Sustainable Lake Management Plan

Black Lake, Ramsey County, MN

VLAWMO
Vadnais Lake Area
Water Management Organization

Prepared by Kristine Jenson, Program Manager
2015

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1. Acknowledgements

VLAWMO wishes to thank the following:

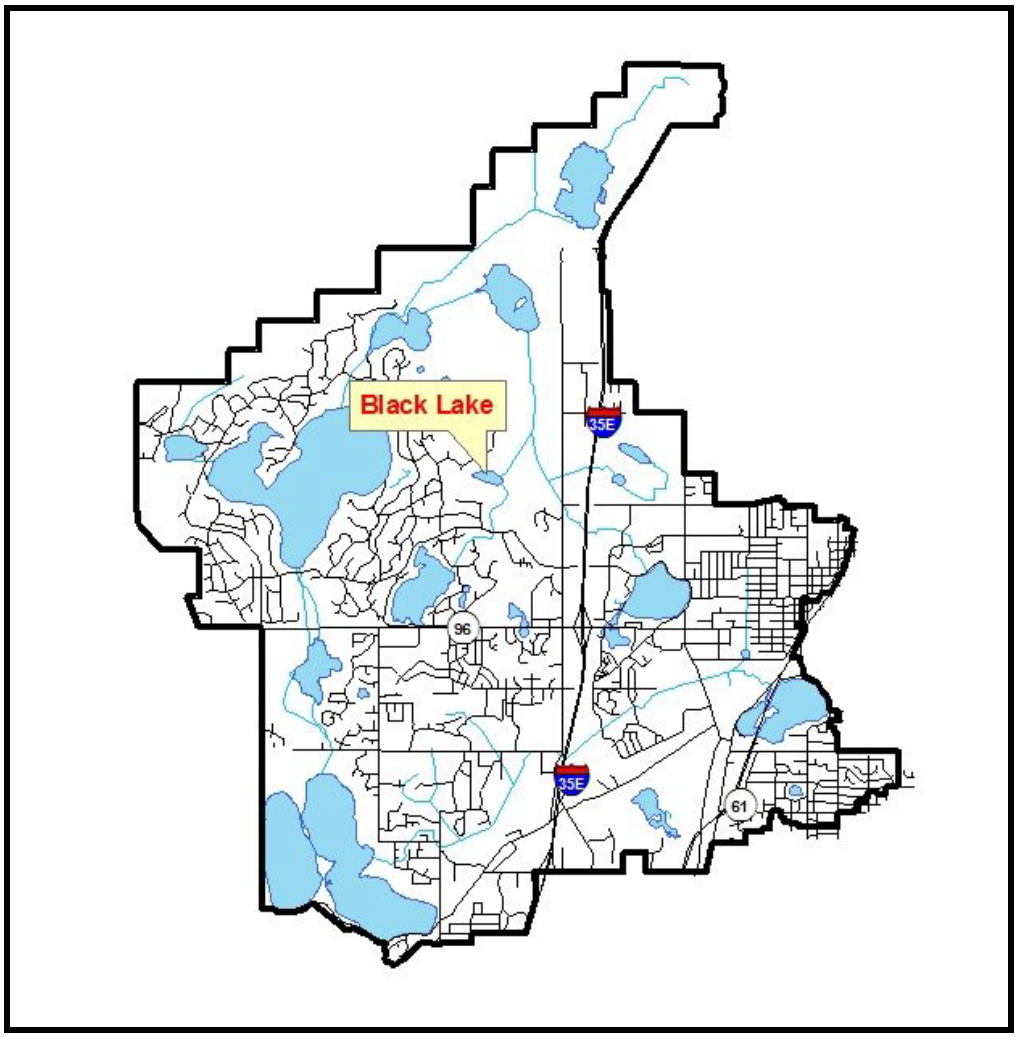
- The City of North Oaks
- The North Oaks Homeowner's Association
- The North Oaks Company for allowing access to Black Lake to collect water quality samples.
- Ramsey Conservation District for assistance with surveys and studies done on Black Lake and in the subwatershed area.

VLAWMO's mission is to protect and enhance the water resources within the watershed. Activities include water quality monitoring, wetland protection, and water quality improvement projects. The cornerstone of VLAWMO's success is our vital partnerships; without the help of all those listed above, we would not be able to fulfill our mission. We appreciate all of your work and assistance.

2. Introduction

Black Lake is located in the City of North Oaks, Ramsey County (Figure 1) and lies within the Vadnais Lake Area Water Management Organization (VLAWMO) watershed area. Black Lake is an 11.5 acre shallow lake with a maximum depth of about 12.5 feet. The lake has no public access and is surrounded by private, residential development, mostly on large, wooded lots and open land.

Figure 1: Location Map



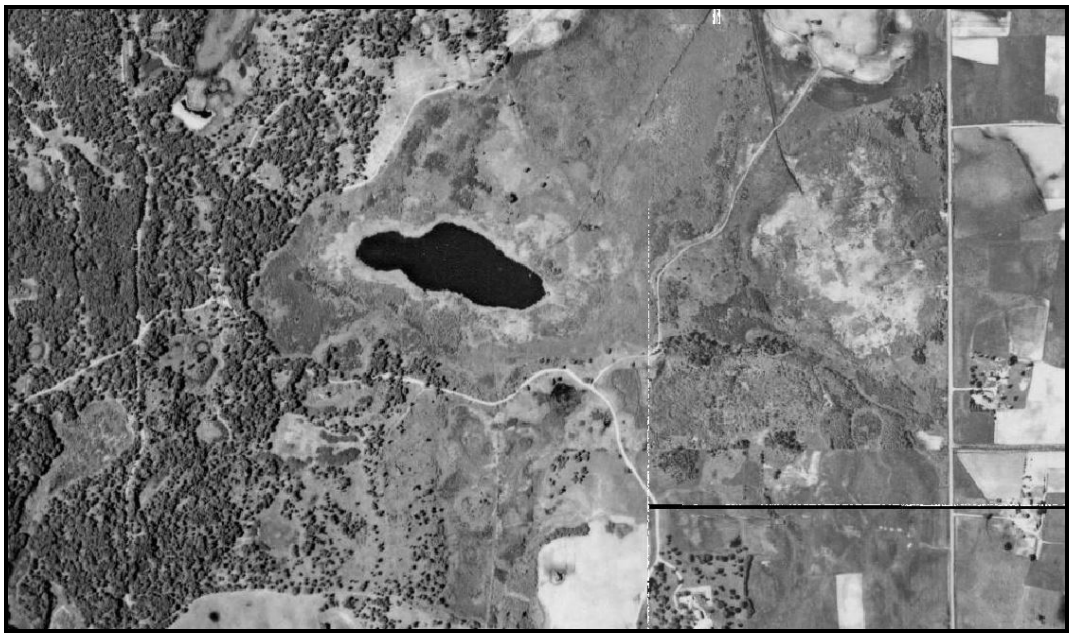
A watershed is the land area that contributes runoff to a particular point along a waterway. Watersheds can be broken down into smaller geographic units called subwatersheds and then even further down into drainage areas. Black Lake lies within the Gilfillan-Tamarack-Wilkinson subwatershed. The lake's drainage area encompasses approximately 385 acres.

This Sustainable Lake Management Plan (SLMP) will look at the overall conditions of the lake and drainage area and tie in the findings from other studies and reports to serve as a tool towards future projects and programs to help protect and enhance the water quality of the lake.

3. Watershed Features

A. History

Figure 2: 1940 Aerial photo of Black Lake



In 1940, there are roads in the area but not much in the way of development.

Figure 3: 1953 Aerial photo of Black Lake

In 1953, the land just south of Black Lake appears to have been excavated to create open water. This area is now considered a wetland.

Figure 4: 1974 Aerial photo of Black Lake

By 1974, residential development is prevalent and I-35E has been constructed east of the lake. Additionally, drainage conduits have been dug which allow water to flow more freely from Black Lake north towards Wilkinson Lake.

Figure 5: 1985 Aerial photo of Black Lake

In 1985, more residential development has occurred in the area, most notably to the southeast of the lake.

Figure 6: 2006 Aerial photo of Black Lake

In the 2006 photo, you can clearly the drainage conduits that were dug years earlier and the residential development around the lake. The area north and east of the lake has remained undeveloped and is used by North Oaks residents for walking and nature viewing.

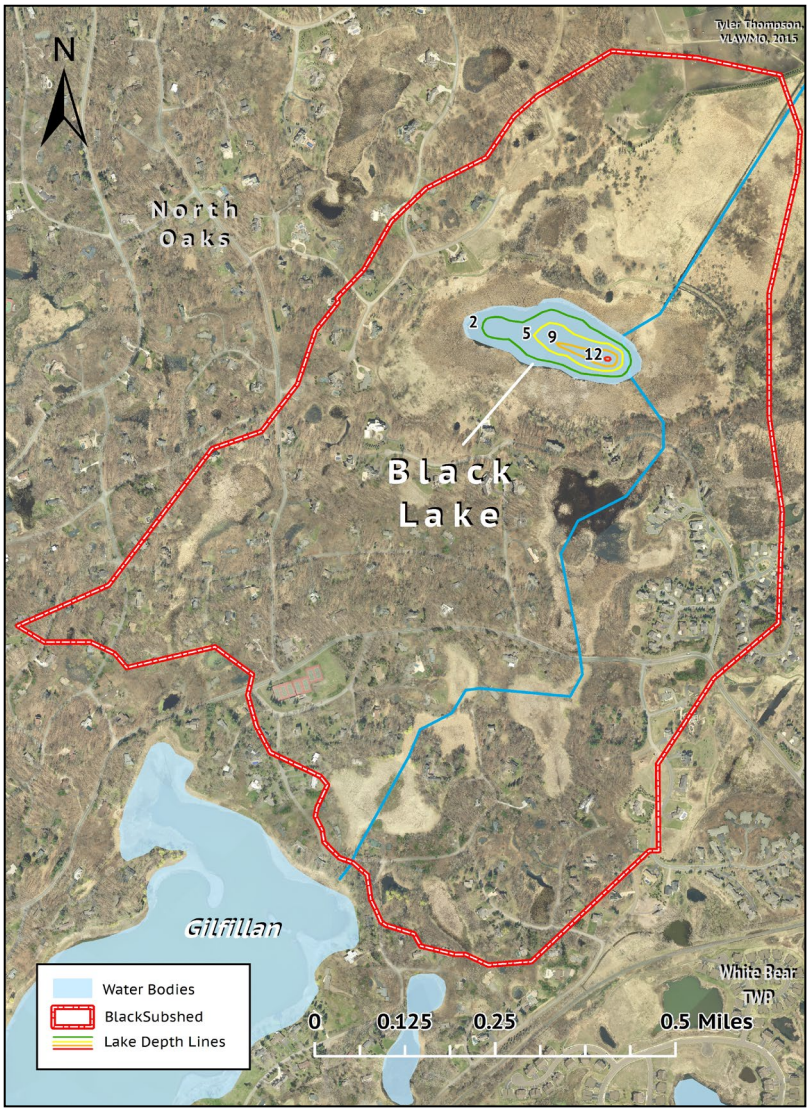
Figure 7: 2012 Aerial photo of Black Lake

As of the 2012 photo, no further changes to the surrounding land appears to have taken place. Residential development is still occurring in other areas of North Oaks.

B. Black Lake Drainage Area

Black receives water from stormwater runoff, groundwater sources, and via streams. The drainage area is approximately 385 acres in size. The subwatershed area is about 33 times larger than the surface area of the lake. The land use within the subwatershed is primarily undeveloped or residential. The lake is surrounded by boggy wetland land which helps to filter pollutants. The water flows north through this drainage area through streams and drainage conduits to Wilkinson Lake. VLAWMO is planning to have a consultant re-evaluate our subwatershed maps to determine that they are as accurate as possible. With that said, this gives a good approximation as to the drainage area into Black Lake.

Figure 8: Black Lake Drainage Area – updated 12/2015



A Retrofit Study was done within the larger subwatershed area of Gilfillan-Tamarack-Wilkinson. This study was done to determine the locations for possible future water quality projects (called Best Management Practices or BMPs for short) that would provide a positive impact within the subwatershed area. That study did not recommend any BMPs within the Black Lake area due to the low development around the lake.

C. Soils

There are a variety of soils found in the Black Lake drainage area. The area has a combination of mucky soils and well drained soils. The mucky soils are found in the wetland areas and/or around Black Lake.

Figure 9: Soils around Black Lake

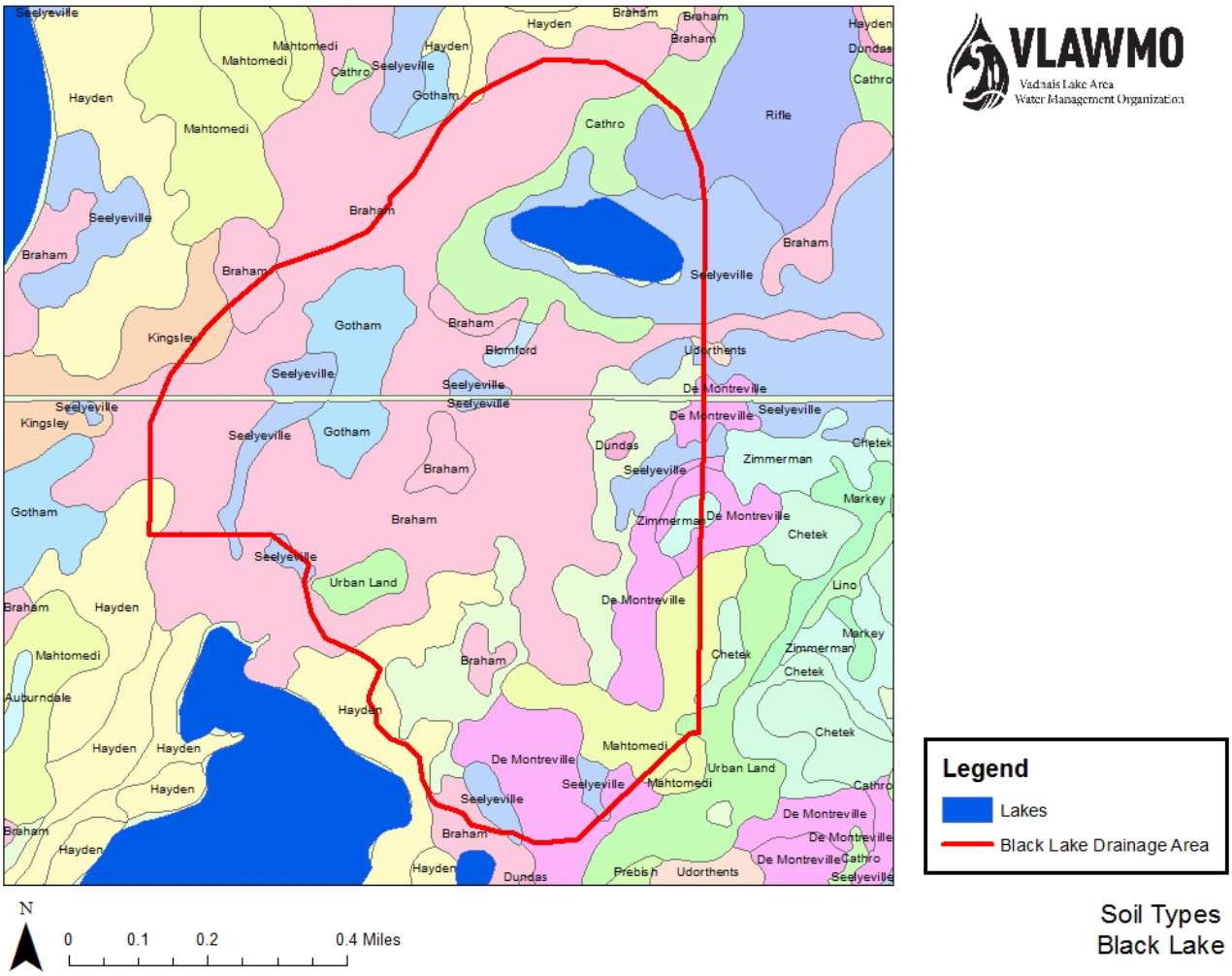


Table 1: Soil types within Black Lake drainage area

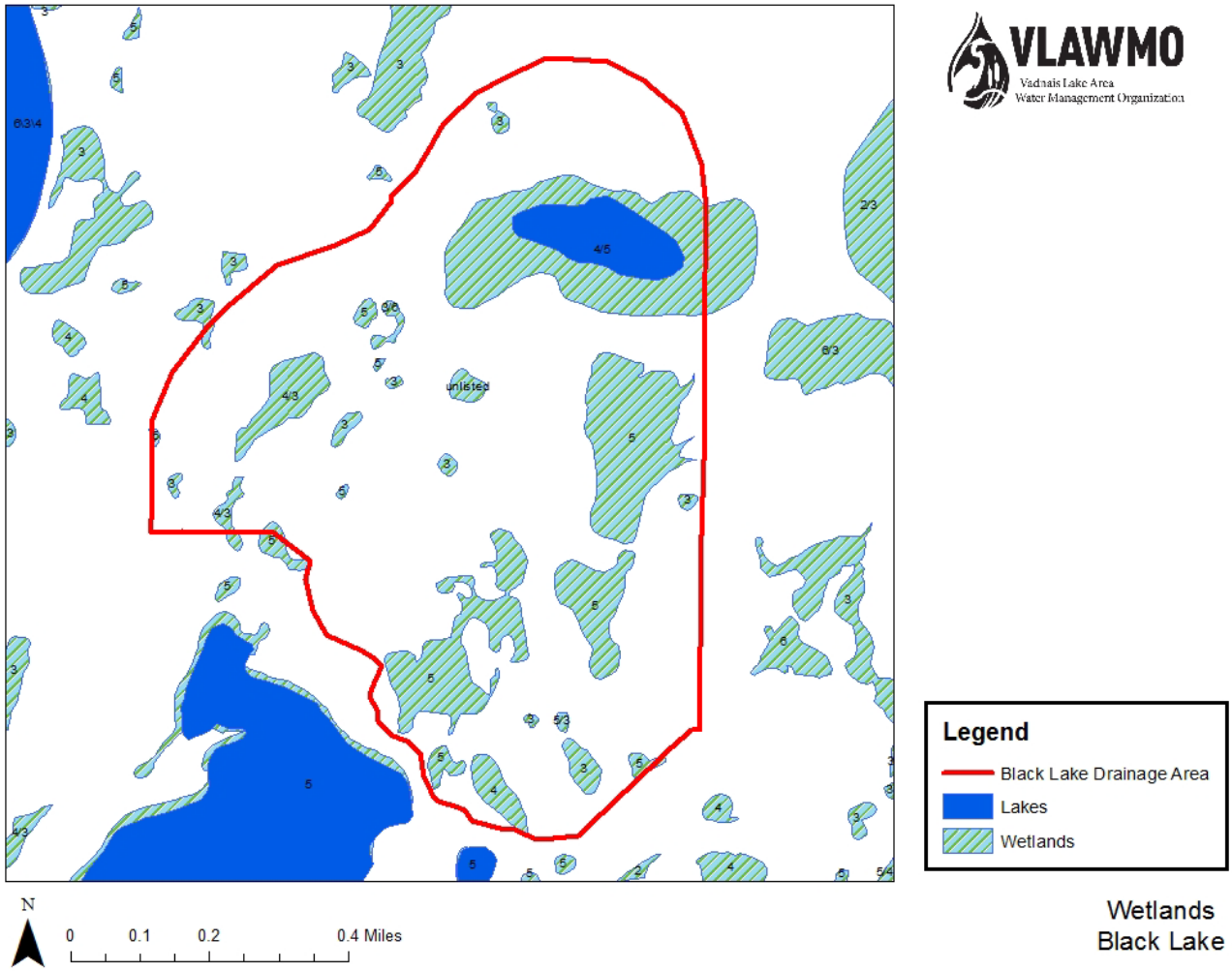
Soil Name	Characteristics
Seelyeville	Organic muck
Gotham	Well drained soils with rapid permeability; found in agriculture and prairie settings
Braham	Well drained soils with rapid permeability; found in agriculture and forest settings
Cathro	Organic soil, poorly drains; found in woodlands as well as in sedge and cattail areas
De Montreville	Well drained soils with rapid permeability; found in agriculture and forest settings
Mahtomedi	Soil drains easily; found in agriculture and forest areas; good for homesites

D. Wetlands

Black Lake and the marsh surrounding it is classified as a Type 4/5 according to the Wetland US Fish & Wildlife Circular 39 classification system. There are other wetlands within the subwatershed classified as either Type 3, 4, 5 or a combination of those numbers.

Type 3 wetlands: inland shallow fresh marshes in which soil is usually waterlogged early during the growing season and often covered with up to 6 inches of water. Vegetation includes grasses, bulrushes, spike rushes, cattails, and smartweeds.
Type 4 wetlands: inland deep fresh marshes where the soil is usually covered with 6 inches to 3 feet of water during the growing season. Vegetation includes cattails, reeds, bulrushes, spike rushes and wild rice. Open areas may have pondweeds, naiads, coontail, water milfoil, and water lilies.
Type 5 wetlands: inland open fresh water, shallow ponds, and reservoirs in which water is usually less than 10 feet deep and fringed by a border of emergent vegetation, much like the type of vegetation found in a Type 4 wetland.

Figure 10: Wetlands around Black Lake



4. Lake Features

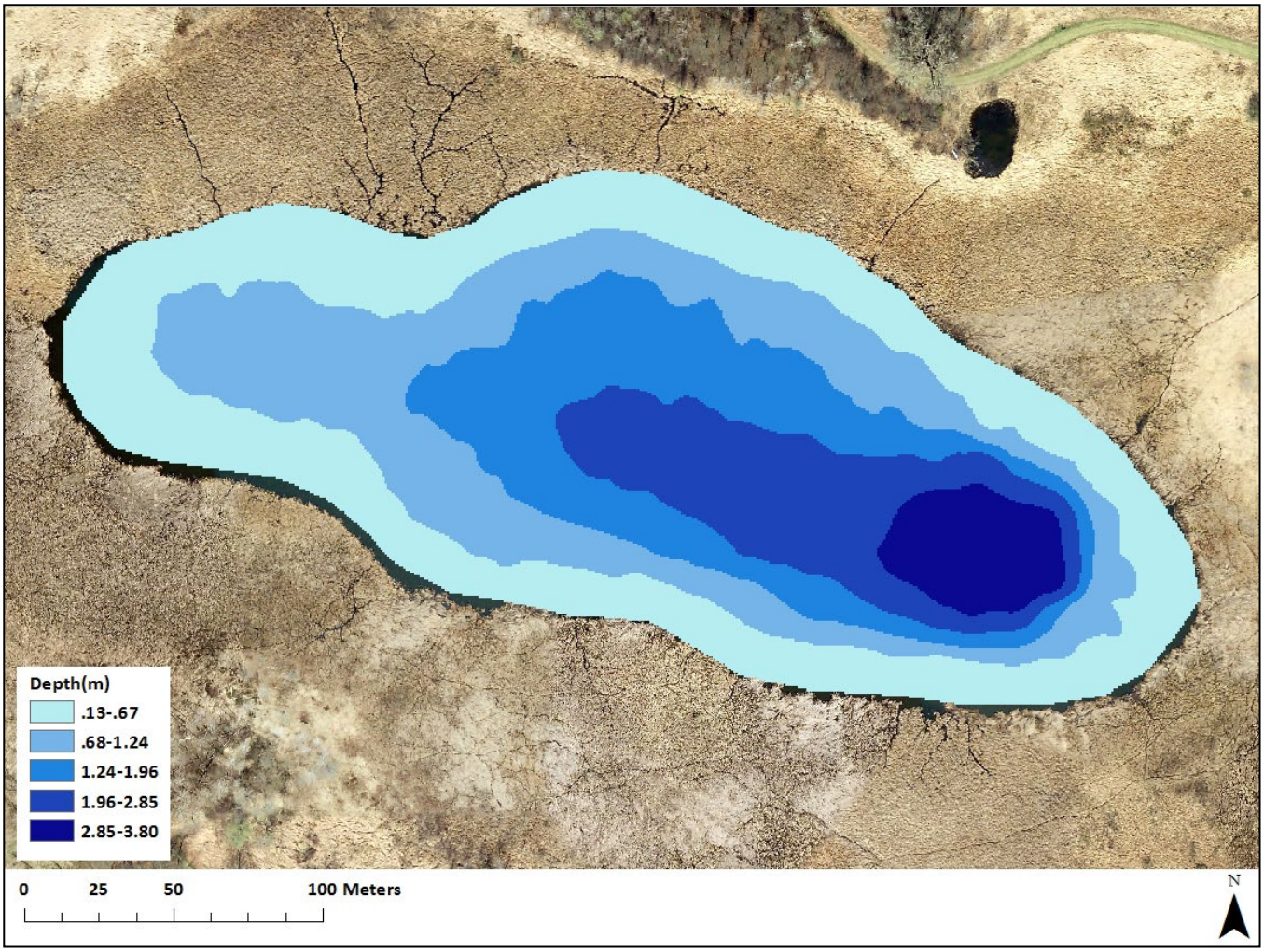
A. Shoreline Inventory

The land immediately surrounding Black Lake is either open land or low density residential. Homes are situated on large lots with no access into Black Lake. There are no obvious signs of shoreline erosion.

B. Lake Depth

A lake depth survey was done in April 2015. A maximum depth of approximately 12.5 feet was found on the eastern side of the lake. The overall depth is approximately 4 feet. The complete findings are located as Appendix A – Black Lake Biovolume, Depth, and Composition Analysis Survey – 4/29/2015.

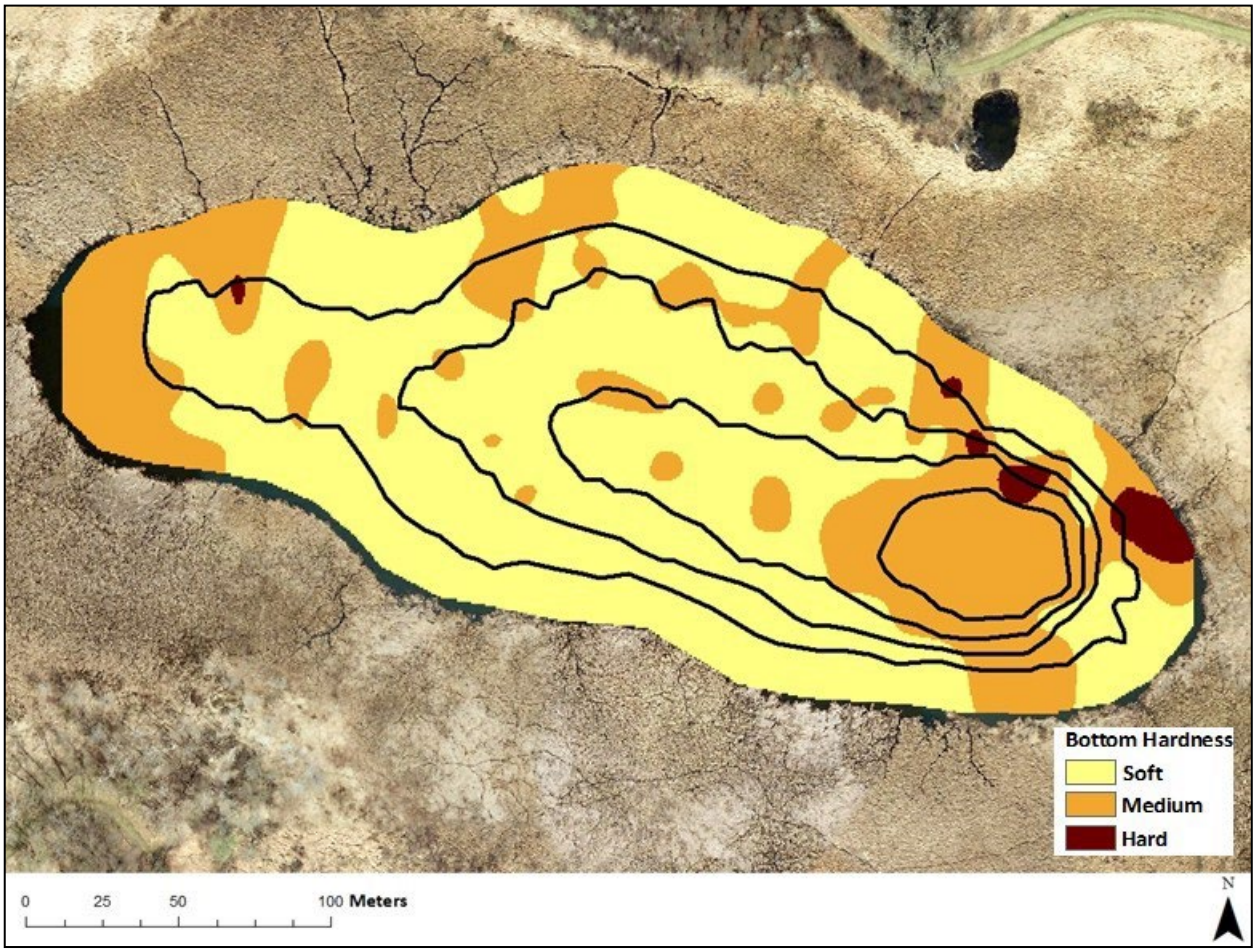
Figure 11: Black Lake Depth – 3 foot intervals- 4/29/2015



C. Lake Bottom Composition

The survey done in April 2015 included analysis of the lake bottom composition (or hardness). Black Lake's bottom is mainly a soft, mucky material. The figure shows the composition of the lake bottom with the 3 foot intervals of depth information.

Figure 12: Black Lake Bottom Composition – 4/29/2015



D. Aquatic Vegetation & Biovolume

In addition to the survey done in April 2015 (Appendix A), a lake depth and vegetation survey was also conducted in July 2014. Black Lake has abundant aquatic vegetation and the findings from this survey are included with Appendix B – Macrophyte & Biovolume Analysis Survey 7/24/14. Due to the large amount of vegetation found in the lake, it was concluded that the 2015 survey be completed to gather more accurate data as to the depth of the lake because the vegetation found in the height of the growing season was skewing the information that was collected. For the 2014 survey, data was collected at 8 points with vegetation found at 7 of the points. For the point where no vegetation was found, it was at one of the deepest areas of the lake. Once water gets deeper than 4 feet, it is difficult for vegetation to grow because the sunlight cannot reach that deep.

Figure 13: Aquatic Vegetation Survey Points

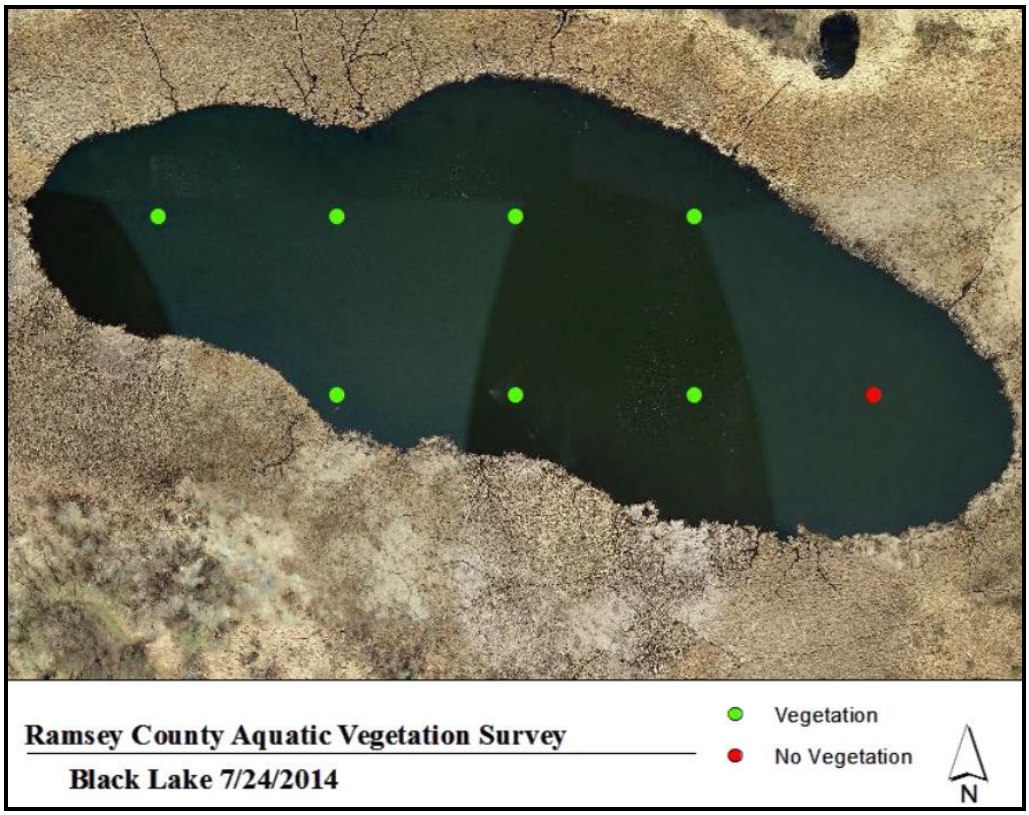


Table 2: Summary of aquatic vegetation found in Black Lake

Common Name	% Occurrence – 7/24/14
Coontail	85.71%
White waterlilly	42.86%
Muskgrass	42.86%
Sago Pondweed	42.86%
Filamentous algae	14.29%
Flatstem pondweed	14.29%

None of the vegetation found as part of the survey is considered invasive to Minnesota lakes. Staff has found wild rice on this lake but the plant was not located at the sampling points. Additionally, there is a significant amount of vegetation surrounding the lake. A visual survey based on what can be seen via canoe while on the lake has shown that there are cattails, arrowhead, jewelweed, and purple loosestrife. Purple loosestrife is an invasive species and is located on the western side of the lake. An additional survey will be completed in the summer of 2015 to assess the vegetation surrounding the lake as well as assess the presence and abundance of wild rice growing within the lake.

Figures 14 and 15 demonstrate the difference in biovolume (abundance of in lake vegetation) from spring and summer conditions. In the summer, the lake is almost entirely filled with vegetation. The spectrum of blue – red indicated the amount of vegetation with blue being little to no vegetation and red being 100% vegetation.

Figure 14: Black Lake Biovolume – Spring Conditions

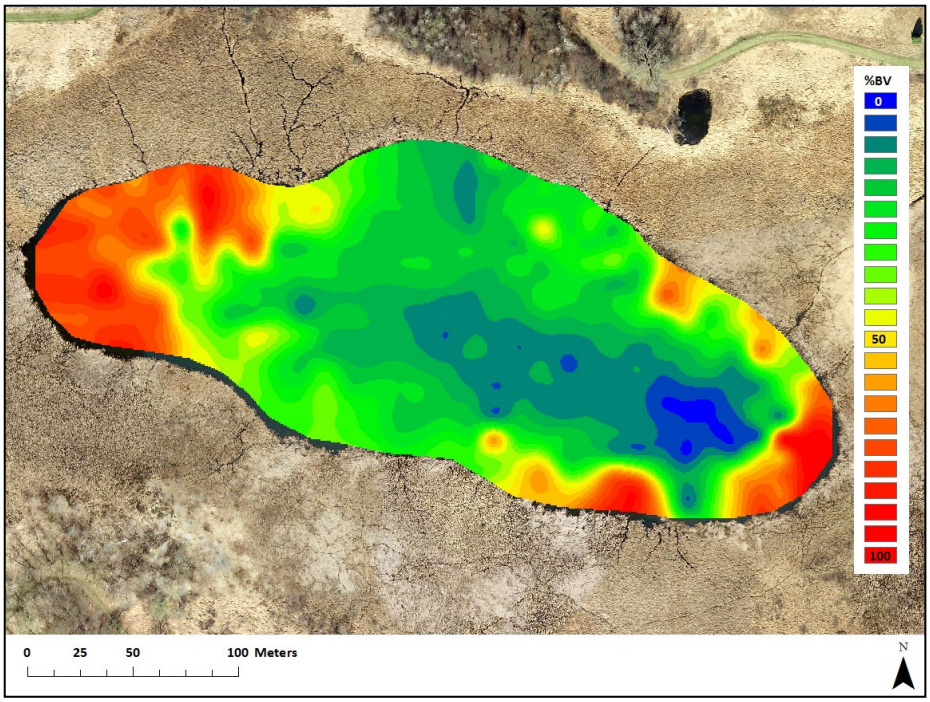


Figure 15: Black Lake Biovolume – Summer Conditions

E. Water Quality Summary

Water quality data has been collected on Black Lake since 2009 and the yearly averages are shown in Table 3. Samples from the lake are collected every two weeks from May through September and tested for Total Phosphorus (TP) and Chlorophyll A (Chl A) and a Secchi Depth Transparency (SDT) measurement is taken. Phosphorus is the primary cause of excessive plant and algae growth in lake systems. Phosphorus originates from a variety of sources, many of which are human related. Major sources include human and animal wastes, soil erosion, detergents, septic systems and stormwater runoff. There can also be internal loading of phosphorus in a lake from the sediment. Chl A is a green pigment in algae. Measuring Chl A concentration gives an indication of how abundant algae are in a waterbody. The State of Minnesota has established water quality standards which state that a shallow lake should have TP levels at 60ug/L or below, Chl A levels at 20 ug/L or below and a SDT of 1 meter or greater. When monitoring data shows that a lake is not meeting these standards, they are placed on the Impaired Waters List and a TMDL study is done to determine sources of pollution and set goals for reductions. Black Lake's data shows that it is not impaired and therefore a TMDL study will not be required.

Table 3: Black Lake Water Quality Annual Averages

Black Lake Historical Avg TP/Chl A/SDT			
Year	TP (ug/L)	Chl A (ug/L)	Secchi (m)
2009	23	5.9	2
2010	34	6.6	2.1
2011	44	6.9	2.3
2012	31	6	2.4
2013	32	6	2
2014	21	8	2

Another water quality indicator VLAWMO monitors is the level of Chloride in the lake. In the spring, just as ice out occurs, a sample is collected. Table 3 shows results from 2010-2014. Since salt is heavily used on roads to clear them of ice and snow, monitoring chloride is important. The State of Minnesota is still working on developing what the limit should be for a lake but given all the discussions that have taken place to date, none of VLAWMO's lakes are in danger of being listed as impaired for chloride levels.

Table 4: Black Lake Chloride Results

Black Lake Chloride Results (mg/L)	
2010	9
2011	10
2012	8
2013	5
2014	5

Another measurement of a lake's health is the Tropic State Index. This is used by State and Federal agencies to track overall health. The data gathered from monitoring (TP, Chl A, and SDT) is put into an equation and the results correspond to a characteristics for the lake. Based on 2014 data, Black Lake falls within the Mesotrophic lake description. Mesotrophic lakes have moderately clear water but may undergo anoxic (low oxygen) levels in the summer.

5. Lake Management Plan for Black Lake

Black Lake is an overall healthy shallow lake. It is surrounded by nature and does not have any direct runoff from roads or commercial and industrial areas. The lake should continue to be monitored for TP and Chl A and if levels start to rise, we will be able to implement other action items.

Table 5: Action List for Black Lake

Action Item	Description	Leader	**Cost Estimate** **$ = <$1,000** **$$ = $1,000-$2,500** **$$$ = $2,500-$5,000** **$$$$ = $5,000-$25,000** **$$$$$ = $25,000-$100,000** **$$$$$$ = >$100,000**
Continued Lake Monitoring	Continue current monitoring program of twice monthly lake sampling to measure nutrient levels, dissolved oxygen and temperature levels.	VLAWMO	$
Enhanced Monitoring	Collect storm samples within the Black Lake Subwatershed to determine areas of concern.	VLAWMO & Ramsey Co	$$
Fish Survey	Conduct a fish survey to determine abundance and type of fish found in Black Lake	VLAWMO	$$
Purple Loosestrife Control	Purchase beetles to combat the Loosestrife infestation.	City of North Oaks, NOHOA, VLAWMO	$

APPENDIX A – BLACK LAKE MACROPHYTE & BIOVOLUME ANALYSIS SURVEY – 7/24/2014

Black Lake

VLAWMO
Vadnais Lake Area
Water Management Organization

Macrophyte & Biovolume Analysis Survey 7/24/14

This document contains two reports of information collected on Black Lake. The first report details the methods and findings of a point intercept survey of macrophyte vegetation and the second report details the methods and results of an aquatic vegetation biovolume data survey.

Data collected and prepared by **Ramsey Conservation District** for

Vadnais Lake Area Water Management Organization
800 East Co. Rd. E, Vadnais Heights, MN 55127
Phone: (651) 204-6070 Fax: (651) 204-6173 www.vlawmo.org

Black Lake Macrophyte Survey

July 24, 2014

Methods:

The point intercept method incorporating a Global Positioning System (GPS) was used to assess the aquatic macrophyte community on Black Lake on July 24, 2014. Samples were taken at evenly spaced (70 m) geo- referenced points. Data on depth, plant species, and abundance rank was recorded.

A double-tined metal rake attached to a rope was used to collect specimens. At each point the device was thrown out approximately 1 meter and then dragged across the substrate for approximately 1 meter. Species were identified and given a ranking based on cover of rake tines. Plant species that were floating in the water at the collection points were also counted. The table below includes the ranking system.

Percent Cover of Tines	Abundance Ranking
81-100	5
61-80	4
41-60	3
21-40	2
1-20	1

Results:

Data was collected at 8 points. Aquatic macrophytes were found at 7 points. Coontail (*Ceratophyllum demersum*), White waterlilly (*Nymphaea odorata*), Muskgrass (*Chara sp.*), and Sago pondweed (*Potamogeton pectinatus*) were the most common species. Also present was Filamentous algae (*Spirogyra spp*) and Flatstem pondweed (*Myriophyllum spicatum*).

The Secchi disk reading was 2.45 m (8.04 ft). A bathymetry was created at 1 ft and 3 ft intervals and is included in this report. The bathymetry, while generally reliable, included areas where Lowrance accoustics were not penetrating the vegetation layer. It is recommended that a more conclusive bathymetry be performed under less dense vegetative conditions in the early spring.

Depth measurements were taken at the 7 survey points where aquatic vegetation was found. Point number, depth, plant species and abundance ranking data is reported in the map and table included in this file.

Percent Occurrence and Average Abundance of Taxa at Black Lake on 07/24/2014

Species	Common Name	Scientific Name	% Occurrence	Avg Abundance
1	Coont	*Ceratophyllum demersum*	85.71%	2.17
2	White waterlilly	*Nymphaea odorata*	42.86%	2.00
3	Muskgrass	*Chara*	42.86%	1.33
4	Sago pondweed	*Potamogeton pectinatus*	42.86%	1.00
5	Filamentous algae	*Spirogyra spp*	14.29%	1.00
6	Flatstem pondweed	*Myriophyllum spicatum*	14.29%	1.00

Table 1. Summary of percent occurrence and average abundance for aquatic plant taxa encountered during a point-intercept survey conducted on Black Lake.

- Percent occurrence represents the number of times a plant species was observed divided by the number of total sample sites where vegetation was observed
- Average abundance is calculated as the average of the abundance ranking for an individual species present

☐ The seasonal timing and water temperature on survey dates have an influence on biodiversity as well as abundance and occurrence. Biovolume and visual observation revealed a higher Coontail abundance than likely what was actually observed with the rake throw survey.

☐ Water was clear at the time of vegetative survey and followed an early summer period of above average rainfall. Black Lake temperature average was 25.03° C (77.05° F) on the July 24, 2014 survey date.

☐ No vegetation was sampled at point 8. The recorded depth at point 8 was 13.1 feet. Point 8 was the location of the Secchi disk reading.

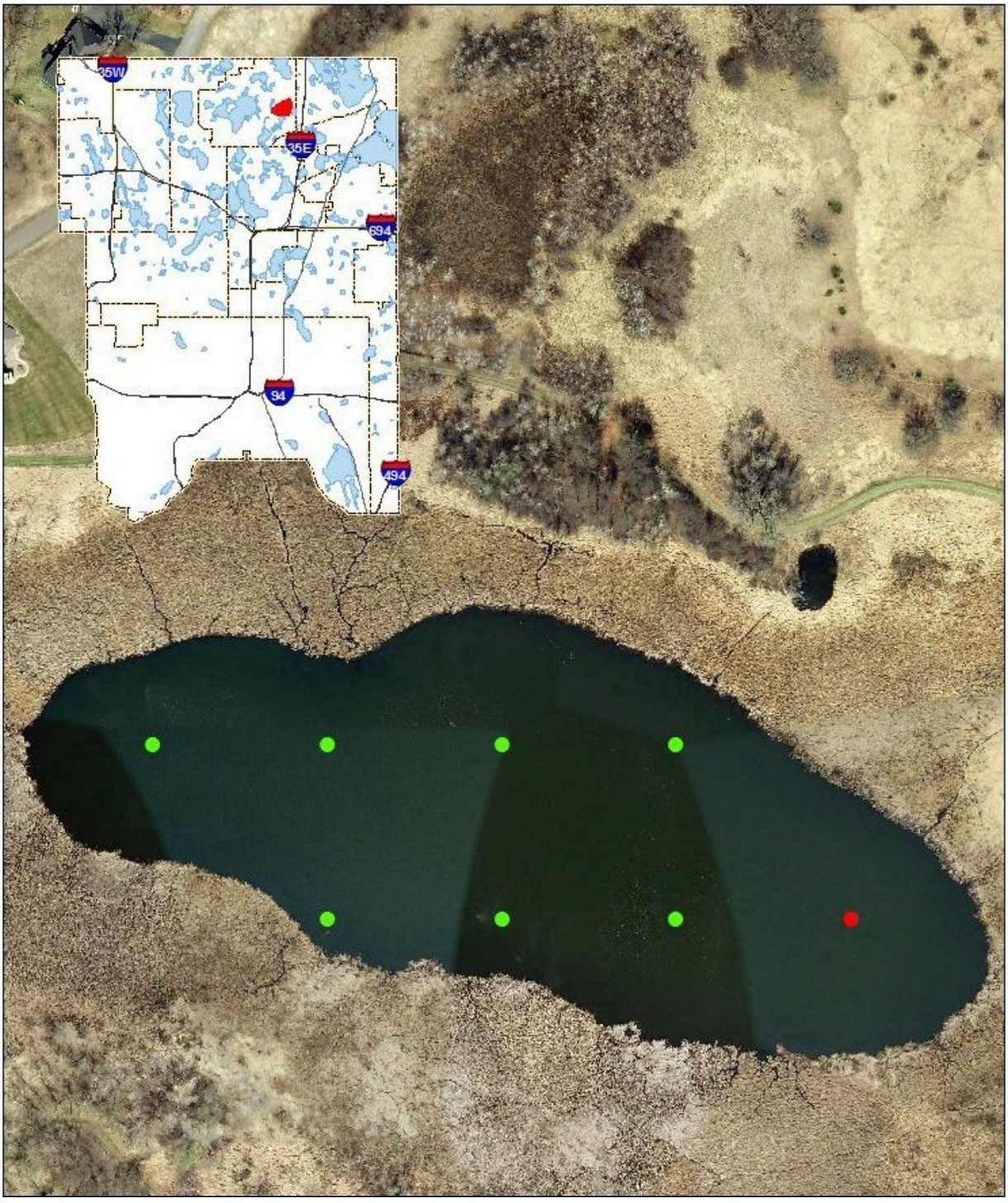
☐ Purple loosestrife (Lythrum salicaria) was noted in greater abundance on the western end of Black Lake. There was lesser abundant presence of Purple loosestrife mid-lake and on the eastern side of Black Lake. Black Lake has an extensive and dense littoral zone that could be further surveyed to reveal the extent of the Purple loosestrife and native emergent abundance.

Point Survey - Vegetation and Depth (07/24/2014)

Point #	Depth (ft)	Coontail	White waterlilly	Chara	Sago pondweed	Filamentous algae	Flat stem pondweed
1	3.9	2	2	2	1		1
2	4.1	2			1		
3	4.9	3					
4	3	2	2	1			
5	3.3			1	1	1	
6	4.9	3	2				
7	7.5	1					

Total Abundance		13	6	4	3	1	1
Count	7	6	3	3	3	1	1
Avg Abundance		2.17	2.00	1.33	1.00	1.00	1.00
% Occurrence		85.71%	42.86%	42.86%	42.86%	14.29%	14.29%

Secchi Depth	8.04 ft (2.45m)



Ramsey County Aquatic Vegetation Survey
Black Lake 7/24/2014

Vegetation
No Vegetation

Black Lake Biovolume Analysis
Survey

July 24, 2014

Methods: A Lowrance HDS-5™ Global Positioning System (GPS) enabled depth finder was used to collect submerged aquatic vegetation and lake bottom data on Black Lake on July 24, 2014. The lake was transected at a minimum distance of 40 meters at a speed of no more than 6 miles per hour. Sonar log data was recorded to assess data on depth (bathymetric) and biovolume.

Data was reprocessed using Contour Innovations, LLC, ciBioBase system to include areas of aquatic vegetation that were topped out at the surface within Black Lake.

Results: The results below were exported from Contour Innovations, LLC, ciBioBase system and include a map and statistics of biovolume information. More robust interactive contour and vegetation map data, including sonar log trip replays, can be viewed on the ciBioBase website: www.cibiobase.com

cBIOBASE VEGETATION ANALYSIS REPORT

Black Lake, Ramsey County Minnesota

Generated: 9/10/2014 4:34:52 PM (UTC)

Waterbody Size: 5.27 ha *(13.00 acres)*

report link

Data Collector
Ann WhiteEagle

Data Collection Date
7/24/2014 1:50:37 PM (UTC)

Average Water Temperature
25.03° C (77.05° F)

Location
Start: 45.09723663, -93.06816101
End: 45.09685898, -93.0674057

Survey Size
Area: 4.83 ha (11.93 acres)
Percent: 91.66% of waterbody
Volume: 50,087.70 cu. m (40.61 acre ft)

Est. Waterbody Volume ?
54,658.00 cu. m
(44.31 acre ft)

Settings

Track Buffer:	25 m
Grid Cell Size:	5 m
Min. BV Detect:	5%
Min. Veg Depth Detect:	0.73152 m

Quality Control
Reviewer: Valley, Ray
Status: Has Issues
Bathymetry and water volume is not reliable due to the dense vegeation. However, given the topped out nature of plant growth, biovolume map is robust. Use manual veg coordinates (right-click on map, add coordinate, reprocess veg and report) to fill in unmapped areas.

Area of Interest Summary

AOI ?	Type ?	PAC ?	Avg BVp ?	SD BVp ?	Avg BVw ?	SD BVw ?	Depth Range	Avg Depth	Distance	No. Points
1	Point	95.6%	98.1%	±6.7%	93.8%	±21.1%	0.31-3.59 m	1.13 m	2.96 km	1,526
	Grid	99.4%	94.7%	±14.1%	94.1%	±16%	0.01-3.58 m	0.9 m	-	1,434

Biovolume Analysis by Quantity

AOI ?	0-5%	5-20%	20-40%	40-60%	60-110%	>80%
–	4.39%	2.03%	0.07%	0.07%	0.59%	92.86%

Biovolume Analysis by Depth

AOI ?	Depth	Type ?	Count	PAC ?	Avg BVp ?	SO BVp ?	Avg BVw ?	SO BVw ?
1	0-1m	Point	554	100%	99.4%	:t2%	99.4%	• 2%
	1-2m		466	100%	98.4%	• 4.7%	98.4%	• 4.7%
	2-3m		473	92.8%	96%	• 10.7%	89.1%	• 26.9%
	3-4m		33	0%			0%	• 0%
	4-5m		0					
	5-6m		0					
	6-7m		0					
	7-8m		0					
	8-9m		0					
	>9m		0					
	0-1m	Grid	1017	100%	97.7%	• 3.8%	97.7%	• 3.8%
	1-2m		218	100%	96.9%	• 9.2%	96.9%	• 9.2%
	2-3m		163	99.4%	81.8%	6%	81.3%	• 26.7%
	3-4m		36	77.8%	40.3%	7.6%	31.4%	• 29.6%
	4-Sm		0					
	5-6m		0					
	6-7m		0					
	7-Sm		0					
	8-9m		0					
	>9m		0					

Glossary

AOI

Area of Imeresr: Defines *the* individual transects or contiguous data samples as depicted by *the* color coding of each trip line. Seperate areas of interest can be generated through merging of multipe trips, appending data to a single sonarl og orllapses in time (greater than five minutes) within a scnar log.

BVp

Biovolume (Plan!):: Refers to the percentage of the water column taKen up by vegetation when vegetation exists. Areas that do not have any vegetation are not taKen into consideration for this calculation.

BVw

Biovolume (All warer): Refers to *the* average percentage of the water column taKen up by vegelation regardless of whether vegetation exists. In areas where no vegelation exists, a zero value is entered into *the* calculation, thus reducing the overall biovolume of the entire area covered by the survey.

PAC

Percell! Area Covered: Refers to the overall surface *area* that has vegelation growing.

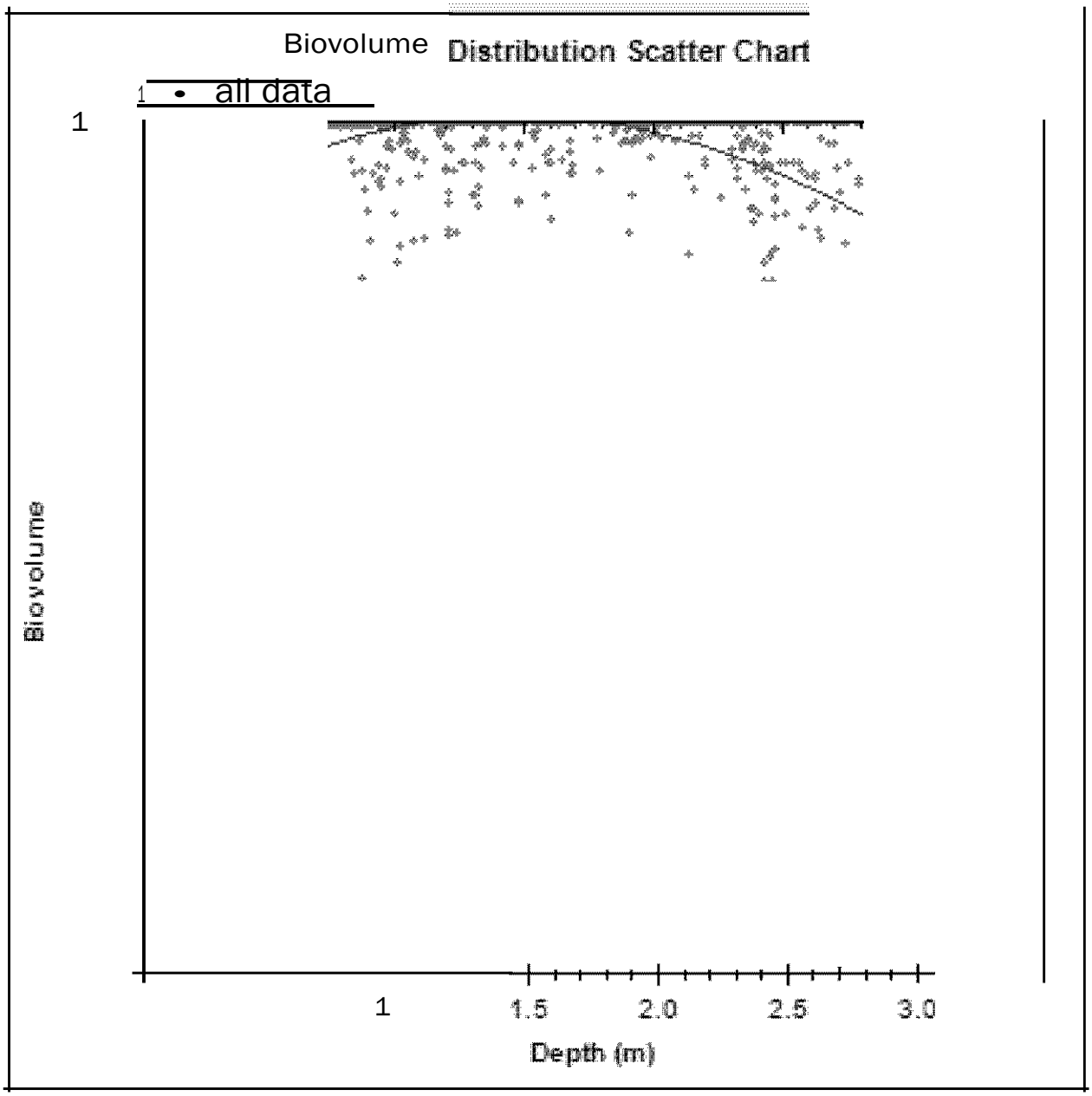
Grid

Geosrarisricallnrerpolared Grid: Interpolated and evenly spaced values representing Kriged (smoothed) output of aggregated data points. The gridded data is most accurate summary of individual survey areas.

Poi nt

Individual Coordinate Poim: A single point represents a summary of scnar pings and the derived bottom and canopy depths. In<Nidual point data create an irregularly spaced dataset that may have ovellaps and/or gaps in the data resultingin a increased potentialfor error.

Biovolume Distribution Scatter Chart

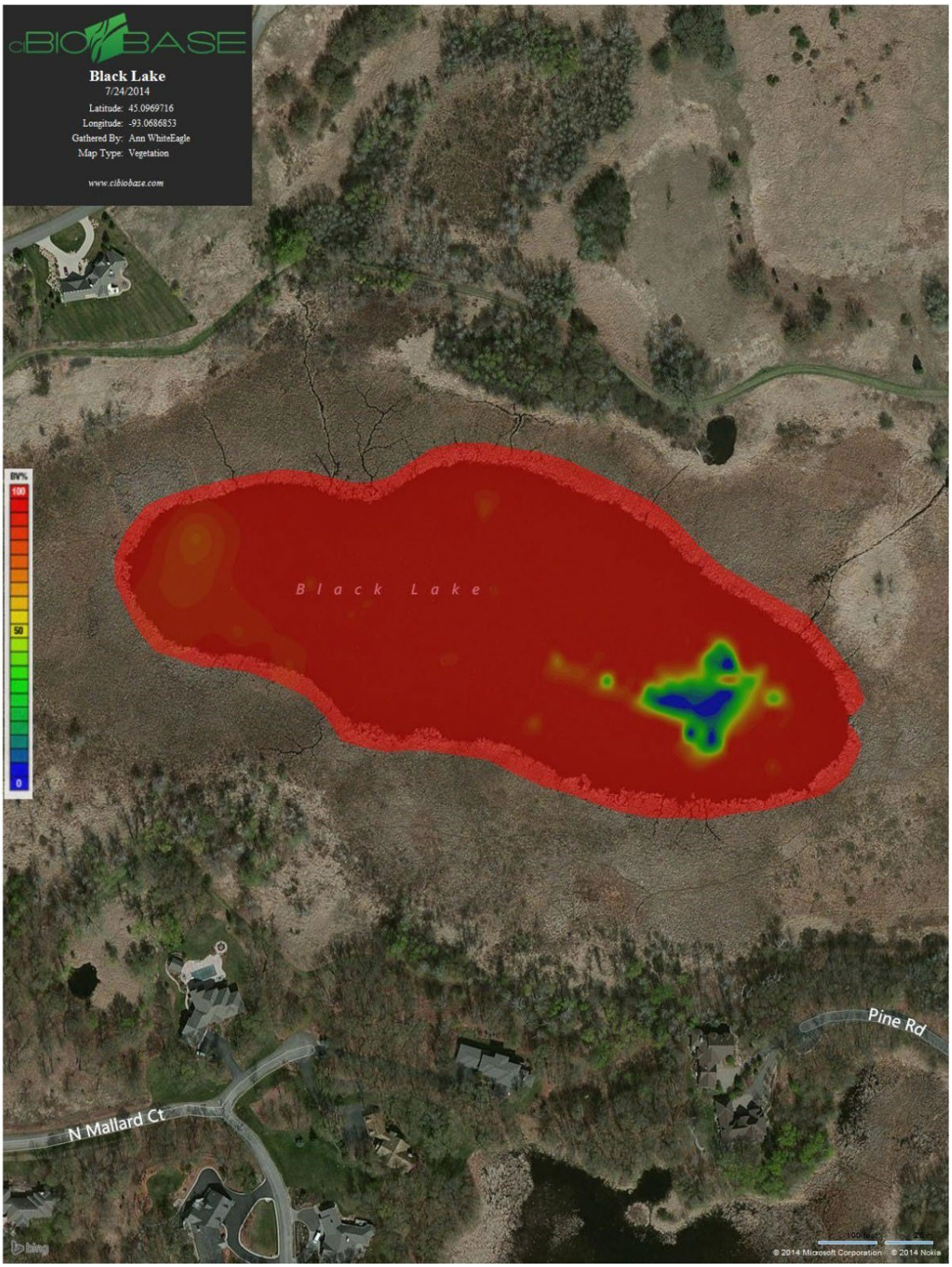


Black Lake Contour Map (3 foot intervals)

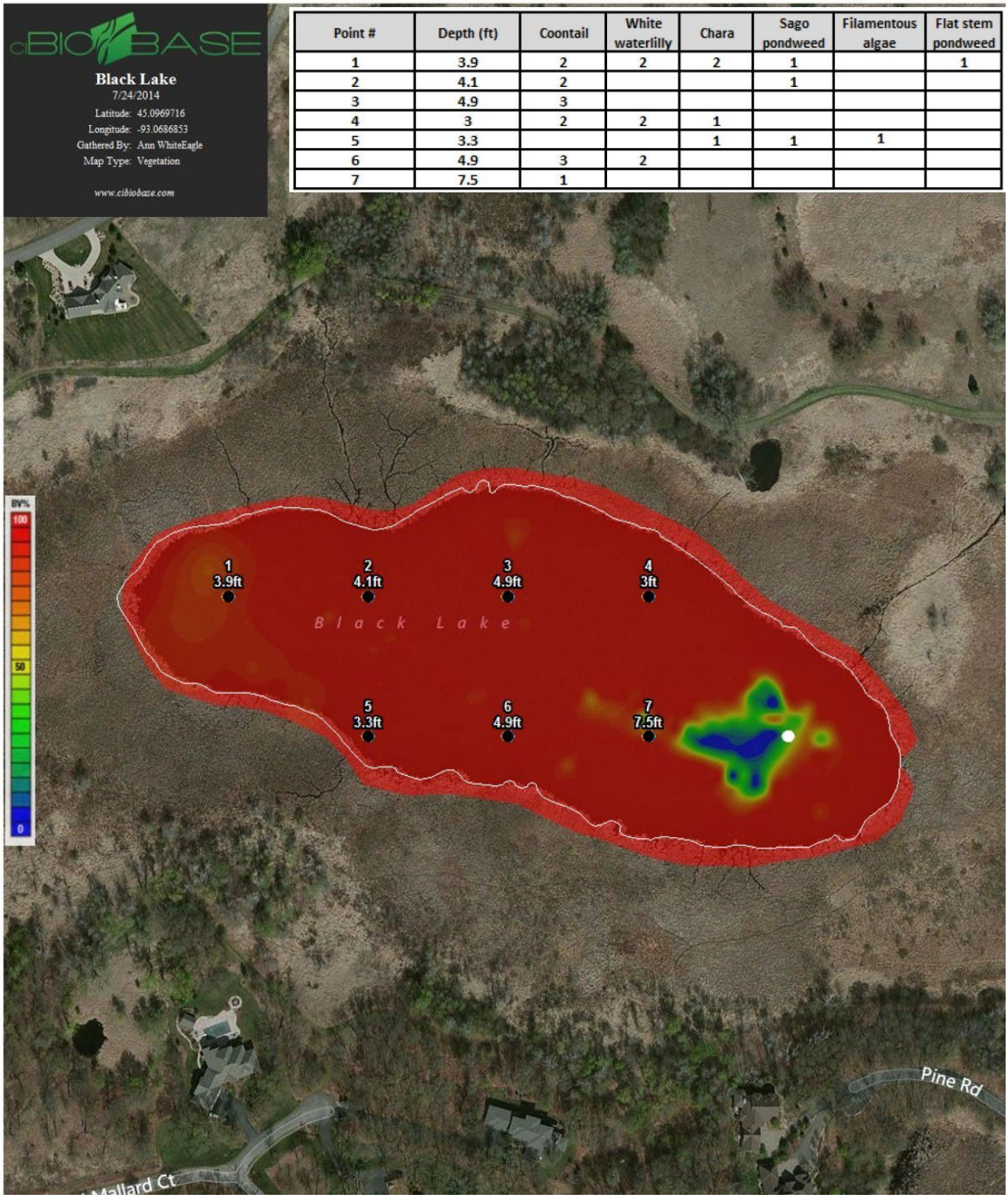
Black Lake Contour Map (1 foot intervals)


cBIOBASE
Black Lake
7/24/2014
Latitude: 45.0969716
Longitude: -93.0686853
Gathered By: Ann WhiteEagle
Map Type: Contour
www.cibiobase.com
Black Lake
N Mallard Ct
Pine Rd
bing
© 2014 Microsoft Corporation © 2014 Nokia

Black Lake Biovolume Map



Macrophyte Survey Points Overlaid on Biovolume Map



Point #	Depth (ft)	Coontail	White waterlilly	Chara	Sago pondweed	Filamentous algae	Flat stem pondweed
1	3.9	2	2	2	1		1
2	4.1	2			1		
3	4.9	3					
4	3	2	2	1			
5	3.3			1	1	1	
6	4.9	3	2				
7	7.5	1					

Appendix B – Black Lake Biovolume, Depth, and Composition Analysis Survey – 4/29/2015

Black Lake

Biovolume, Depth, and Composition Analysis Survey - 4/29/2015

This document contains the report of information collected on Black Lake. The report details the methods and results of a data survey including vegetation biovolume distribution, lake depth (bathymetry), and bottom hardness (composition).

Data collected and prepared by **Ramsey Conservation District** for

Vadnais Lake Area Water Management Organization
800 East Co. Rd. E, Vadnais Heights, MN 55127
Phone: (651) 204-6070 Fax: (651) 204-6173 www.vlawmo.org

Black Lake Biovolume Analysis Survey

April 29, 2015

Methods:

A Lowrance HDS-5™ Global Positioning System (GPS) enabled depth finder was used to collect submerged aquatic vegetation biovolume, lake depth (bathymetry), and bottom hardness (composition) data on Black Lake on April 29, 2015. The lake was transected at a maximum distance of 25 meters between transects at a speed of no more than 5 miles per hour. Sonar log data was recorded using the Lowrance HDS-5™ Global Positioning System (GPS) enabled depth finder to assess this data.

Data was reprocessed using Contour Innovations, LLC, ciBioBase system to include areas of aquatic vegetation that were topped out at the surface within Black Lake.

Results:

The results below were exported from Contour Innovations, LLC, ciBioBase system and processed using ArcGIS software. Results include maps and statistics of biovolume distribution represented as total percent of water column occupied by plant matter. Additional results include contour depth maps at both one and three foot intervals as well as bottom hardness (composition) maps. Bottom hardness is represented as soft, medium, or hard; with soft bottoms characterized as muck or loose silt or sand and medium to harder bottoms characterized as compacted sand, gravel, or rock. More robust interactive contour and vegetation map data, including sonar log trip replays, can be viewed on the ciBioBase website: www.cibiobase.com.

Figure 1. Location of Black Lake shown in red within VLAWMO and Ramsey County Boundaries.

BIOBASE

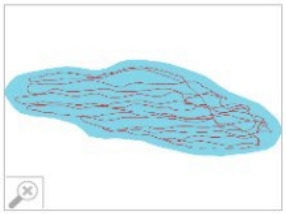
VEGETATION ANALYSIS REPORT

Black Lake, Ramsey County Minnesota

Generated: 4/30/2015 6:05:54 PM (UTC)

Waterbody Size: 5.27 ha *(13.00 acres)*

report link



Data Collector
Laura Triplett

Data Collection Date
4/29/2015 2:47:01 PM (UTC)

Average Water Temperature
13.76° C (56.77° F)

Location
Start: 45.09693527, -93.06926727
End: 45.09745789, -93.06782532

Survey Size
Area: 5.11 ha (12.64 acres)
Percent: 97.06% of waterbody
Volume: 59,048.20 cu. m (47.87 acre ft)

Est. Waterbody Volume ?
60,848.60 cu. m
(49.33 acre ft)

Settings
Track Buffer: 15 m
Grid Cell Size: 5 m
Min. BV Detect: 5%
Min. Veg Depth Detect: 0.73152 m

Quality Control
Reviewer: McCormack, Ian
Status: Passed

Area of Interest Summary

AOI ?	Type ?	PAC ?	Avg BVp ?	SD BVp ?	Avg BVw ?	SD BVw ?	Depth Range	Avg Depth	Distance	No. Points
1	Point	88.9%	21.1%	±17.1%	18.7%	±17.4%	0.3-3.83 m	1.18 m	4.58 km	1,503
	Grid	94.4%	30.9%	±22.3%	29.2%	±22.8%	0.12-3.78 m	1.28 m	-	1,004

B10volume Analysts by Quanllty

AOI ?	0-5%	5-2011	20-4011	40-6	60-3011	>8011
1	11.11%	5768%	216,.	479'1'	279	193%

Brovolume Analysts by Depth

AOI	Depth	Type	Coont	PAC	AvgBVp ?	SOBVp	AvgBVW	S0 BVw >
1	0-1m	Point	308	97.1%	41%	:!23.8%	39.8%	:!24.4%
	1-2m		705	97.6%	18.4%	18.1%	18%	18.4%
	2-3m		364	885%	94%	12.8'!6	84'!6	t4%
	3-4m		126	214%	7.3%	±1.1'16	16'!6	t3%
	4-5m							
	5-6m							
	6-7m							
	7-8m							
	8-9m							
	>9m							
	0-1m	Gnd	470	996%	461%	:!21 9%	459%	±22%
	1-2m		333	985%	19 3%	•8 5%	19'111	•87'111
	2-3m		161	888%	92'111	•2	82'111	J4%
	3-4m		40	225%	7 1%	.08'!6	16%	t3%
	4-5m							
	5-6m							
	6-7m							
	7-8m							
	8-9m							
	>9m							

Glossary

AOI

Area of Inreresr: Defines file Indr.tdualtranseels or conuguous data samples as depteled by111e color coding of eacn tnp line Seperate areas of Interest can be generated lhrough merging of multrple trips, appendrng data to a srngle sonar log or lapses In lime (greater lllan five minutes) wlthrn a sonar log

BVp

Biovotume (Plan!); Refers to11\e percentage or tne water cotumn taken up by vegetation wnen vegetation eXists Areas tnaldo not nave any vegetation are not taken into consideration rorlhts calculation.

BVw

B/ovolume (All warer): Relers to111e average percentage of tne water column taken up by vegetation regardless of wnelher vegetabon exists. In areas where no vegetation exists, a zero value IS entered Into 111e caltulabon thus reduCing the overall blovolume or111e entire area covered by tne survey

PAC

Percent *Area Covered:* Refers to tne overall surface area tnat has vegetation groWing

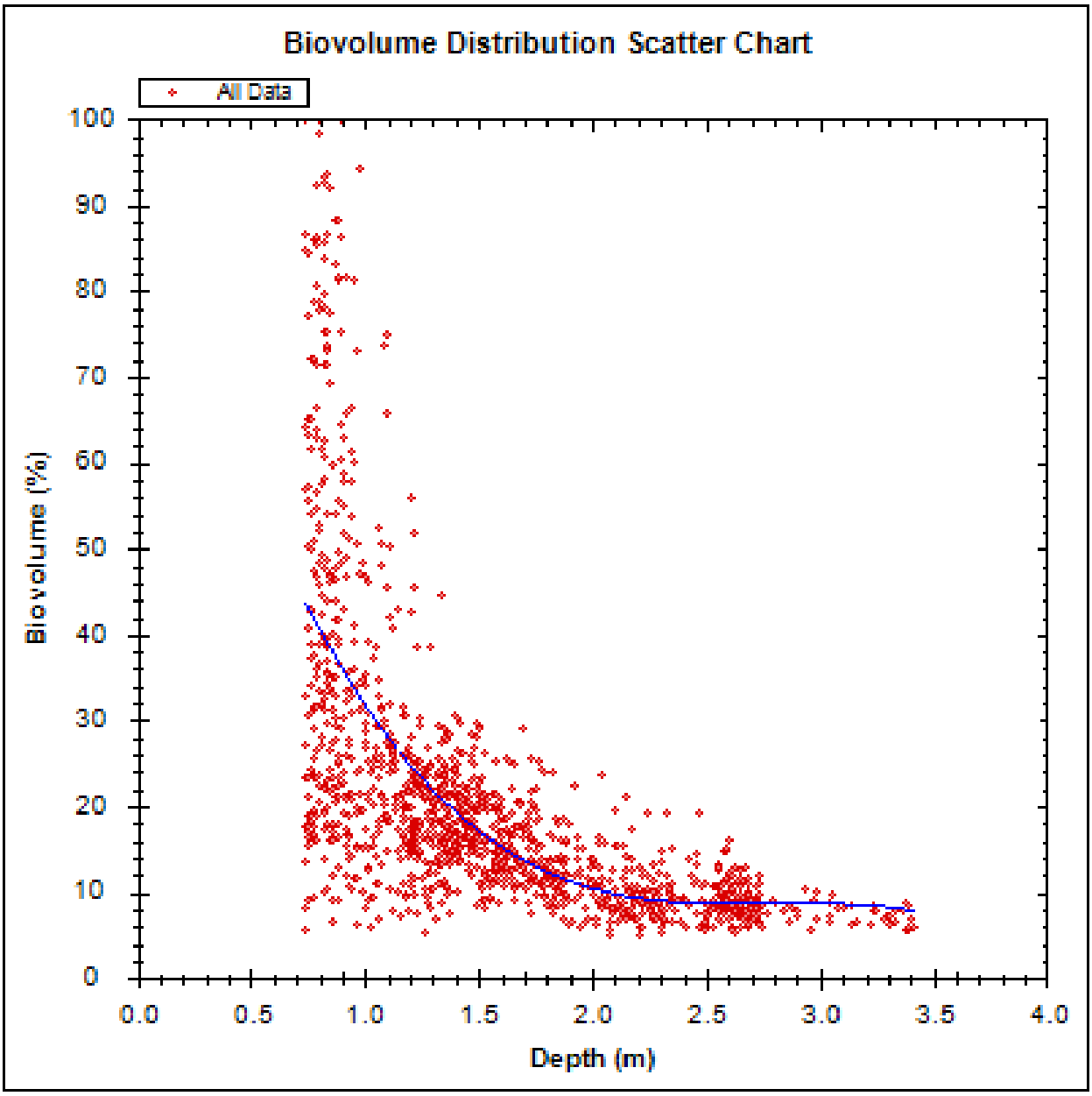
Grid

GeostatJSIJca *Interpolated Gnd:* Interpolated and even! ;, spaced values represenung krlged (smoothed) output or aggregated data pomts The gndded data IS most accurate summary olIndlvldual survey areas

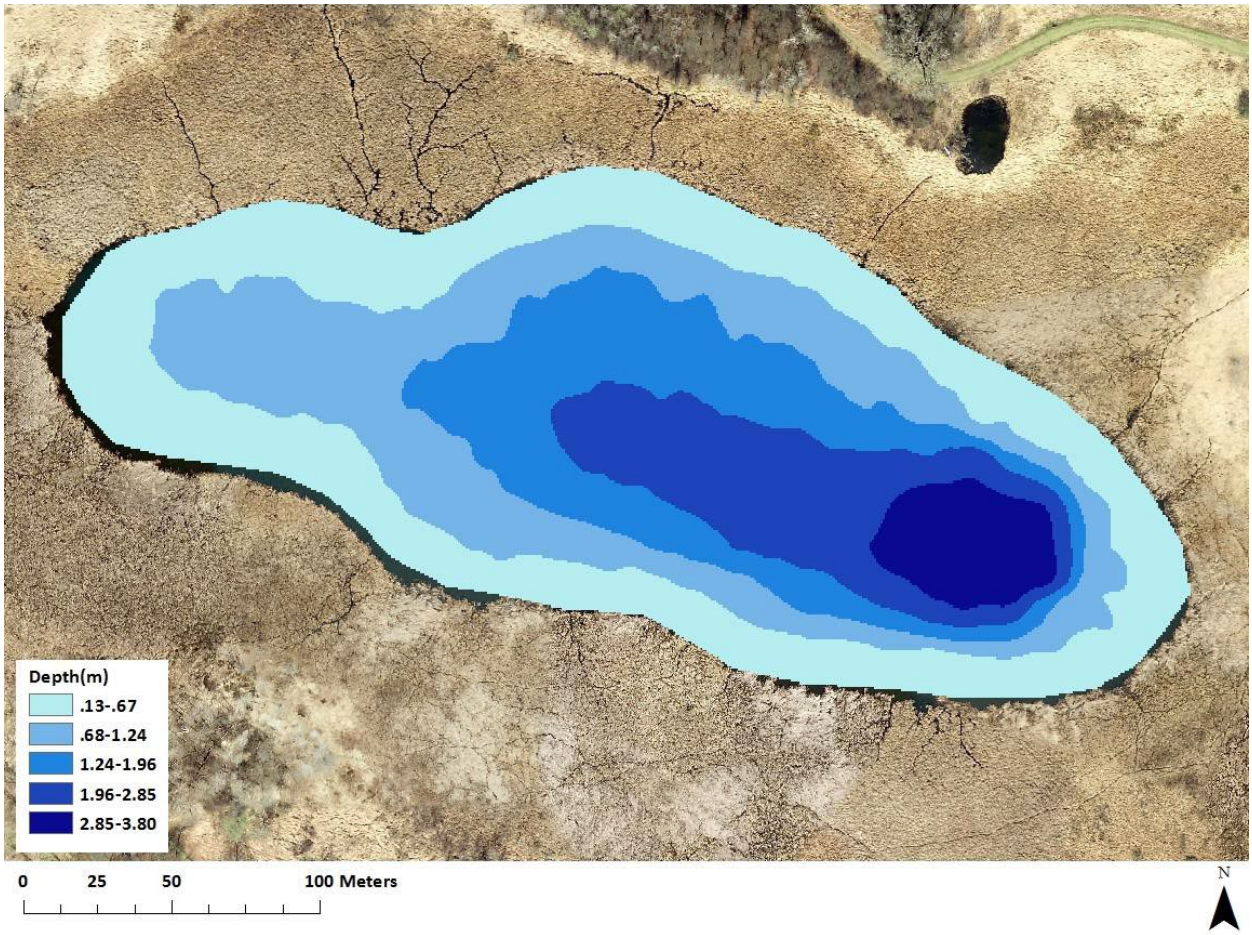
Point

Indrvidul Coordin re *Poinr:* As ingle point rtpresents a summary or sonar pings and the denved boUom and canopy depths IndiVldualpo10ldata create an trregulallly spaced dataset tnat *may* have overlaps and/or gaps 1n the data resuttlngrn a Increased potenball or error

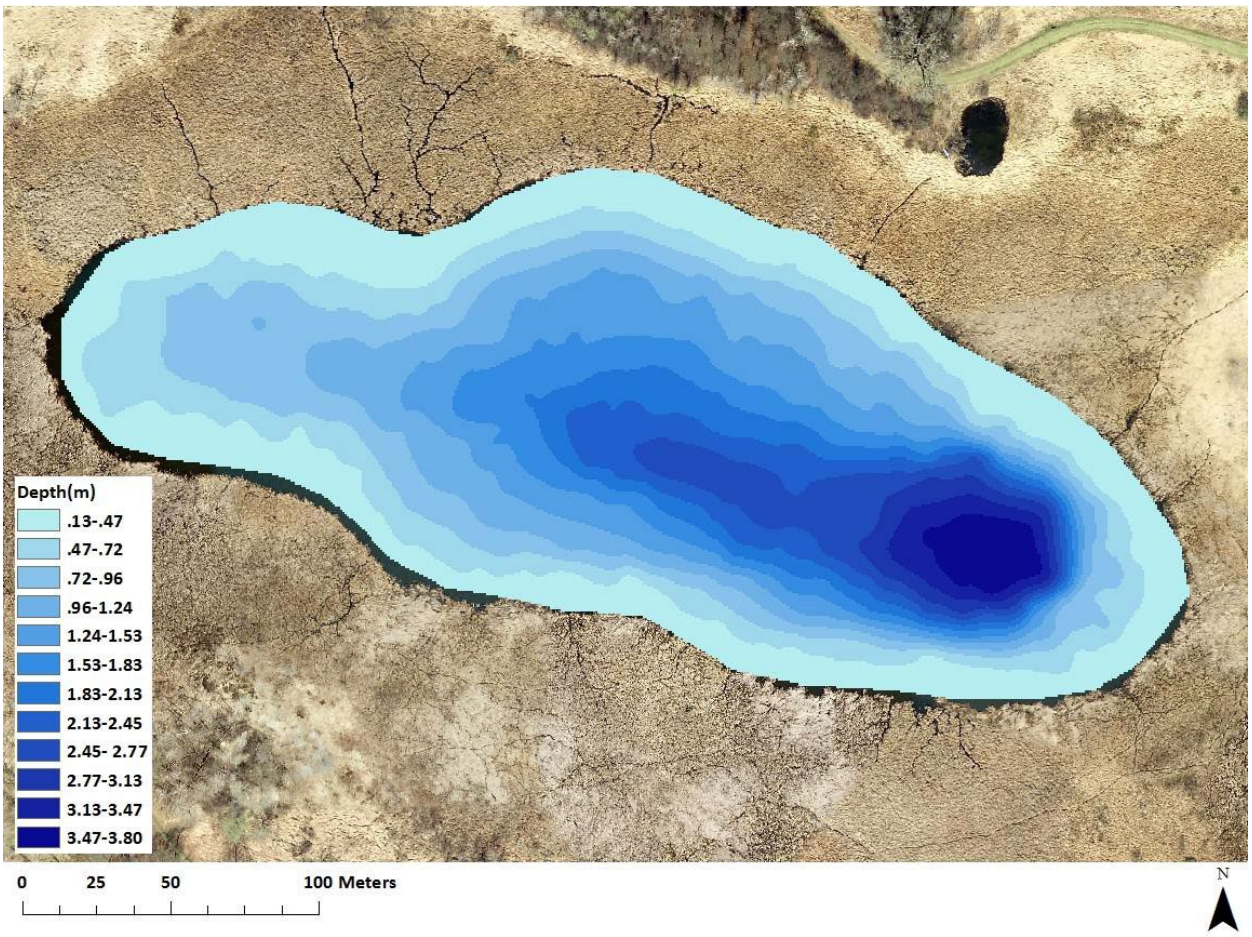
Addlhonal Inforlnahon


Biovolume Distribution Scatter Chart
All Data
Biovolume (%)
100
90
80
70
60
50
40
30
20
10
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Depth (m)

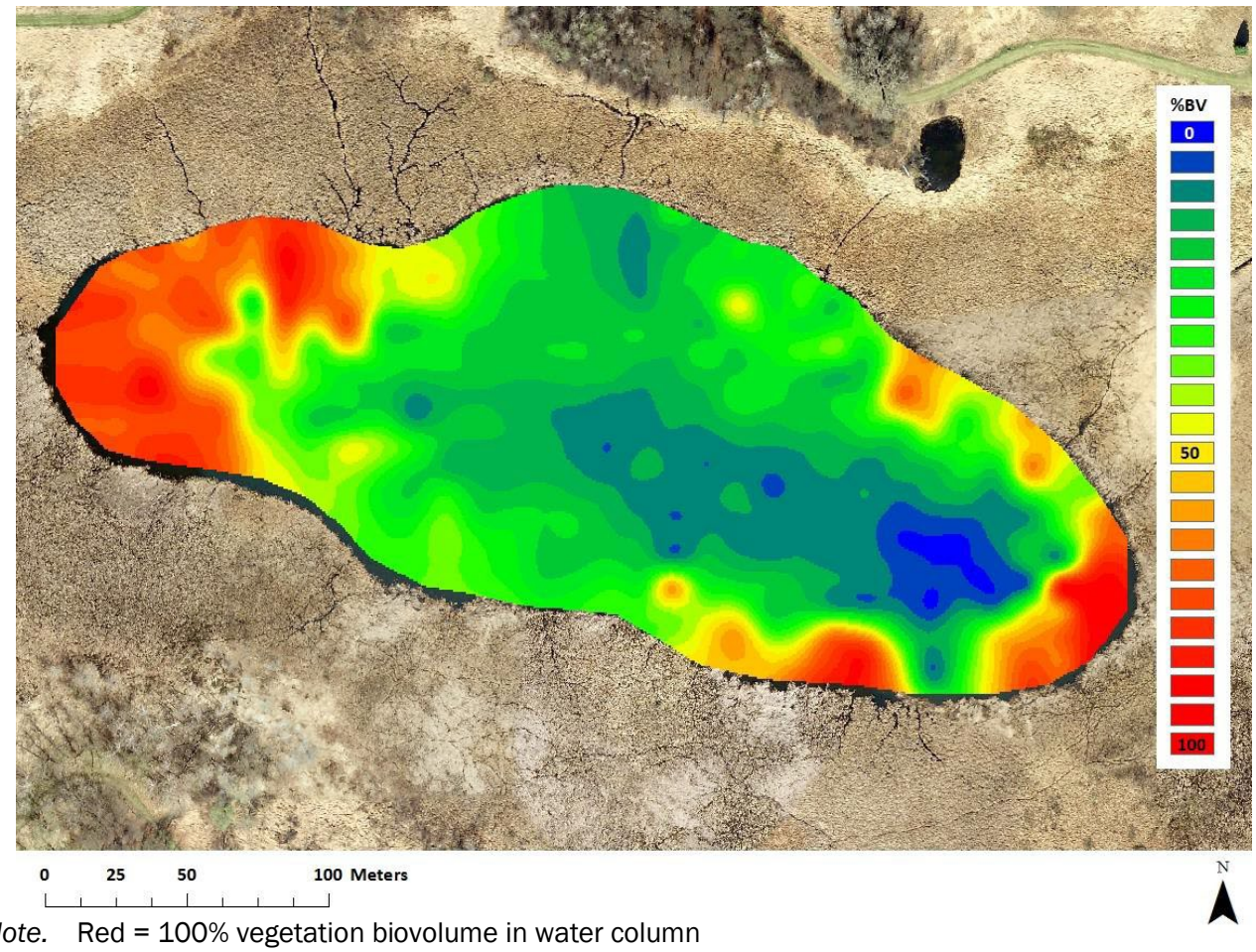
Black Lake Contour Map (3 foot intervals)



Black Lake Contour Map (1 foot intervals)

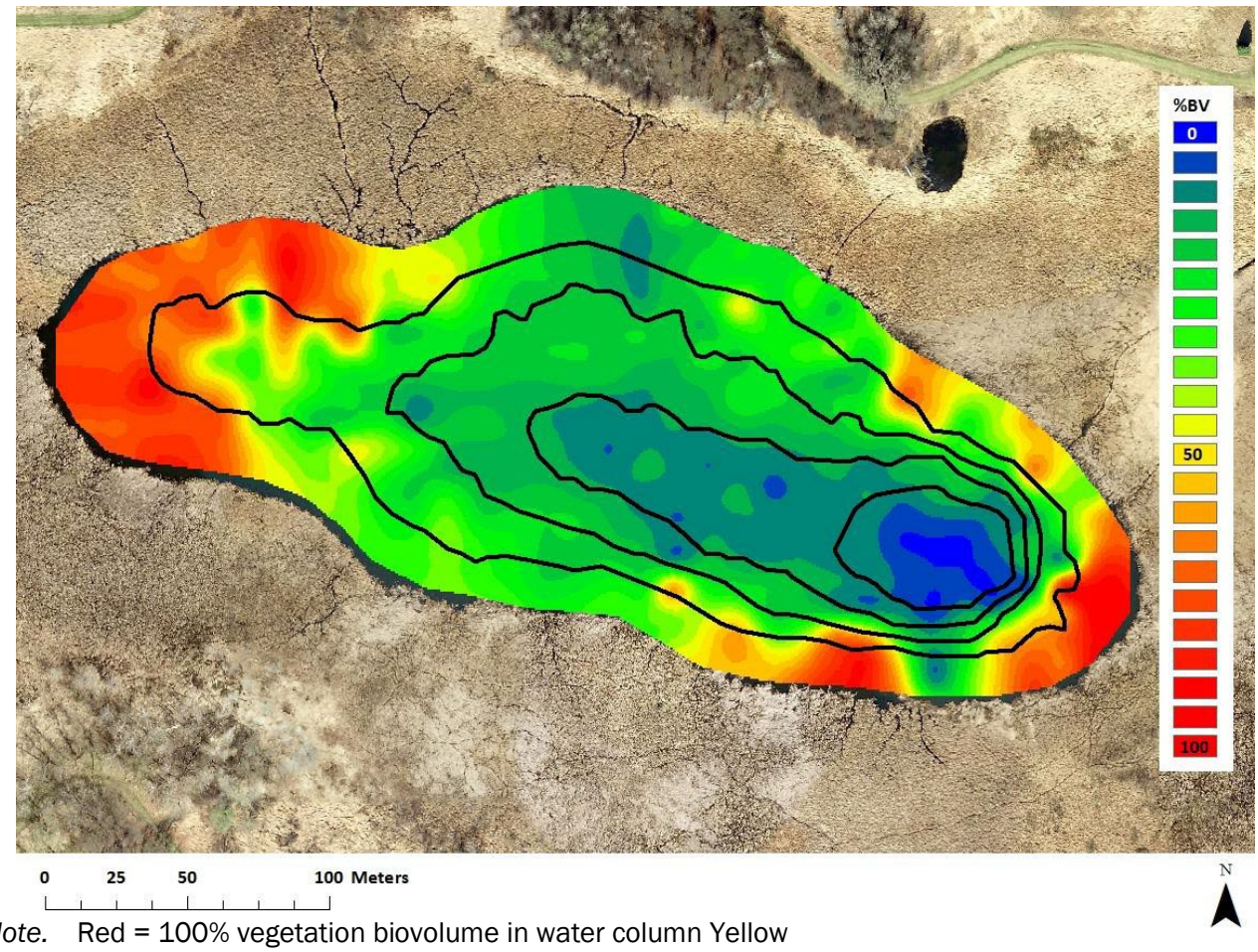


Black Lake Biovolume Map



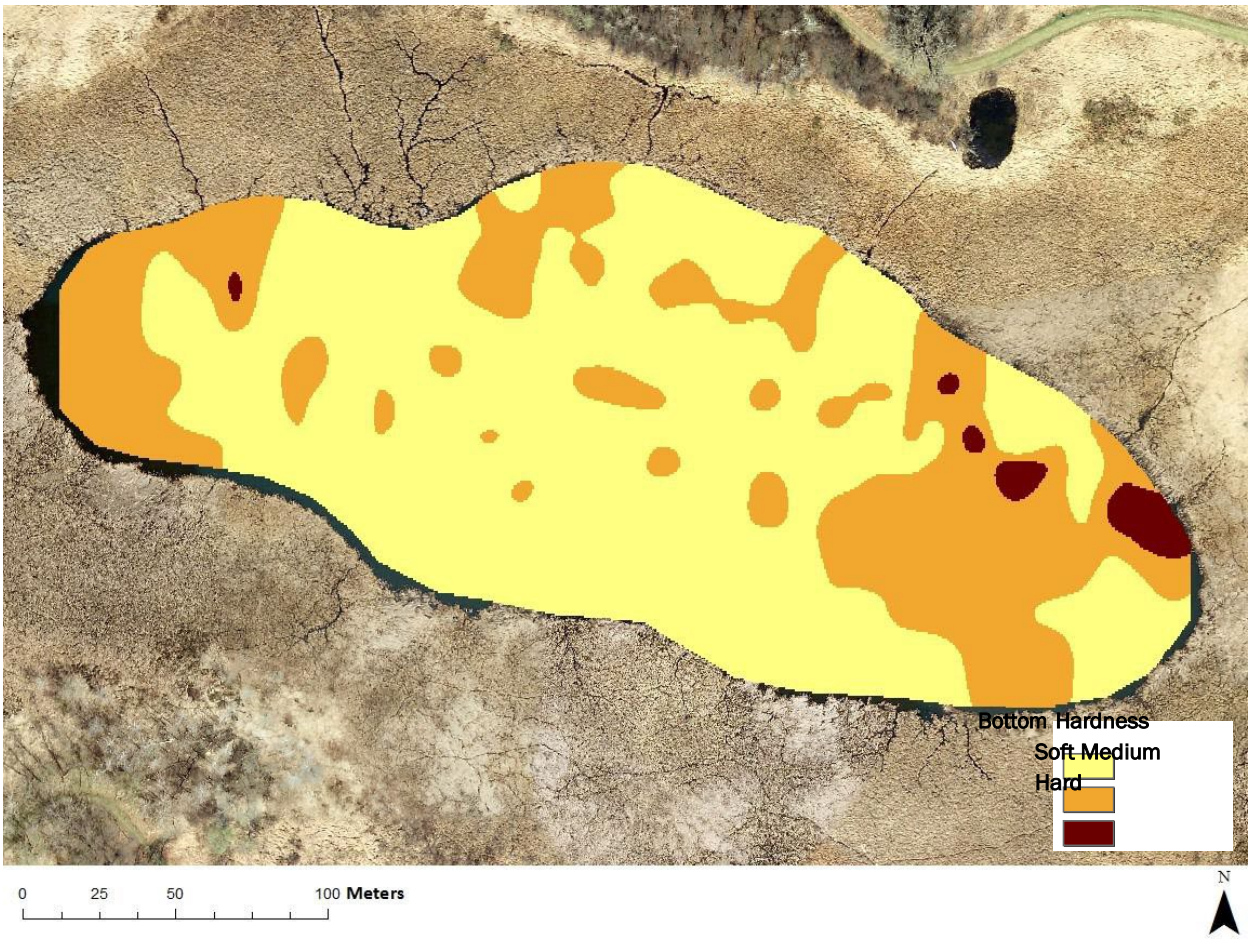
Note. Red = 100% vegetation biovolume in water column
Yellow = 50% vegetation biovolume in water column
Blue = 0% vegetation biovolume in water column

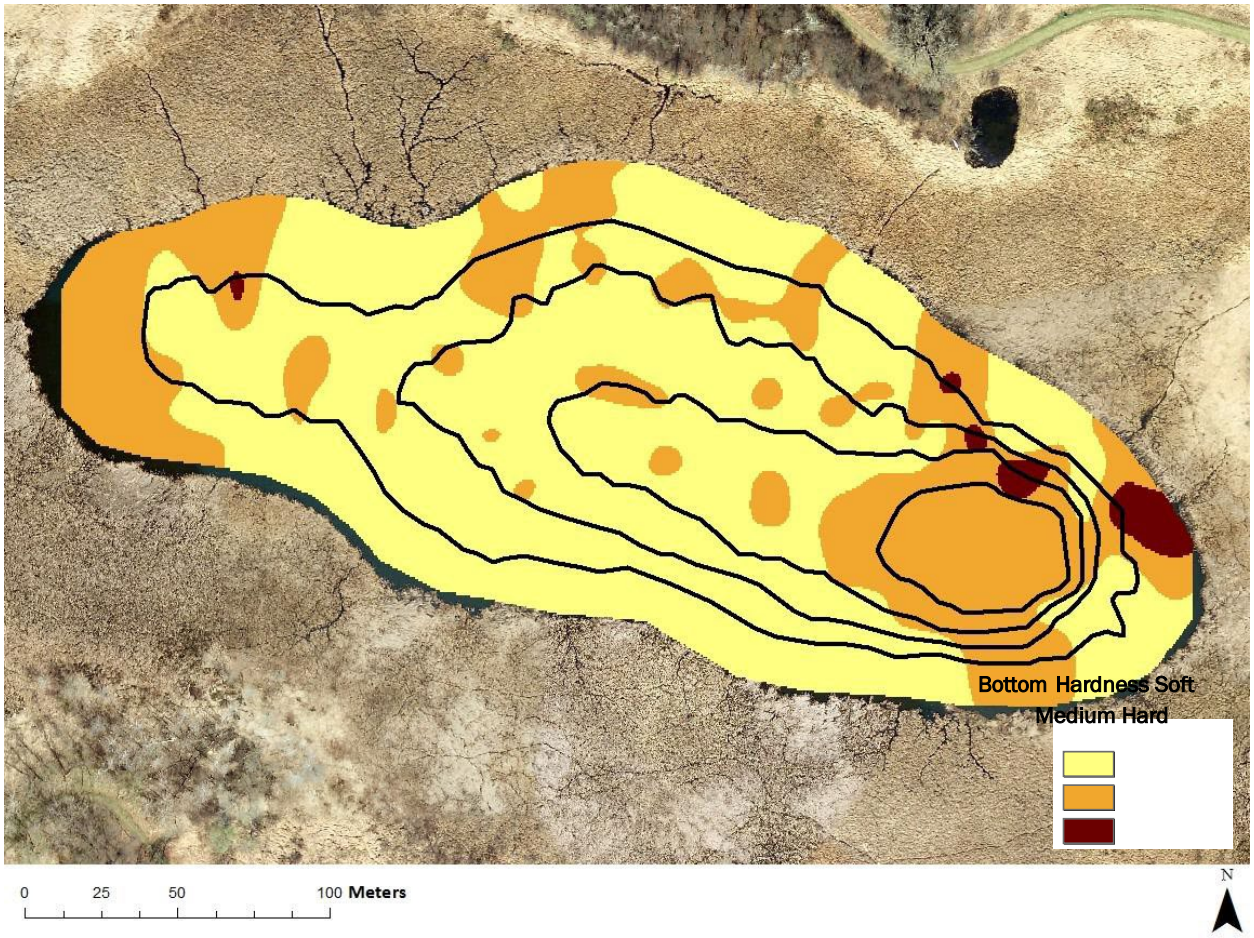
Black Lake Biovolume Map with 3ft Contours



Note. Red = 100% vegetation biovolume in water column Yellow = 50% vegetation biovolume in water column Blue = 0% vegetation biovolume in water column

Black Lake Bottom Hardness (Composition) Map




Bottom Hardness Soft
Medium Hard
0
25
50
100 Meters
N