seedling removal

Other removal techniques

Mechanical

- Prescribed fire for seedlings; prescribed burns in early spring and fall annually or biannually to control buckthorn may have to be continued for several years

Chemical

- Cut-stump and stem treatment with glyphosate; 20%-25% active ingredient cut-stump; or basal bark spray treatment around the stem with 25-50% a.i. triclopyr (Garlon) – consideration of worker safety issues will dictate chemical selection. Glyphosate products registered for wetland/aquatic use should be used on water bodies and wetlands. Sponge applicators can help prevent chemical spill or spread to workers.
- Fosamine, a non-selective bud inhibitor for woody species, can be applied as a basal bark treatment in the fall at 3% a.i. concentration in winter

Another technique is goat rental.

The method of buckthorn control should be selected based on the site, safety concerns, and opportunities for continued vegetation management.

Other Sources for Guidance

University of Minnesota:
http://www.extension.umn.edu/environment/agroforestry/woody-vegetation-control.html

University of Wisconsin:
http://mipncontroldatabase.wisc.edu/search?name=common_buckthorn&habitat=7&season=7

Minnesota Department of Natural Resources:
http://www.dnr.state.mn.us/invasives/terrestrialplants/woody/buckthorn/control.html

U.S. Department of Agriculture Natural Resources Conservation Service:
https://efotg.sc.egov.usda.gov/references/public/MN/797Buckthorn.pdf
See Buckthorn Control Quick Guide for a summary of control techniques.