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LAKE REDSTONE, SAUK COUNTY

2017-18 AQUATIC PLANT MANAGEMENT SUMMARY REPORT
WDNR WBIC: 1280400

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January 7, 2019

LAKE REDSTONE PROTECTION DISTRICT
LA VALLE, WI 53941

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2017-18 AQUATIC PLANT MANAGEMENT SUMMARY REPORT- LAKE REDSTONE

PREPARED FOR THE LAKE REDSTONE PROTECTION DISTRICT

INTRODUCTION

This report discusses aquatic plant management activities completed by the Lake Redstone Protection District (LRPD) and Lake Education and Planning Services (LEAPS) during the 2017 and 2018 season on Lake Redstone.

2017 SPRING EWM MANAGEMENT PLANNING

Based on summer point-intercept surveys completed by Aquatic Plant Habitat Services (APHS) in 2016 and discussions with the Lake Redstone Protection District (LRPD) and Lake Education and Planning Services (LEAPS), a proposal was made by the LRPD and a permit application submitted to the Wisconsin Department of Natural Resources (WDNR) to treat three areas on Lake Redstone totaling 1.76 acres (Table 1). The proposals for these three areas include the application of a liquid formulation of the active ingredient 2, 4-D (Shredder Amine 4) at 2.0 ppm in Hummingbird Bay (1.45 acres); and diquat (Tribune) at the maximum label rate on the other two areas in Woodpecker Bay (0.31 acres).

All three of these bays were surveyed in the summer of 2016, and were surveyed again in 2017 post-treatment, and will be surveyed again in 2018.

Table 1 - 2017 Early Season EWM Treatment Proposal

2017 Lake Redstone Modified Spring EWM Chemical Treatment Proposal (4/4/2017)													
Treatment Area Characteristics					Eurasian Watermilfoil — 2,4-D (DMA 4)			Eurasian Watermilfoil — Diquat (Reward)					
Treatment Site	Site Name	Acreage	Mean Depth (feet)	Volume (acre-feet)	Treatment a.i. ppm	Treatment application (gal)	Application rate (gal/ac-ft)	Treatment Rate (1.5 gal/acre)	Application rate (gal/ac-ft)	Max allowed diquat ion (2lbs/gallon)	Total diquat ion (mg) (Col.M x 453594)	Treatment a.i. ppm (Col.L/1233481.84)	Exceeds suggested DNR rate (0.37 ppm a.i.)
WP-17-1	Woodpecker Bay	0.11	3.00	0.33				0.17	0.50	1.00	453592.00	0.37	no
WP-17-2	Woodpecker Bay	0.20	3.00	0.60				0.30	0.50	1.00	453592.00	0.37	no
HB-17	Hummingbird Bay	1.45	3.22	4.67	2.0	6.6	1.42						
Total		*1.76*		*5.60*		*6.6*		*0.47*					
					EWM Treatment (1.45 acres); early spring application			EWM Treatment (0.31 acres); early spring application					
					DMA 4 (liquid) (EWM)					Reward (liquid Diquat)		0.25-0.5 gallons/acre-ft	
					Treated at 1.50 parts per million (1.07 gal/acre-ft, liqui								
					Treated at 2.00 parts per million (1.42 gal/acre-ft, liqui								
					Treated at 2.50 parts per million (1.78 gal/acre-ft, liqui								
					Treated at 3.00 parts per million (2.13 gal/acre-ft, liqui								

Figure 1 - 2017 EWM treatment areas

2017 EARLY SEASON EWM TREATMENT DETAILS

On May 8, 2017 Cason and Associates, the applicator retained by the LRPD completed the application of Shredder Amine 4 (2,4-D) and Tribune (diquat) to 1.75 acres in Hummingbird and Woodpecker Bays.

Following the 2017 early season herbicide application volunteers from the LRPD collected chemical concentration data for 2,4-D from two sites in Hummingbird Bay and at the outlet of Lake Redstone (Figure 2). No herbicide concentration testing was completed in the areas treated with diquat in Woodpecker Bay because the Wisconsin State Lab of Hygiene does not have the capability to run assays for diquat. Each site was sampled at seven different times after treatment: 3, 6, 9, 24, 36, 48 and 72 HAT (**H**ours **A**fter **T**reatment). Chemical concentration testing is used to determine the concentration reached in the treated areas and to determine how long the herbicide remains in contact with the target plant. In the 2017 early season treatment, the target concentration in Hummingbird Bay was 2000 ppb or 2.0 mg/l.

2017 Lake Redstone Chemical Concentration Monitoring Planning 2-14-2017 (LEAPS)										
Location	SITE_NAME	Lat	Long	3 HAT	6 HAT	9 HAT	24 HAT	36 HAT	48 HAT	72 HAT
Hummingbird Bay	In-Humbd17	43.612	-90.083	x	x	x	x	x	x	x
Hummingbird Bay	ML-Humbd17	43.613	-90.085	x	x	x	x	x	x	x
Oulet/Spillway	Outlet16	43.587	-90.087	x	x	x	x	x	x	x
				3	3	3	3	3	3	3
In - Bay Tip										21
Mid - Bay Middle										
ML - Main Lake Mouth										

Figure 2 - Chemical Concentration Testing Sites in Hummingbird Bay and the Outlet of Lake Redstone

The concentration of herbicide in Hummingbird Bay never reached the target concentration of 2000 ppb. At 3 HAT, the concentration in the inland site of the Bay reached nearly 1000 ppb but it steadily declined after that (Figure 3, Table 2). The herbicide did stick around for 24 HAT at about ¼ the expected concentration. The middle site in the bay showed a concentration of only a 1/3 of the expected dose at its highest point. At the outlet of the lake, very low levels of 2,4-D were documented in the first day, but by 24 HAT, it was not detected at all.

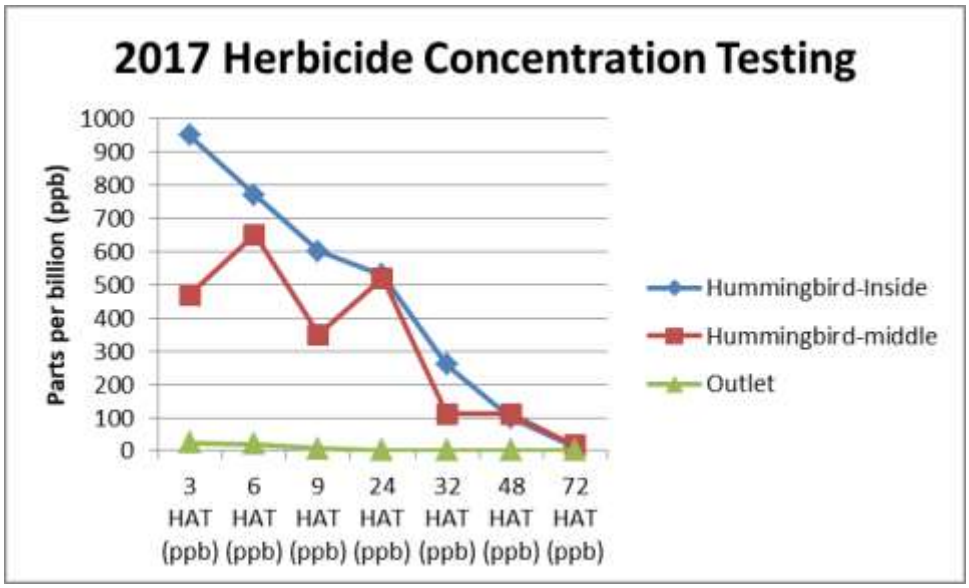


Figure 3 - 2017 Lake Redstone Concentration Testing Results

Table 2 - 2017 Concentration Testing Results

2017 Lake Redstone Chemical Concentration Monitoring Resuolts (LEAPS)										
Location	**SITE_NAME**	**Lat**	**Long**	**3 HAT (ppb)**	**6 HAT (ppb)**	**9 HAT (ppb)**	**24 HAT (ppb)**	**32 HAT (ppb)**	**48 HAT (ppb)**	**72 HAT (ppb)**
Hummingbird Bay	In-Humbd17	43.612	-90.083	950	770	600	530	260	100	9.9
Hummingbird Bay	ML-Humbd17	43.613	-90.085	470	650	350	520	110	110	16.1
Oulet/Spillway	Outlet16	43.587	-90.087	23	21	6.5	ND	ND	ND	ND
	In - Bay Tip									
	Mid - Bay Middle									
	ML - Main Lake Mouth									

The results of 2017 herbicide concentration testing suggest that a higher concentration of herbicide containing 2,4-D was needed to reach the target 2000 ppb, and keep it at that level for at least 24 hours. Hummingbird Bay is a very small bay (less than 1.5 acres) and it appears that the herbicide applied left the bay shortly after being applied. Given the size of the bay and the amount of herbicide used during the treatment, once the herbicide left the bay, it dissipated rather quickly, although it did reach the outlet, albeit, at a very low concentration.

As will be discussed in a later section of this summary, the effectiveness of the Hummingbird Bay treatment was less than what was expected. Future chemical treatments in Hummingbird bay will need to consider a higher initial concentration.

Based on 2017 summer plant survey work, the use of diquat was ineffective in Woodpecker Bay.

The LRPD partnered with APHS to complete an aquatic plant survey of thirteen bays on Lake Redstone in September 2017 (Table 3, Figure 4). Several bays were surveyed for the first time including Killdeer, Warbler, Mockingbird, Eagle, and Quail. Chickadee South, Cardinal, and Oriole Bays were chemically treated in 2016 so survey work in 2017 was considered post-summer work. Hummingbird and Woodpecker Bays were surveyed as a result of chemical treatment in 2017. Martin-Meadowlark, Swallow, and Mourning Dove were surveyed in preparation for possible treatment in 2018.

Table 3 - 2017 Summer PI Surveys on Lake Redstone

2017 Lake Redstone Proposed Summer PI Surveys, North to South (02/01/2017)					
Treatment Site	**Name of Bay**	**Acreage**	**# of PI Points**	**Last Treated**	**NOTES**
KD-SS-17	Killdeer	3.00	TBE	NT	PrePI
MM-SS-17	Martin-Meadowlark	3.00	54	2015	PrePI
WB-SS-17	Warbler	1.60	TBE	NT	PrePI
MB-SS-17	Mockingbird	0.50	TBE	NT	PrePI
WP-SS-17	Woodpecker	4.60	83	2017	ActivePI
SW-SS-17	Swallow	3.80	72	2015	PrePI
HB-SS-17	Hummingbird	1.70	59	2017	ActivePI
CHS-SS-17	Chickadee South	4.10	56	2016	PostPI
EG-SS-17	Eagle	9.70	TBE	NT	PrePI
QL-SS-17	Quail	3.50	TBE	NT	PrePI
MD-SS-17	Mourning Dove	12.90	122	2013	PrePI
CD-SS-17	Cardinal	2.10	67	2016	PostPI
OR-SS-17	Oriole	8.90	68	2016	PostPI
TOTAL		*59.40*			

Included in 2017 Spring Treatment

PrePI - PI survey to set up possible spring treatment in the following year

ActivePI - PI survey of bays treated in this current year

PostPI - PI survey of bays treated in the previous year

NT - Never has been treated

TBE - To be established

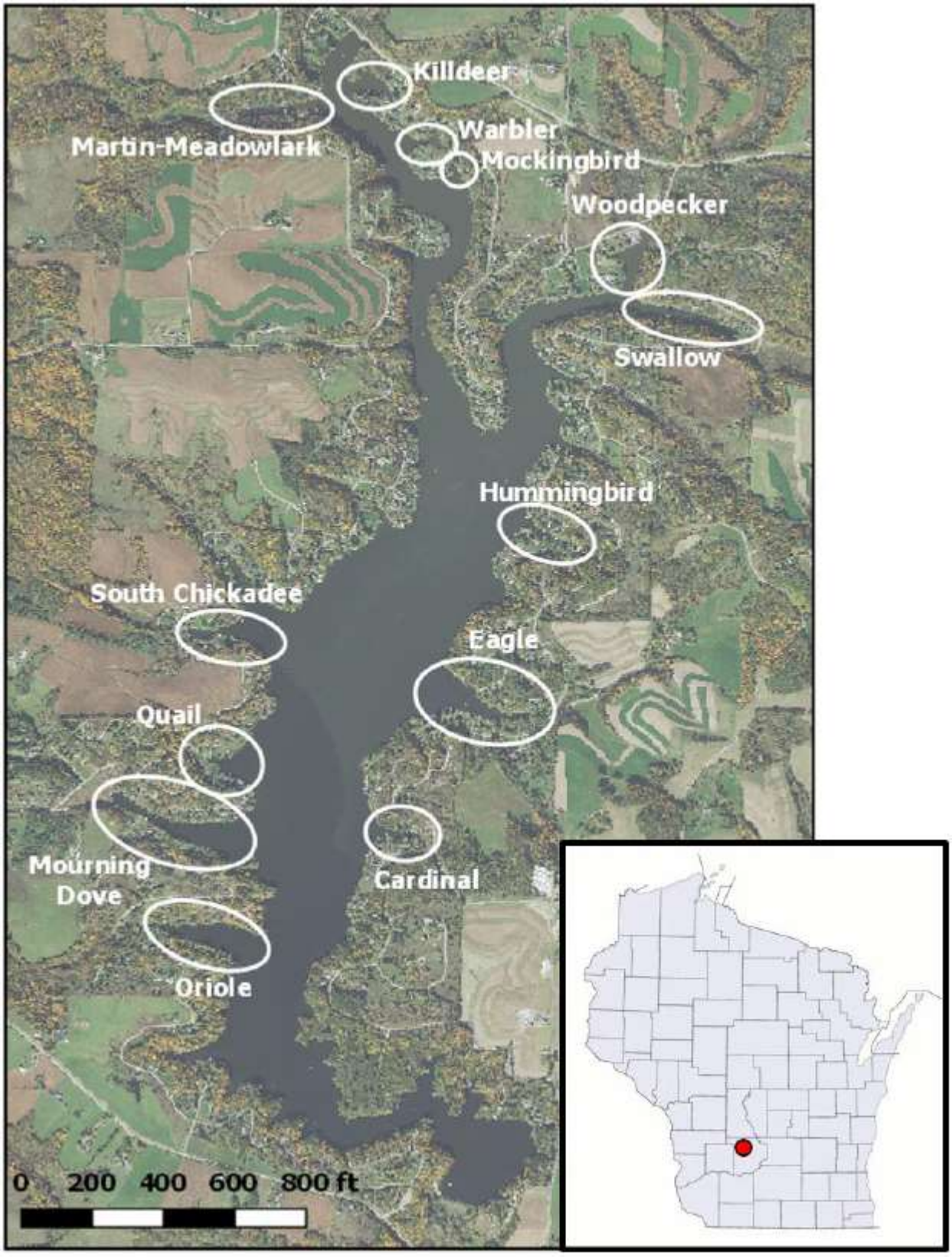


Figure 4 – 2017 Summer PI Survey Bays

Field methods followed the standardized protocol developed by the Wisconsin Department of Natural Resources (WDNR) in Hauxwell et. al (2010) and the surveys were completed on September 8&9, 2017. The WDNR generated a point-intercept map for all thirteen of the lakes and Aquatic Plant Habitat Services (APHS) recorded individual plant survey data at each point within each bay (Table 4).

Table 4 - Summary PI Statistics for All 13 Bays Surveyed in 2017 (APHS, 2017)

Bay & Year		1	2	3	4	5	6				7		8	
							Average # of species per site				Species Richness			
		Total # sites visited	Total # sites w/ vegetation	Max. depth of plants	Total # sites shallower than max. depth of plants	Littoral frequency**	a) Shallower than max. depth	b) Vegetated sites only	c) Native shallower than max. depth	d) Native at veg. sites only	a) Total # species on rake at all sites	b) Including visuals	Simpson's Diversity Index	Littoral frequency of EWM
Martin-Meadowlark	2014	52	45	4	52	86.54	2.25	2.6	1.81	2.41	7	9	0.8	42
	2015	54	30	3	50	60.00	1.12	1.87	1.12	1.87	7	8	0.75	**0**
	2016	54	50	4	54	92.59	2.63	2.84	2.41	2.83	8	9	0.83	22
	2017	55	37	3	48	77.08	1.54	2.00	1.31	1.80	6	6	0.79	23
Swallow	2014	70	43	4	64	67.19	1.36	2.02	0.83	1.56	7	7	0.69	52
	2015	71	37	5	71	52.10	0.72	1.38	0.69	1.32	8	10	0.66	**1**
	2016	72	44	4	65	67.69	1.23	1.82	1.09	1.65	7	7	0.70	9
	2017	72	40	4	66	60.61	1.30	2.15	0.98	1.76	8	8	0.78	29
Cardinal	2015	67	33	7	46	71.74	1.15	1.61	0.85	1.39	7	8	0.74	30
	2016	65	39	6	45	86.67	1.73	2.00	1.42	1.83	9	11	0.83	**31**
	2017	66	35	7	46	76.09	1.61	2.11	1.11	1.65	8	9	0.76	50
Chickadee* (South Arm)	2015	55	7	3	11	63.64	1.00	1.57	0.45	1.25	4	5	0.61	55
	2016	56	7	5	28	25.00	0.46	1.86	0.36	1.43	6	7	0.71	**11**
	2017	56	11	5.5	36	30.56	0.53	1.73	0.25	1.13	3	4	0.54	28
Oriole	2015	68	26	9	48	54.17	0.90	1.65	0.63	1.36	5	5	0.70	27
	2016	62	28	7	44	63.64	0.91	1.43	0.77	1.26	6	6	0.69	**14**
	2017	56	22	9.5	46	47.83	0.76	1.59	0.52	1.09	5	6	0.57	24
Eagle	2014	105	16	6.5	55	29.09	0.56	1.94	0.38	1.40	7	7	0.76	15
	2017	100	14	5	40	35.00	0.58	1.64	0.28	1.10	4	7	0.57	30
Hummingbird	2016	59	34	6	59	57.63	0.93	1.62	0.58	1.21	7	9	0.66	36
	2017	63	32	6	63	50.79	0.81	1.59	0.52	1.27	7	8	0.65	**29**
Mourning Dove	2016	122	59	7.5	89	66.29	1.04	1.58	0.88	1.39	9	10	0.68	17
	2017	122	56	6.5	78	71.79	1.19	1.66	0.88	1.28	8	9	0.62	31
Woodpecker	2016	83	22	4.5	77	28.57	0.77	2.68	0.68	2.36	7	8	0.82	9
	2017	85	15	4	70	21.43	0.39	1.80	0.29	1.43	4	4	0.68	**10**
Warbler	2017	62	9	3	18	50.00	0.78	1.56	0.33	1.50	4	7	0.58	44
Killdeer	2017	62	5	3	10	50.00	1.00	2.00	0.60	2.00	4	4	0.72	40
Mockingbird	2017	35	15	5	35	42.86	0.71	1.67	0.63	1.47	7	8	0.74	6
Quail	2017	75	23	8.5	67	34.33	0.64	1.87	0.42	1.27	5	6	0.67	22

**All data are for South Arm of Chickadee Bay only.*

***Also known as the "frequency of occurrence at sites shallower than the maximum rooting depth of plants"*

Herbicide treatment occurred during years when littoral frequency of EWM is red.

SUMMER PI SURVEY RESULTS FOR BAYS TREATED IN 2017

One of the first uses of summer PI data is to determine the impacts of chemical treatment in the year of the survey on the target (EWM) and non-target (native) aquatic plants. In 2017, three areas in two bays were chemically treated: Hummingbird Bay and two areas in Woodpecker Bay (Figure 1).

HUMMINGBIRD BAY (TREATED IN 2017)

The first PI survey of Hummingbird bay was completed in 2016 and identified EWM at 24 out of 65 points included in the survey. In 2017 after an early season chemical treatment, EWM was identified at 35 points out of 65 included in the survey. Points with EWM included actual on-rake points and visual sightings at points. In both 2016 and 2017, EWM was the second most common aquatic plant in the bay. Coontail was the most common plant in both years. The frequency of occurrence of EWM in 2016 was 38.18%, and just slightly but not significantly less in 2017 at 35.29%. This is not what the expected outcome for chemical treatment in 2017 was. It was expected that EWM in Hummingbird bay would be significantly reduced after treatment. This did not happen, suggesting that the concentration of herbicide used (2000 ppb) was not sufficient to provide even seasonal control of EWM in the bay, much less extended results.

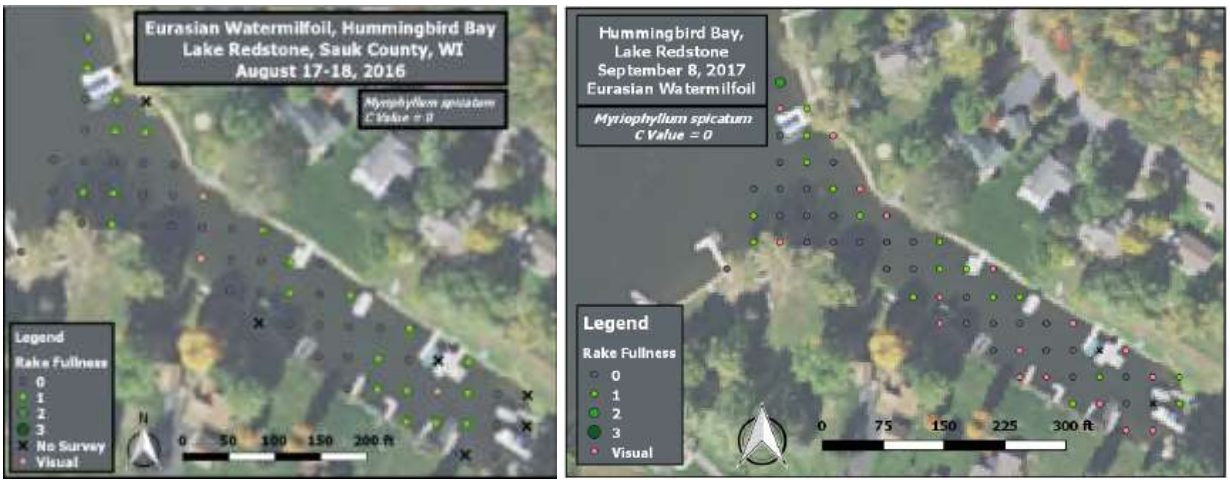


Figure 5 – 2016 and 2017 EWM in Hummingbird bay (APHS, 2016 & 2017)

Native aquatic plant differences in Hummingbird Bay from 2016 to 2017 were not statistically significant. The number of different plant species, the number of points with vegetation, the number of different plants per point, and the general rake density per point had minor, not-significant changes from 2016 to 2017.

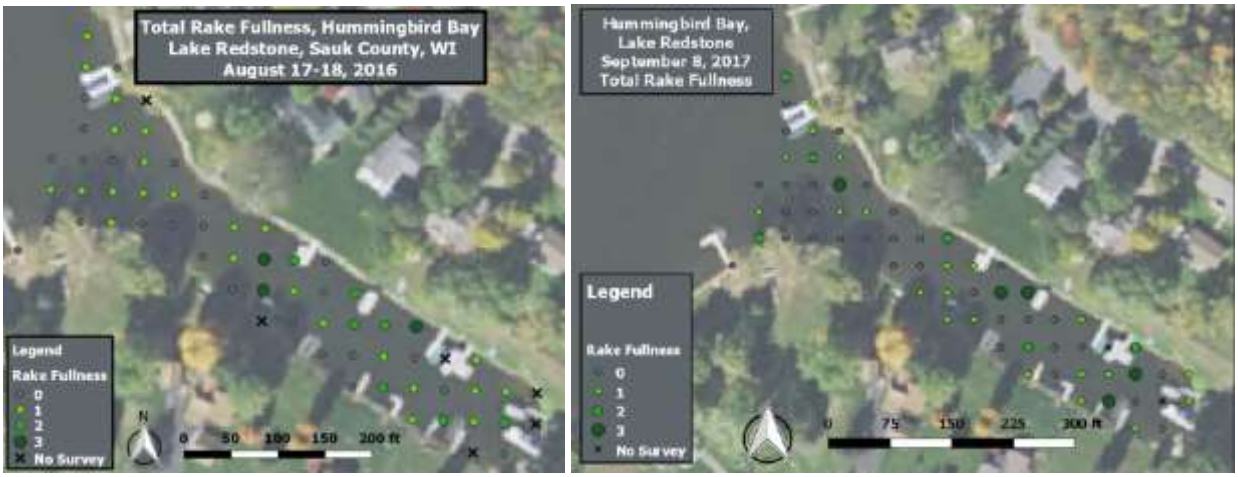


Figure 6 – 2016 and 2017 Total Rake Fullness in Hummingbird Bay (APHS, 2016 & 2017)

WOODPECKER BAY (TREATED IN 2017)

The first summer PI survey in 2016 identified 8 sites with EWM and a relative frequency in the bay of 11.86% (Figure 6). In 2017, after a spring treatment of two small spots near the boat landing, the summer PI survey identified 16 sites with EWM and a relative frequency of 26% (Figure 6). In both 2016 and 2017, EWM was the third most common plant in Woodpecker Bay. While the amount of EWM identified in 2017 is greater than what was found in 2016, it is not considered a significant difference, probably based on the fact that EWM was only found on the rake at 7 points in each year. The number of visual sightings increased from 1 in 2016 to 9 in 2017.

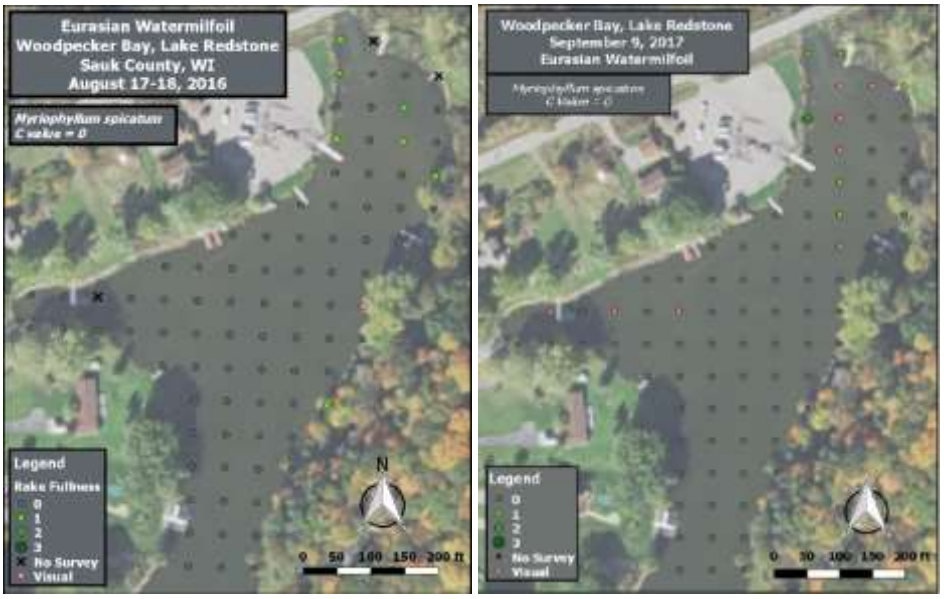


Figure 7 - 2016 and 2017 EWM in Woodpecker Bay (APHS, 2016 & 2017)

Native aquatic plants statistics declined in 2017 from what was determined in 2016. Only 4 different species of plants were found in 2017 compared to 8 in 2016. The number of points with vegetation, the number of different plants per point, and the general rake density per point were all down in 2017 when compared to 2016. While it cannot be stated definitively that these declines were the result of the chemical treatment, chemical treatment could have contributed.

Two areas in Woodpecker Bay were chemically treated in 2017: one on the east shore across from the landing and one on the west shore between the boat landing and the bridge to the north (Figure 1). In the treatment area on the east shore, there was an absence of aquatic plants during the September PI Survey (Figure 7). Aquatic plant density appears to be less in the west shore treatment area, although there is still vegetation present.

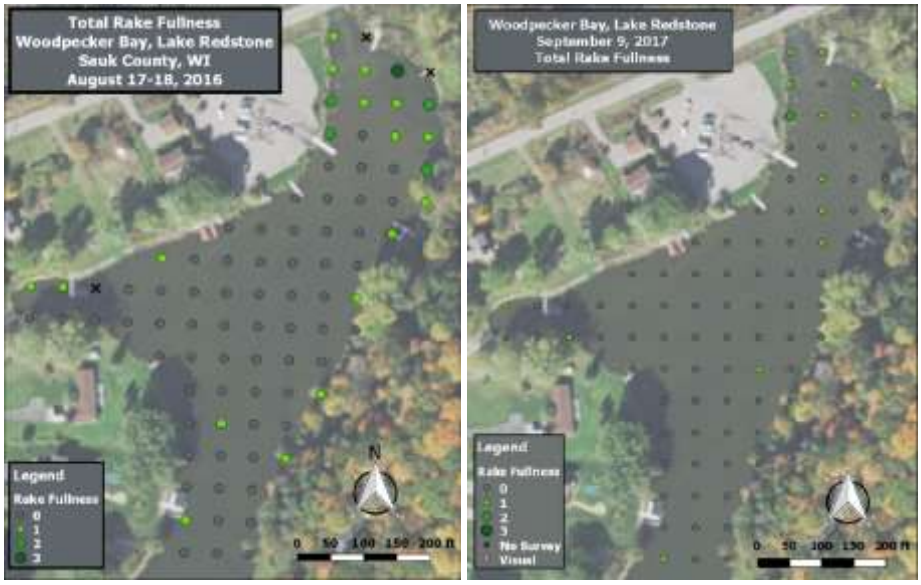


Figure 8 - 2016 and 2017 Total Rake Fullness in Woodpecker Bay (APHS, 2016 & 2017)

SUMMER PI SURVEY RESULTS FROM OTHER BAYS

Summer PI surveys are used to do other things than just compare changes in bays that have been chemically treated in the same year the survey takes place. Summer PI surveys are also used to help determine changes in bays that were treated in the year prior to the year of the survey. PI survey data from the year prior to treatment, the year of treatment, and the year after treatment can help determine longer term treatment impacts on EWM and native plants.

Summer PI surveys are also used to determine if a first time bay or a bay that was treated 2 or more years ago should be considered for chemical treatment based on the littoral frequency of EWM during the survey.

CARDINAL BAY (TREATED IN 2016)

In 2016, diquat was used to chemically treat 1.3 acres of EWM in Cardinal Bay. EWM was the second-most common plant in each of the three years of summer PI survey data (2015-2017). Table 5 compares basic EWM numbers from each year of the surveys. The numbers in red reflect the year EWM was chemically treated. It appears that the year of treatment was effective in reducing the amount of EWM in the bay, but the results did not last into a second year as survey numbers in the year after treatment are as high or higher than they were in the year prior to treatment.

Table 5 - 2015-17 Summer PI Survey EWM Results for Cardinal Bay (APHS, 2015, 2016, & 2017)

Cardinal Bay	# of Species	Most Common	Rake Sites (EWM)	Visual Sites (EWM)	Total Sites (EWM)	Rake Density (EWM)	Littoral Frequency (EWM)
2015	8	2nd	14	7	21	1.43	30.43
2016	10	2nd	14	5	19	1	31.11
2017	9	2nd	23	14	37	1.22	50

CHICKADEE BAY (TREATED IN 2016)

In 2016, 2,4-D at a concentration of 2.0 ppm was used to chemically treat 3.3 acres of EWM in Chickadee Bay South. EWM was the most common plant in the year prior to and the year after chemical treatment, but only the 2nd most common in the year of treatment. Table 6 compares basic EWM numbers from each year of the surveys. The numbers in red reflect the year EWM was chemically treated. It appears that the year of treatment was effective in reducing the amount of EWM in the bay, but like Cardinal Bay, the results did not last into a second year as survey numbers in the year after treatment are as high or higher than they were in the year prior to treatment.

Table 6 - 2015-17 Summer PI Survey EWM Results for Chickadee Bay South (APHS, 2015, 2016, & 2017)

Chickadee South	# of Species	Most Common	Rake Sites (EWM)	Visual Sites (EWM)	Total Sites (EWM)	Rake Density (EWM)	Littoral Frequency (EWM)
2015	6	1st	11	4	15	1.09	34.38
2016	6	2nd	3	0	3	1.33	10.71
2017	4	1st	10	2	12	1.4	27.78

ORIOLE BAY (TREATED IN 2016)

In 2016, 2,4-D at a concentration of 2.0 ppm was used to chemically treat 7.2 acres of EWM in Oriole Bay. EWM was the 2nd most common plant in each year of the surveys, including the treatment year. Table 7 compares basic EWM numbers from each year of the surveys. The numbers in red reflect the year EWM was chemically treated. It appears that the year of treatment was effective in reducing the amount of EWM in the bay, but like the other two bays treated in 2016, the results did not last into a second year as survey numbers in the year after treatment are as high or higher than they were in the year prior to treatment.

Table 7 - 2015-17 Summer PI Survey EWM Results for Oriole Bay (APHS, 2015, 2016, & 2017)

Oriole Bay	# of Species	Most Common	Rake Sites (EWM)	Visual Sites (EWM)	Total Sites (EWM)	Rake Density (EWM)	Littoral Frequency (EWM)
2015	5	2nd	13	5	18	1	27.08
2016	6	2nd	6	7	13	1	13.64
2017	6	2nd	11	5	16	1.27	23.91

EAGLE, KILLDEER, MOCKINGBIRD, QUAIL, AND WARBLER BAYS (FIRST TIME BAYS)

Each of these bays were surveyed for the first time in 2017 based on comments made by the LRPD constituency, LRPD Board, and the Cason and Associates Fall EWM Survey. Tables 8-12 reflect the amount of EWM identified in each of these bays during the 2017 survey. An informal statistic that might be used to determine whether a new bay should be considered for chemical management of EWM might be the littoral frequency. The average littoral frequency of all bays that have been treated since 2015 is about 40%. The minimal littoral frequency when a chemical treatment was completed was 27%. Under this scenario, Eagle, Killdeer, and Warbler bays could be considered for chemical treatment in 2018. If using the 40% threshold, then only Killdeer and Warbler bays would be considered.

Table 8 – 2017 Summer PI Survey EWM Results – Eagle Bay (APHS, 2017)

Eagle Bay	# of Species	Most Common	Rake Sites (EWM)	Visual Sites (EWM)	Total Sites (EWM)	Rake Density (EWM)	Littoral Frequency (EWM)
2017	7	1st	12	15	27	1	30

Table 9 - 2017 Summer PI Survey EWM Results – Killdeer Bay

Killdeer Bay	# of Species	Most Common	Rake Sites (EWM)	Visual Sites (EWM)	Total Sites (EWM)	Rake Density (EWM)	Littoral Frequency (EWM)
2017	4	1st	4	5	9	1	40

Table 10 - 2017 Summer PI Survey EWM Results – Mockingbird Bay

Mockingbird Bay	# of Species	Most Common	Rake Sites (EWM)	Visual Sites (EWM)	Total Sites (EWM)	Rake Density (EWM)	Littoral Frequency (EWM)
2017	8	3rd	2	8	10	1	5.71

Table 11 - 2017 Summer PI Survey EWM Results – Quail Bay

Quail Bay	# of Species	Most Common	Rake Sites (EWM)	Visual Sites (EWM)	Total Sites (EWM)	Rake Density (EWM)	Littoral Frequency (EWM)
2017	6	2nd	15	12	27	1.2	22.39

Table 12 - 2017 Summer PI Survey EWM Results – Warbler Bay

Warbler Bay	# of Species	Most Common	Rake Sites (EWM)	Visual Sites (EWM)	Total Sites (EWM)	Rake Density (EWM)	Relative Frequency (EWM)
2017	7	1st	8	5	13	1	44.44

MARTIN-MEADOWLARK (TREATED IN 2015)

Last chemically treated in 2015, Martin-Meadowlark Bay is an example of a successful chemical treatment that lasted more than one season. PI plant survey work in both 2016 and 2017 indicates that the level of EWM has still not reached a level high enough to consider chemical treatment (Table 13). Although it has continued to recover since it was mostly wiped out in 2015, it remains only the 5th most common aquatic plant species in the bay. Under either threshold (27% or 40% littoral frequency), Martin-Meadowlark Bay would not be considered for chemical treatment in 2018.

Table 13 – 2015-2017 Summer PI Survey EWM Results – Martin-Meadowlark Bay

Martin-Meadowlark Bay	# of Species	Most Common	Rake Sites (EWM)	Visual Sites (EWM)	Total Sites (EWM)	Rake Density (EWM)	Littoral Frequency (EWM)
2015	8	NA	0	0	0	NA	NA
2016	8	6th	12	7	19	1	22.22
2017	6	5th	11	19	30	1.09	22.92

MOURNING DOVE (TREATED IN 2013)

Mourning Dove Bay was last treated in 2013, and remains another example of a successful chemical treatment with multiple years of relief. Mourning Dove Bay did not have a summer PI survey completed in 2015, but did in both 2016 and 2017. The amount of EWM in the bay has increased over the last two years (Table 14) to the point where the level is above the 27% threshold, but below the 40% threshold. With this in mind, Mourning Dove Bay should be considered for chemical treatment in 2018, 5 years after it was last chemically treated.

Table 14 – 2016-2017 Summer PI Survey EWM Results – Mourning Dove Bay

Mourning Dove Bay	# of Species	Most Common	Rake Sites (EWM)	Visual Sites (EWM)	Total Sites (EWM)	Rake Density (EWM)	Littoral Frequency (EWM)
2016	9	2nd	15	6	21	1.07	16.85
2017	9	2nd	24	13	37	1.33	30.77

SWALLOW BAY (TREATED IN 2015)

Last chemically treated in 2015, Swallow Bay is another example of a successful chemical treatment that lasted more than one season, although not as successful as Martin-Meadowlark and Mourning Dove Bays given that EWM in 2017, only two years after the last treatment, has returned to a level where it once again should be considered for chemical treatment in 2018. It exceeds the 27% threshold, but does not exceed the 40%

threshold. EWM in this bay appears to be expanding more rapidly than in other bays, as it went from only 16 sites in 2016 with a littoral frequency of 9.23 to 46 points and a littoral frequency of 28.79 in 2017.

Table 15 – 2015-2017 Summer PI Survey EWM Results – Swallow Bay

Swallow Bay	# of Species	Most Common	Rake Sites (EWM)	Visual Sites (EWM)	Total Sites (EWM)	Rake Density (EWM)	Littoral Frequency (EWM)
2015	10	5th	1	4	5	1	1.41
2016	7	3rd	6	10	16	1.17	9.23
2017	8	3rd	19	27	46	1	28.79

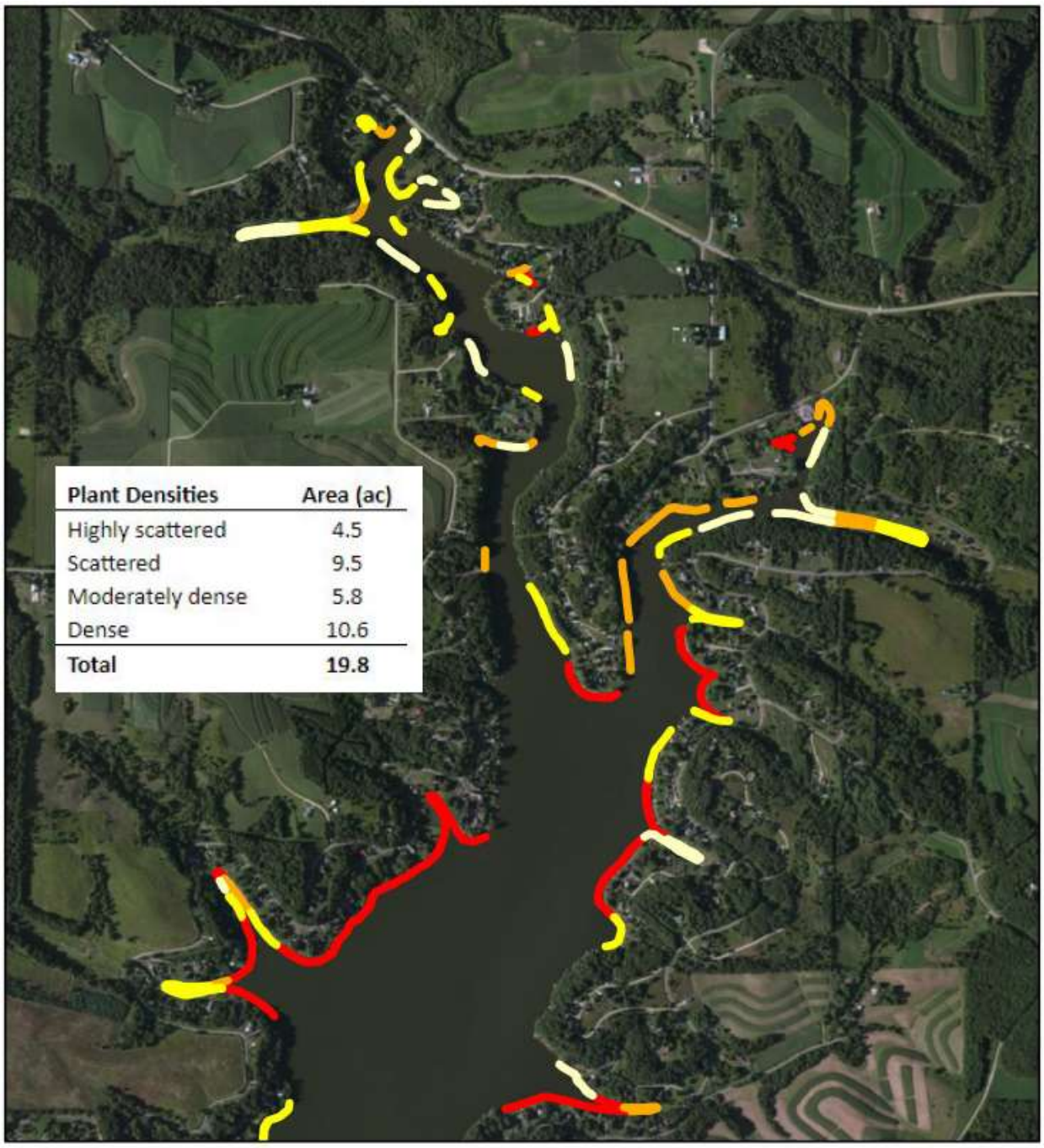
2017 CASON AND ASSOCIATES FALL EWM MAPPING

Cason and Associates conducted a fall EWM bed-mapping survey on October 5, 2017 to document the density of EWM along the shores and in the bays of Lake Redstone based on a visual survey. During the survey, the density of EWM is categorized in four different levels Dense (red), Moderate (orange), Scattered (yellow), and Highly scattered (white) (Figure 9). This survey is another tool that can be used to help determine which bays are considered for chemical treatment in the coming year. In this case that would be 2018. Based on results from the 2017 summer PI surveys, Cardinal, Chickadee South, Eagle, Killdeer, Mourning Dove, Swallow, and Warbler bays could be considered for chemical treatment in 2018.

Cardinal is shown to have light to dense growth EWM; Chickadee South has light growth EWM; Eagle has moderate to dense growth EWM; Killdeer has scattered growth EWM; Mourning Dove has light to dense growth EWM; Swallow has light to moderate growth EWM; and Warbler has moderate growth EWM. Under these conditions, Chickadee South and Killdeer can be removed from 2018 chemical treatment consideration. One other bay worth considering for chemical treatment in 2018 would be the bay just north of Chickadee Bay North, called Chippewa Bay for lack of a better name for it.

According to the 2017 Cason fall EWM survey there are about 19.8 acres of EWM along the shores of Lake Redstone. This number is far less than the 27.7 acres surveyed in 2016, and less than the acreage mapped in the fall of 2015 (22.5 acres).

The Cason fall EWM survey is only a visual survey with a few rake tosses throughout, but the results of it help to further determine which bays to consider for chemical treatment in the following year.



Plant Densities - October 5, 2017

0 0.35 0.7 1.4 Kilometers

- Highly scattered EWM
- Scattered EWM
- Moderately dense EWM
- Dense EWM

N W E S

Cason & ASSOCIATES, LLC
LAKE & POND MANAGERS

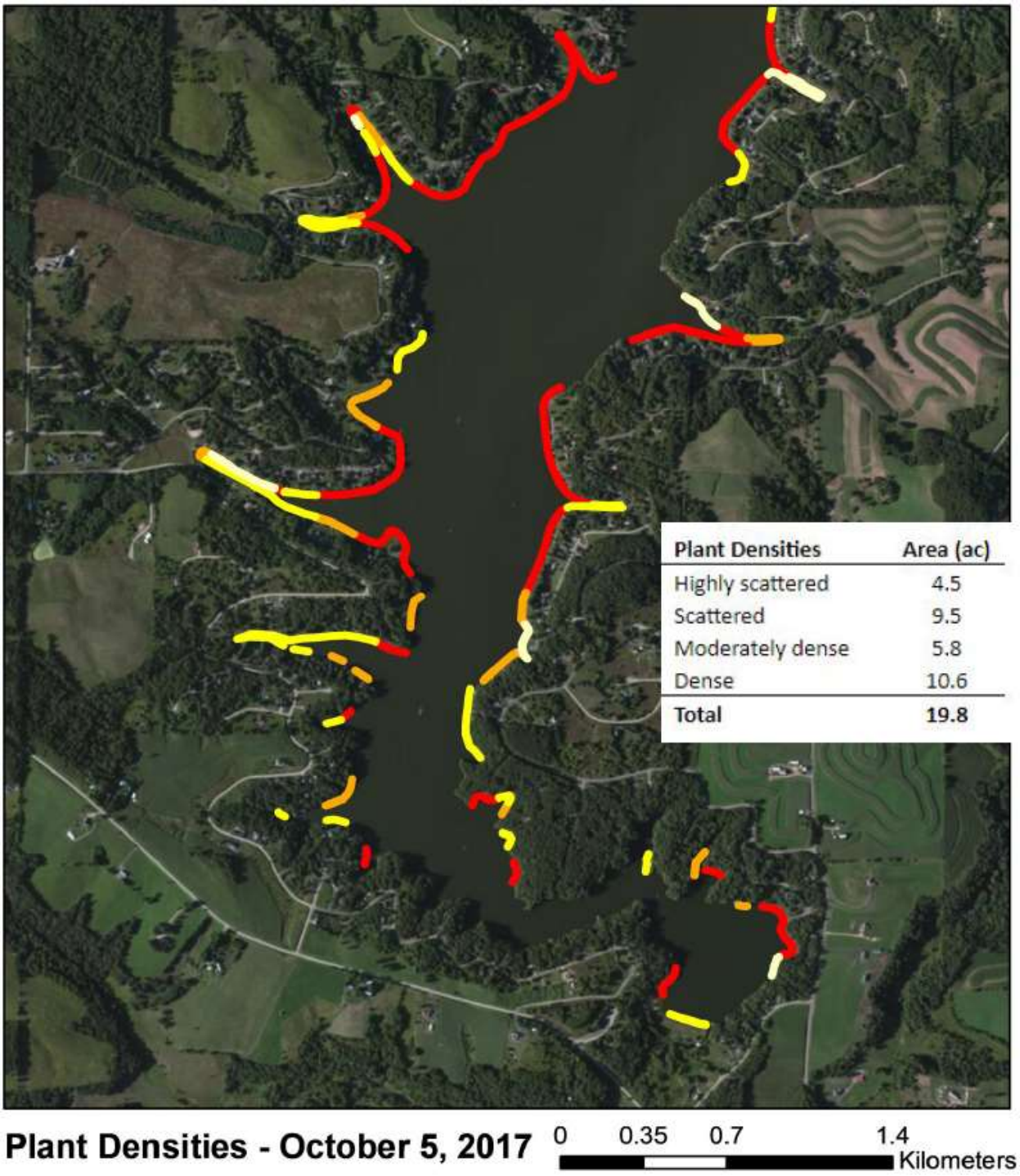


Figure 9 - 2017 Cason and Associates Fall EWM Survey, October 5, 2017 (Cason, 2017)

Based on summer point-intercept surveys completed by APHS in 2017 and discussions with the LRPD and LEAPS, a proposal was made by the LRPD and a permit application submitted to the WDNR to treat four bays on Lake Redstone totaling 17.17 acres (Table 16, Figure 10). The proposals for these four bays include the application of a liquid formulation of the active ingredient 2, 4-D (Shredder Amine 4) at 3.0 ppm in Eagle (3.7 acres) and Mourning Dove (7.31 acres); and at 2.5 ppm in Swallow (4.07 acres) bays; and the application of diquat (Tribune) at the maximum label rate to Cardinal Bay (2.09 acres).

All four of these bays were surveyed in the summer of 2017, and were surveyed again in 2018 post-treatment, and will be surveyed again in 2019.

Table 16 - 2018 Early Season EWM Treatment Proposal

2018 Lake Redstone Modified Spring EWM Chemical Treatment Proposal (5/13/2018) 6" of depth added to treatment volume										
Treatment Area Characteristics								Shredder Amine 4)		
Treatment Site	2017 Littoral Frequency	Rake Fullness Value (Density)	2017 Summer PI Points (rake/visual)	% of total points surveyed	Acreage	Mean Depth (feet)	Volume (acre-feet)	Treatment a.i. ppm	Treatment application (gal)	Application rate (gal/ac-ft)
Cardinal_2018	50.0	1.23	23/14	56	*2.09	4.00	*8.36	NA - see diquat table below.		
Eagle_2018	30.0	1.00	12/15	27	3.70	4.73	17.50	3.0	37.3	2.13
MourningDove_2018	30.77	1.33	24/13	30	7.31	5.12	37.43	3.0	79.7	2.13
Swallow_2018	28.79	1.0	19/27	64	4.07	3.17	12.90	2.5	23.0	1.78
Total					*15.08*		*67.83*		*140.0*	
								EWM Treatment (15.08 acres); early spring application		

2018 Lake Redstone-Cardinal Bay EWM Treatment Proposal - Diquat (5/13/2018) 6" of depth added to treatment volume										
Treatment Area Characteristics					Eurasian Watermilfoil — Diquat (Reward)					
Treatment Location	Site Name	Acreage	Mean Depth (feet)	Volume (acre-feet)	Max Label Treatment Rate (2 gal/acre)	Application rate (gal/ac-ft)	Max allowed diquat ion (2lbs/gallon)	Total diquat ion (mg) (Col.M x 453594)	Treatment a.i. ppm (Col.L/12334 81.84)	Exceeds label or DNR rate
Cardinal Bay	Cardinal_2018	2.09	4.0	8.36	2.60	0.311	0.622	282138.565	0.229	no
Total		*2.09*		*8.36*	*2.60*					
EWM Treatment (2.09 acres); early spring application-Diquat										
Reward (liquid Diquat)				0.25-0.5 gallons/acre-ft			Total - 2.6 gallons			

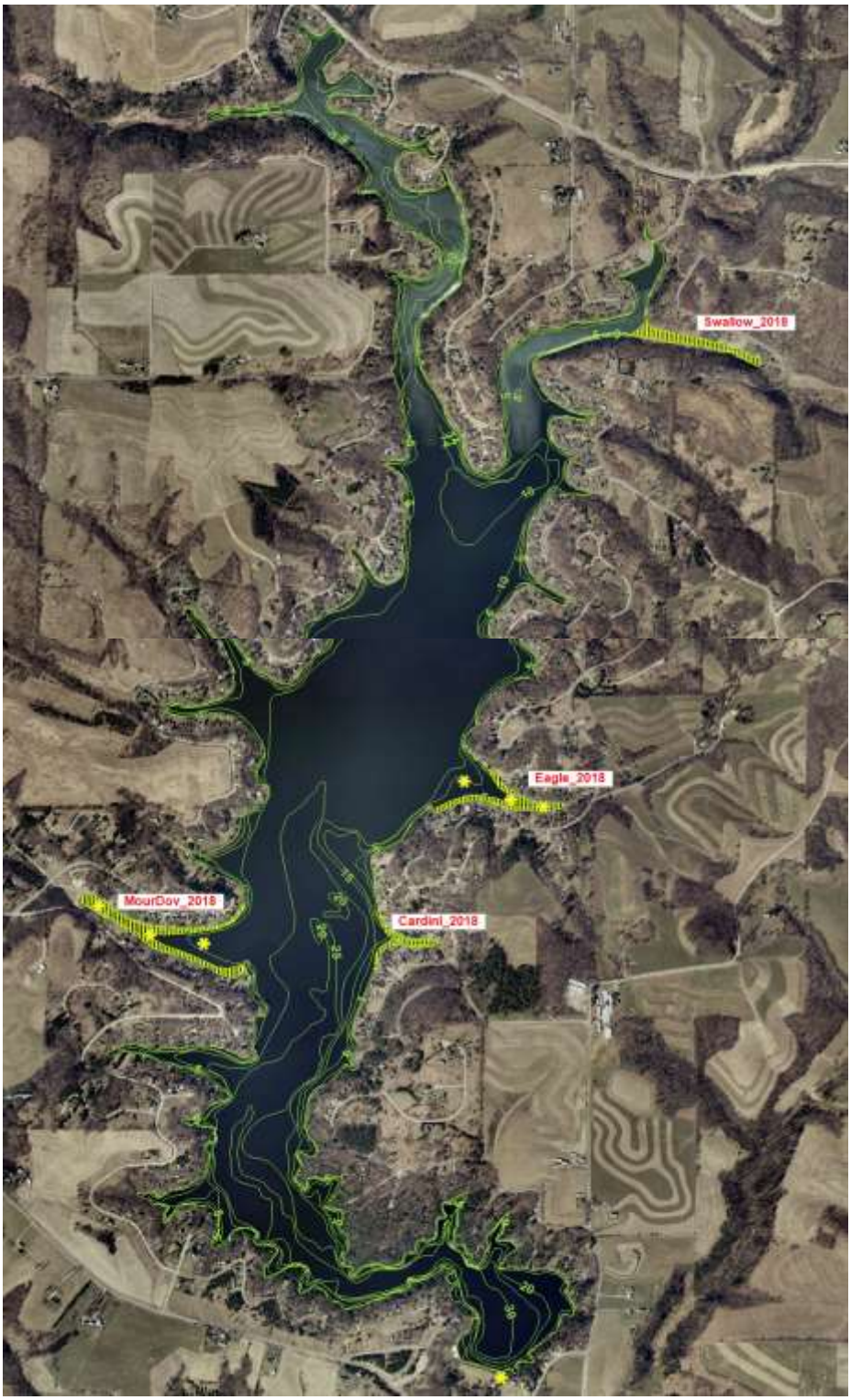


Figure 10 - 2018 EWM whole bay treatment areas

2018 EARLY SEASON EWM TREATMENT DETAILS

On May 14, 2018 Cason and Associates, the applicator retained by the LRPD completed the application of DMA 4 (2,4-D) and Reward (diquat) to four bays totaling 17.17 acres. The average depth of the treated areas was increased by 6 inches just prior to the treatment date to account for high water conditions in Lake Redstone. This resulted in a bit more herbicide being applied.

2018 CHEMICAL CONCENTRATION TESTING

Following the 2018 early season herbicide application volunteers from the LRPD collected chemical concentration data for 2,4-D from three sites in Eagle Bay, three sites in Mourning Dove Bay, and at the outlet of Lake Redstone (Table 17, Figure 11). No herbicide concentration testing was completed in Cardinal Bay where diquat was used because the Wisconsin State Lab of Hygiene does not have the capability to run assays for diquat. Herbicide concentration testing was not completed in Swallow Bay in an effort to save costs. Each site was sampled at six different times after treatment: 1, 3, 5, 7, 24, and 48 HAT (**H**ours **A**fter **T**reatment). Chemical concentration testing is used to determine the concentration reached in the treated areas and to determine how long the herbicide remains in contact with the target plant. In the 2018 early season treatment, the target concentration in the three bays treated with 2,4-D was 2000 ppb or 2.0 mg/l.

Table 17 – 2018 2,4-D Chemical Concentration Testing sites in Lake Redstone

2018 Lake Redstone Chemical Concentration Monitoring Planning 5-2-2018 (LEAPS)				
Location	**SITE_NAME**	**Station Name**	**Station ID**	**WBIC**
Eagle (site 4 on map)	Eagle Bay In	Lake Redstone - Eagle Bay In (Site 1)	10051038	1280400
Eagle (site 5 on map)	Eagle Bay Middle	Lake Redstone - Eagle Bay Middle (Site 2)	10051039	1280400
Eagle (site 6 on map)	Eagle Bay Out	Lake Redstone - Eagle Bay Out (Site 3)	10051040	1280400
Mourning Dove (site 8 on map)	MourDove In	Lake Redstone - Mourning Dove Bay In (Site 1)	10051041	1280400
Mourning Dove (site 9 on map)	MourDove Middle	Lake Redstone - Mourning Dove Bay Middle (Site 2)	10051042	1280400
Mourning Dove (site 10 on map)	MourDove Out	Lake Redstone - Mourning Dove Bay Out (Site 3)	10051043	1280400
Oulet/Spillway (site 15 on map)	Outlet_18	Big Creek - Below Dam	573127	1280200

Figure 11 - Chemical Concentration Testing Sites in Eagle (4-6) and Mourning Dove (8-10) Bays, and at the Outlet of Lake Redstone (15)

The concentration of herbicide in both bays never reached the target concentration of 2000 ppb. In Eagle Bay, the concentration of herbicide reached nearly 1000 ppb in the middle and outer sites within the first 24 HAT. The highest it reached at the inner most point was only 400 ppb, 20% of the target concentration. In Mourning Dove Bay the middle site reached about 900 ppb within the first 24 HAT. The inner and outer sites reached or exceeded 800 ppb but did not do so until at least 7-8 HAT (outer site) and at least 24 HAT (inner site). However, this level was only maintained in both sites for a short time.

Given that the herbicide applied did not reach the inner sites in either bay until at least 7 HAT suggests that perhaps the herbicide was not applied directly to the waters of the inner most sites or that water movement from the inner most parts of the bays to the main basin of the lake washed the herbicide out. At least in Eagle Bay, the latter seems more plausible since herbicide concentrations were the highest for the longest at the outer most site tested. This was not the case in Mourning Dove Bay where the middle site reached and maintained the highest concentration of herbicide supporting the notion that the herbicide was applied to the middle of the bay, but not to the inner most part of the bay. Herbicide also moved out of Mourning Dove Bay faster than it moved into the bay. This supports the idea that water movement out of the bay took precedent to herbicide dissipation throughout the bay.

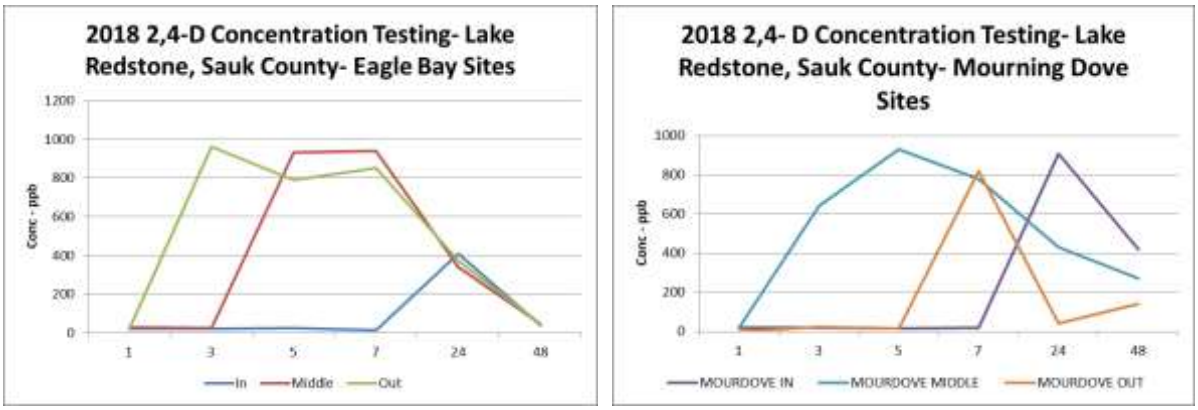


Figure 12 - 2018 Lake Redstone Concentration Testing Results

Summer PI surveys, observations by Lake Redstone constituency, and the fall EWM survey by Cason and Associates suggest that aquatic plant growth was way down throughout Lake Redstone in 2018, so it is difficult to determine the full impacts of the 2018 chemical treatments. Water clarity was considered worse in 2018 than it has been in previous years with the water maintaining a brown and turbid look much of the year.

Even the effectiveness of diquat in Cardinal Bay cannot be directly assessed based on plant survey results. Based on 2017 summer plant survey work, the use of diquat was ineffective in Woodpecker Bay.

The LRPD partnered with APHS to complete an aquatic plant survey of eight bays on Lake Redstone in August 2018 (Table 19, Figure 13). No new bays were surveyed in 2018. Two bays were surveyed based on chemical application in 2017(Hummingbird and Woodpecker); four bays were surveyed based on chemical application in 2018 (Cardinal, Eagle, Mourning Dove, and Swallow); and two bays that had been treated prior to 2017 were surveyed for possible chemical treatment in 2019 (Martin-Meadowlark and Chickadee).

Table 18 - 2018 Plan for Summer PI Surveys

2018 Lake Redstone Proposed Summer PI Surveys, North to South (05/02/2018)					
Treatment Site	**Name of Bay**	**Acreage**	**# of PI Points**	**Last Treated**	**NOTES**
MM-SS-18	Martin-Meadowlark	3.00	54	2015	PrePI
WP-SS-18	Woodpecker	4.60	83	2017	PostPI
SW-SS-18	Swallow	3.80	72	2015	ActivePI
HB-SS-18	Hummingbird	1.70	59	2017	PostPI
CHS-SS-18	Chickadee South	4.10	56	2016	PrePI
CHA-SS-18	Chickadee North	7.93	64	NT	PrePI
EG-SS-18	Eagle	9.70	100	NT	ActivePI
MD-SS-18	Mourning Dove	12.90	122	2013	ActivePI
CD-SS-18	Cardinal	2.10	67	2016	ActivePI
TOTAL		***49.83***	***677.00***		

Included in 2018 Spring Treatment Proposal

PrePI - PI survey to set up possible spring treatment in the following year
ActivePI - PI survey of bays treated in this current year
PostPI - PI survey of bays treated in the previous year
NT - Never has been treated
TBE - To be established

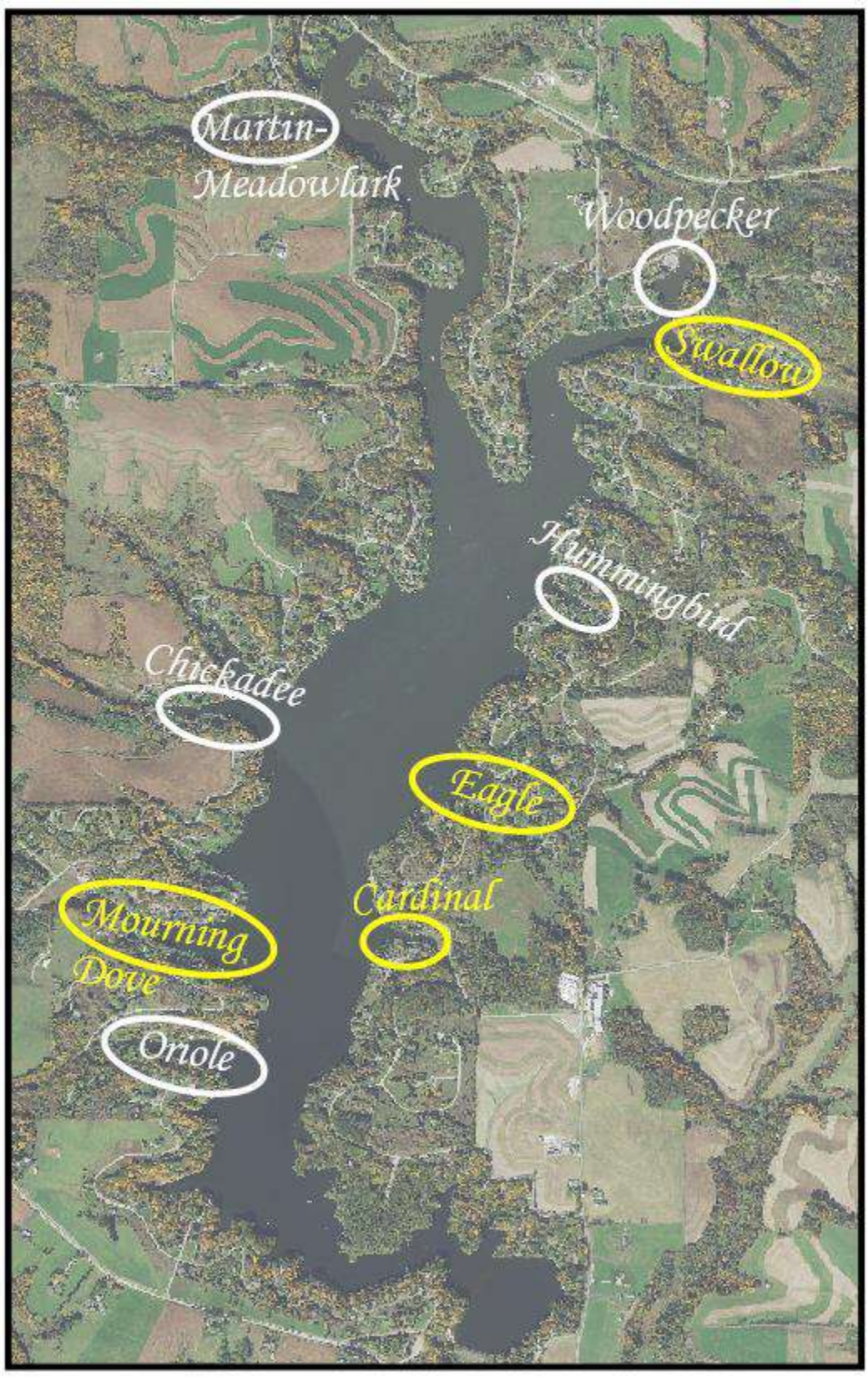


Figure 13 – 2018 Summer PI Survey Bays (APHS, 2018)

SUMMER PI SURVEY RESULTS FOR BAYS TREATED IN 2018

One of the first uses of summer PI data is to determine the impacts of chemical treatment in the year of the survey on the target (EWM) and non-target (native) aquatic plants. In 2018, four bays were chemically treated: Cardinal, Eagle, Mourning Dove, and Swallow (Figure 13). Of note in 2018 is the fact that visual assessment of aquatic plant growth by LRPD constituents, Cason and Associates, and LEAPS all indicate that aquatic plant growth in general was down. Summer PI survey numbers for EWM in all eight of the bays surveyed reflect lower numbers whether chemically treated or not, supporting the notion that 2018 was not a great year for EWM. Furthermore, the littoral frequency of all plants in all bays was less during the 2018 than during surveys completed in previous years (Table 19).

Table 19 - Summary Plant Statistics for All Bays Surveyed in 2018 (APHS, 2018)

Bay & Year		1	2	3	4	5	6 Average # of species per site				7 Species Richness		8	
		Total # sites visited	Total # sites w/ vegetation	Max. depth of plants	Total # sites shallower than max. depth of plants	Littoral frequency**	a) Shallower than max. depth	b) Vegetated sites only	c) Native shallower than max. depth	d) Native at veg. sites only	a) Total # species on rake at all sites	b) Including visuals	Simpson's Diversity Index	Littoral frequency of EWM
Martin-Meadowlark	2014	52	45	4	52	86.5	2.25	2.6	1.81	2.41	7	9	0.8	42
	2015	54	30	3	50	60.0	1.12	1.87	1.12	1.87	7	8	0.75	0
	2016	54	50	4	54	92.6	2.63	2.84	2.41	2.83	8	9	0.83	22
	2017	55	37	3	48	77.1	1.54	2.00	1.31	1.80	6	6	0.79	23
	2018	56	35	3	53	66.0	1.11	1.69	1.04	1.72	7	7	0.72	6
Swallow	2014	70	43	4	64	67.2	1.36	2.02	0.83	1.56	7	7	0.69	52
	2015	71	37	5	71	52.1	0.72	1.38	0.69	1.32	8	10	0.66	1
	2016	72	44	4	65	67.7	1.23	1.82	1.09	1.65	7	7	0.70	9
	2017	72	40	4	66	60.6	1.30	2.15	0.98	1.76	8	8	0.78	29
	2018	72	29	4	58	50.0	0.71	1.41	0.71	1.41	5	7	0.56	0
Cardinal	2015	67	33	7	46	71.7	1.15	1.61	0.85	1.39	7	8	0.74	30
	2016	65	39	6	45	86.7	1.73	2.00	1.42	1.83	9	11	0.83	31
	2017	66	35	7	46	76.1	1.61	2.11	1.11	1.65	8	9	0.76	50
	2018	70	39	11	60	65.0	1.10	1.69	0.90	1.54	10	11	0.75	20
Chickadee* (South Arm)	2015	55	7	3	11	63.6	1.00	1.57	0.45	1.25	4	5	0.61	55
	2016	56	7	5	28	25.0	0.46	1.86	0.36	1.43	6	7	0.71	11
	2017	56	11	5.5	36	30.6	0.53	1.73	0.25	1.13	3	4	0.54	28
	2018	55	9	5.5	32	28.1	0.44	1.56	0.22	1.40	4	5	0.61	22
Oriole	2015	68	26	9	48	54.17	0.90	1.65	0.63	1.36	5	5	0.70	27
	2016	62	28	7	44	63.6	0.91	1.43	0.77	1.26	6	6	0.69	14
	2017	56	22	9.5	46	47.8	0.76	1.59	0.52	1.09	5	6	0.57	24
	2018	56	13	6	32	40.6	0.56	1.38	0.50	1.23	5	6	0.62	6
Eagle	2014	105	16	6.5	55	29.1	0.56	1.94	0.38	1.40	7	7	0.76	15
	2017	100	14	5	40	35.0	0.58	1.64	0.28	1.10	4	7	0.57	30
	2018	98	15	5	42	35.7	0.50	1.40	0.45	1.46	6	8	0.79	5
Hummingbird	2016	59	34	6	59	57.6	0.93	1.62	0.58	1.21	7	9	0.66	36
	2017	63	32	6	63	50.8	0.81	1.59	0.52	1.27	7	8	0.65	29
	2018	60	31	5.5	56	55.4	1.00	1.81	0.75	1.56	8	9	0.78	25
Mourning Dove	2016	122	59	7.5	89	66.3	1.04	1.58	0.88	1.39	9	10	0.68	17
	2017	122	56	6.5	78	71.8	1.19	1.66	0.88	1.28	8	9	0.62	31
	2018	122	36	6	75	48.0	0.84	1.75	0.81	1.69	8	8	0.72	3
Woodpecker	2016	83	22	4.5	77	28.6	0.77	2.68	0.68	2.36	7	8	0.82	9
	2017	85	15	4	70	21.4	0.39	1.80	0.29	1.43	4	4	0.68	10
	2018	84	14	3.5	45	31.1	0.62	2.00	0.58	1.86	5	7	0.71	4

*All data are for South Arm of Chickadee Bay only.

**Also known as the "frequency of occurrence at sites shallower than the maximum rooting depth of plants"

Herbicide treatment occurred during years when littoral frequency of EWM is red.

CARDINAL BAY (TREATED IN 2018)

In 2018, EWM was the second-most common plant with scattered distribution at 12 near-shore sites and visual observation at another 4 points. EWM littoral frequency was 20% in 2018, 50% in 2017, 31% in 2016, and 30% in 2015. It was also the second-most common plant in 2016 and 2017. Herbicide was applied in Cardinal Bay in spring of 2016 and 2018. A chi-squared test of EWM revealed a significant decrease in EWM between 2017 and 2018.

These results were welcomed given that chemical treatment of EWM in Cardinal Bay in 2016 using diquat was for the most part ineffectual. It was theorized that the failure of the 2016 EWM treatment was due to just the outer portions of the bay nearest the main body of the lake being chemically treated. In 2018, the entire bay was chemically treated, not just the outer most edges. Comparing EWM numbers across the four years the bay has been surveyed and the two years it has been treated shows the decline in EWM brought about in 2018 (Table 20).

There was no significant decrease in native plant species in 2018 when compared to 2017.

Figure 14 – 2017 & 2018 Summer PI EWM Results, Cardinal Bay (APHS, 2017 & 2018)

Table 20 - 2015-2018 Summer PI Survey EWM Results – Cardinal Bay

Cardinal Bay	# of Species	Most Common	Rake Sites (EWM)	Visual Sites (EWM)	Total Sites (EWM)	Rake Density (EWM)	Littoral Frequency (EWM)
2015	8	2nd	14	7	21	1.43	30.43
2016	10	2nd	14	5	19	1	31.11
2017	9	2nd	23	14	37	1.22	50
2018	11	2nd	12	4	16	1.08	20

EAGLE BAY (TREATED IN 2018)

In 2017 EWM was the most common plant in the bay. In 2018, after chemical treatment it was only the 5th most common plant. In 2018 EWM was only found at 2 survey points and another 8 visual observations (Figure 15). Littoral frequency of EWM was <5% in 2018, 30% in 2017, and 15% in 2014. Herbicide treatment was done in spring 2018 to control EWM. Comparisons between 2017 and 2018 using chi-squared tests reveal a significant decrease in EWM. Comparing EWM numbers across the two years the bay has been surveyed shows the decline in EWM brought about in 2018 (Table 21).

There was no significant decrease in native plant species in 2018 when compared to 2017.

Figure 15 - 2017 & 2018 Summer PI EWM Results, Eagle Bay (APHS, 2017 & 2018)

Table 21- 2017-2018 Summer PI Survey EWM Results – Eagle Bay

Eagle Bay	# of Species	Most Common	Rake Sites (EWM)	Visual Sites (EWM)	Total Sites (EWM)	Rake Density (EWM)	Littoral Frequency (EWM)
2017	7	1st	12	15	27	1	30
2018	8	5th	2	8	10	1	4.76

MOURNING DOVE BAY (TREATED IN 2018)

In 2017, EWM was the 2nd most common plant. In 2018, after chemical treatment it was only the 5th most common plant. In 2018, EWM was found at 2 survey points and another 2 visual observations. Littoral frequency of EWM was 3% in 2018, 31% in 2017 and 17% in 2016. Herbicide treatment occurred in spring 2013 and 2018 to control EWM. There was a significant decrease in EWM occurrence between 2017 and 2018. Comparing EWM numbers across the three years the bay has been surveyed shows the decline in EWM brought about in 2018 (Table 22).

There was a significant decrease in coontail between 2017 and 2018 (Figure 17). While this change in coontail is of note, unless a summer PI survey in 2019 reveals a similar change, it is of not great concern. In both 2017 and 2018, coontail is the most common aquatic plant species in the bay.

Mourning Dove Bay was last chemically treated in 2013.

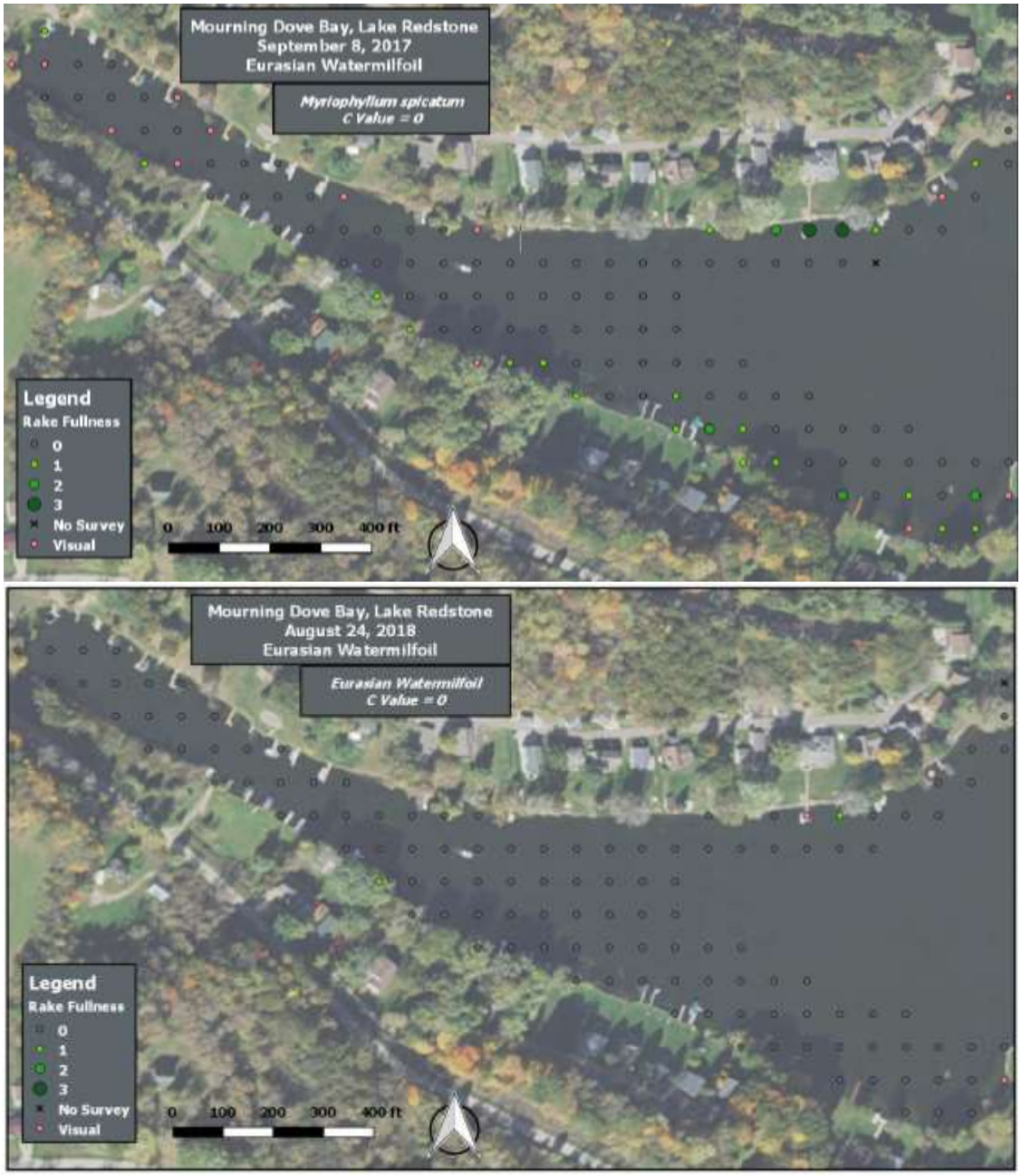


Figure 16 - 2017 & 2018 Summer PI EWM Results, Mourning Dove Bay (APHS, 2017 & 2018)

Table 22- 2016-2018 Summer PI Survey EWM Results – Mourning Dove Bay

Mourning Dove Bay	# of Species	Most Common	Rake Sites (EWM)	Visual Sites (EWM)	Total Sites (EWM)	Rake Density (EWM)	Littoral Frequency (EWM)
2016	9	2nd	15	6	21	1.07	16.85
2017	9	2nd	24	13	37	1.33	30.77
2018	8	5th	2	2	4	1	2.67

Figure 17 – Changes in Coontail distribution and density in Mourning Dove Bay from 2017 to 2018 after chemical treatment (APHS, 2017 & 2018)

SWALLOW BAY (TREATED IN 2018)

In 2017, EWM was the 3rd most common aquatic plant in the bay. The same was true in 2016, a year after the first chemical treatment in Swallow Bay. In 2018, following chemical treatment in the spring, EWM was only the 6th most common plant species. In 2018, EWM was only observed visually at one site, and therefore the littoral frequency was 0%. By contrast, littoral frequency of EWM was 29% in 2017, 9% in 2016, 1% in 2015, and 52% in 2014 Herbicide treatment was done in spring 2015 and 2018 to control EWM. A chi-squared test of the 2017 EWM data compared to 2018 reveals a significant decrease in EWM. The same was true when comparing EWM occurrence in 2014 to 2018. Comparing EWM numbers across the four years the bay has

been surveyed and the two years it has been treated shows the decline in EWM brought about in 2018 (Table 23).

A significant decrease in small duckweed and coontail was found between 2017 and 2018. These changes could be of some concern, but need to be corroborated in the 2019 Summer PI survey to truly determine this.

Figure 18 - 2017 & 2018 Summer PI EWM Results, Swallow Bay (APHS, 2017 & 2018)

Table 23- 2015-2018 Summer PI Survey EWM Results – Swallow Bay

Swallow Bay	# of Species	Most Common	Rake Sites (EWM)	Visual Sites (EWM)	Total Sites (EWM)	Rake Density (EWM)	Littoral Frequency (EWM)
2015	10	5th	1	4	5	1	1.41
2016	7	3rd	6	10	16	1.17	9.23
2017	8	3rd	19	27	46	1	28.79
2018	7	6th	0	1	1	NA	NA

SUMMER PI SURVEY RESULTS FROM OTHER BAYS

Summer PI surveys are used to do other things than just compare changes in bays that have been chemically treated in the same year the survey takes place. Summer PI surveys are also used to help determine changes in bays that were treated in the year prior to the year of the survey. PI survey data from the year prior to

treatment, the year of treatment, and the year after treatment can help determine longer term treatment impacts on EWM and native plants.

Summer PI surveys are also used to determine if a first time bay or a bay that was treated 2 or more years ago should be considered for chemical treatment based on the littoral frequency of EWM during the survey.

HUMMINGBIRD BAY (TREATED IN 2017)

In 2018, EWM was found at 14 survey points and another 10 visual observations (18 sites and 17 visual in 2017), making it the second most common plant species distributed throughout Hummingbird Bay. EWM littoral frequency was 25% in 2018, 29% in 2017 and 36% in 2016. Herbicide treatment was conducted in Hummingbird Bay in spring 2017. There was no statistically significant difference in EWM between 2017 and 2018 and no decrease in native species. Comparing EWM numbers across the three years the bay has been surveyed shows a decline in EWM through 2018 (Table 24).

Table 24 - 2016-2018 Summer PI Survey EWM Results – Hummingbird Bay

Hummingbird Bay	# of Species	Most Common	Rake Sites (EWM)	Visual Sites (EWM)	Total Sites (EWM)	Rake Density (EWM)	Littoral Frequency (EWM)
2016	7	2nd	21	3	24	1	35.59
2017	8	2nd	18	17	35	1.06	28.57
2018	9	2nd	14	10	24	1	25

WOODPECKER BAY (TREATED IN 2017)

In 2018, EWM was found at 2 survey points and 3 visual observations making it a plant of low occurrence. The littoral frequency was 4% in 2018, 10% in 2017, and 9% in 2016. Herbicide treatment was conducted in the northern section of the bay in spring of 2017. There was no significant difference in EWM in 2018 compared to 2017. There was no statistically significant difference in EWM between 2017 and 2018 and no decrease in native species. Comparing EWM numbers across the three years the bay has been surveyed shows a decline in EWM from 2016 to 2018 (Table 25).

Table 25- 2015-2018 Summer PI Survey EWM Results – Woodpecker Bay

Woodpecker Bay	# of Species	Most Common	Rake Sites (EWM)	Visual Sites (EWM)	Total Sites (EWM)	Rake Density (EWM)	Littoral Frequency (EWM)
2016	7	5th	7	1	8	1	9.09
2017	4	3rd	7	9	16	1.14	10
2018	6	4th	2	3	5	1	4.44

CHICKADEE BAY (TREATED IN 2016)

Chickadee Bay South was chemically treated in 2016. Three surveys were completed: one the year before treatment, one the year of treatment, and one the year after treatment. Based on results from the survey completed the year after the treatment (2017), Chickadee Bay South was gain added to the survey list in 2018. Table 26 compares basic EWM numbers from each year of the surveys. The numbers in red reflect the year EWM was chemically treated. It appears that the year of treatment was effective in reducing the amount of

EWM in the bay, but like Cardinal Bay, the results did not last into a second year as survey numbers in the year after treatment are as high or higher than they were in the year prior to treatment. In 2018, like all of the other bays surveyed the same year, the numbers went back down.

Table 26 - 2015-18 Summer PI Survey EWM Results for Chickadee Bay South

Chickadee South	# of Species	Most Common	Rake Sites (EWM)	Visual Sites (EWM)	Total Sites (EWM)	Rake Density (EWM)	Littoral Frequency (EWM)
2015	6	1st	11	4	15	1.09	34.38
2016	6	2nd	3	0	3	1.33	10.71
2017	4	1st	10	2	12	1.4	27.78
2018	5	1st	7	1	9	1.14	21.88

MARTIN-MEADOWLARK (TREATED IN 2015)

Last chemically treated in 2015, Martin-Meadowlark Bay is an example of a successful chemical treatment that has lasted more than one season. PI plant survey work in the three years following when it was treated (2016-18) indicates that the level of EWM has still not reached a level high enough to consider chemical treatment. Table 27 compares basic EWM numbers from each year of the surveys.

Table 27 – 2015-2018 Summer PI Survey EWM Results – Martin-Meadowlark Bay

Martin-Meadowlark Bay	# of Species	Most Common	Rake Sites (EWM)	Visual Sites (EWM)	Total Sites (EWM)	Rake Density (EWM)	Littoral Frequency (EWM)
2015	8	NA	0	0	0	NA	NA
2016	8	6th	12	7	19	1	22.22
2017	6	5th	11	19	30	1.09	22.92
2018	6	3rd	3	4	7	1	5.66

BAYS TO BE CONSIDERED FOR CHEMICAL TREATMENT IN 2019

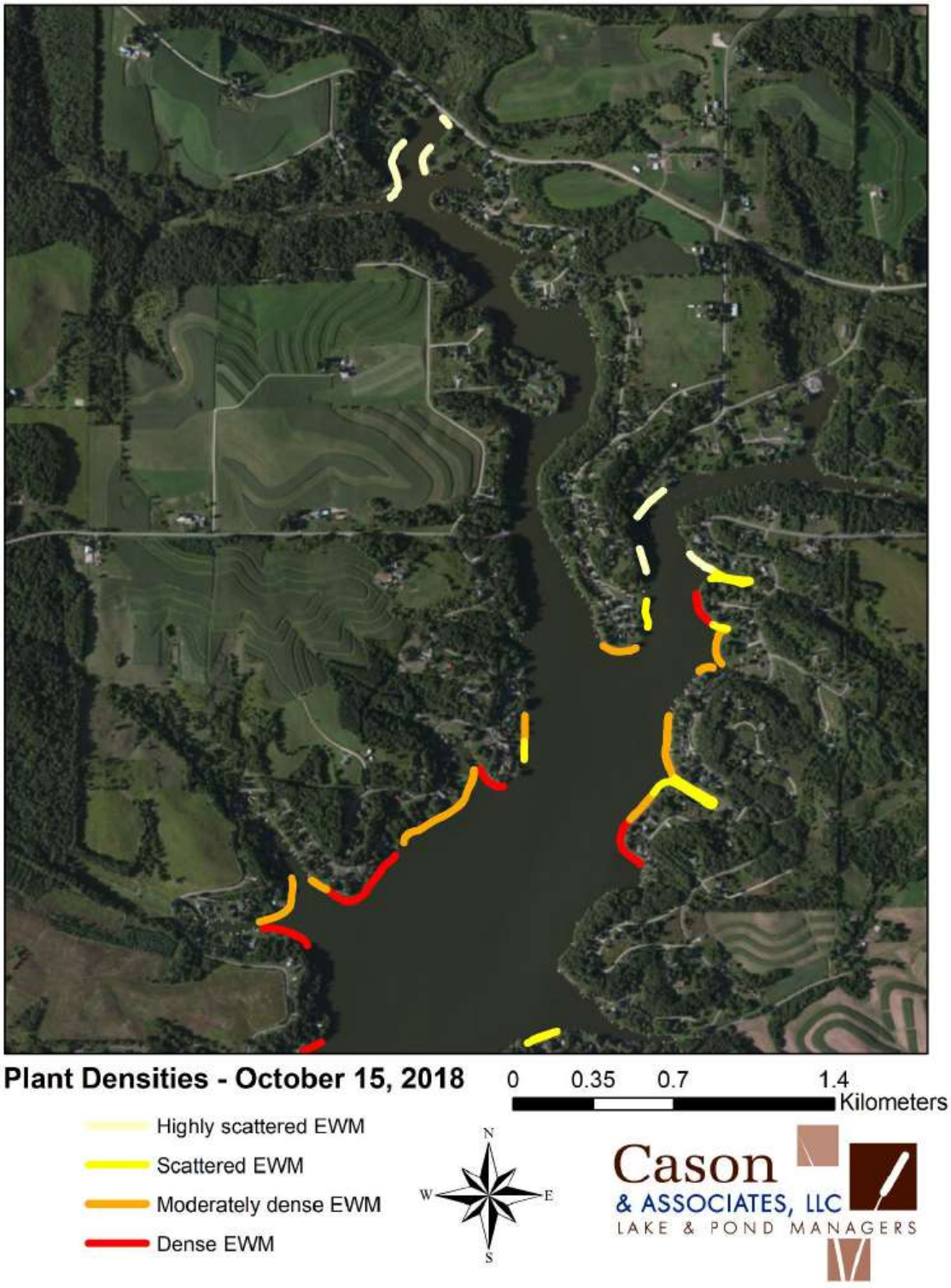
Based on summer PI survey results from 2018, there is no bay in Lake Redstone where the littoral frequency of EWM reached or exceeded the level recommended for chemical treatment consideration (27% littoral frequency. At the present time there will be no early season EWM treatment proposal made for Lake Redstone in 2019.

2018 CASON AND ASSOCIATES FALL EWM MAPPING

Cason and Associates conducted a fall EWM bed-mapping survey on October 15, 2018 to document the density of EWM along the shores and in the bays of Lake Redstone based on a visual survey. During the survey, the density of EWM is categorized in four different levels Dense (red), Moderate (orange), Scattered (yellow), and Highly scattered (white) (Figure 19). This survey is another tool that can be used to help determine which bays are considered for chemical treatment in the coming year. In this case that would be 2019. Based on results from the 2018 summer PI surveys, no bay would be considered for chemical treatment in 2019.

Except for possibly Chickadee Bay, the 2018 Cason fall EWM survey confirms what the 2018 summer PI surveys indicated. According to the 2018 Cason fall EWM survey there are about 12.04 acres of EWM along the shores of Lake Redstone. This number is much less than the 19.8 acres surveyed in 2017, far less than the 27.7 acres surveyed in 2016, and much less than the acreage mapped in the fall of 2015 (22.5 acres).

The Cason fall EWM survey is only a visual survey with a few rake tosses throughout, but the results of it help to further determine which bays to consider for chemical treatment in the following year.


Plant Densities - October 15, 2018
0
0.35
0.7
1.4
Kilometers
Highly scattered EWM
Scattered EWM
Moderately dense EWM
Dense EWM
N
W
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Cason
& ASSOCIATES, LLC
LAKE & POND MANAGERS

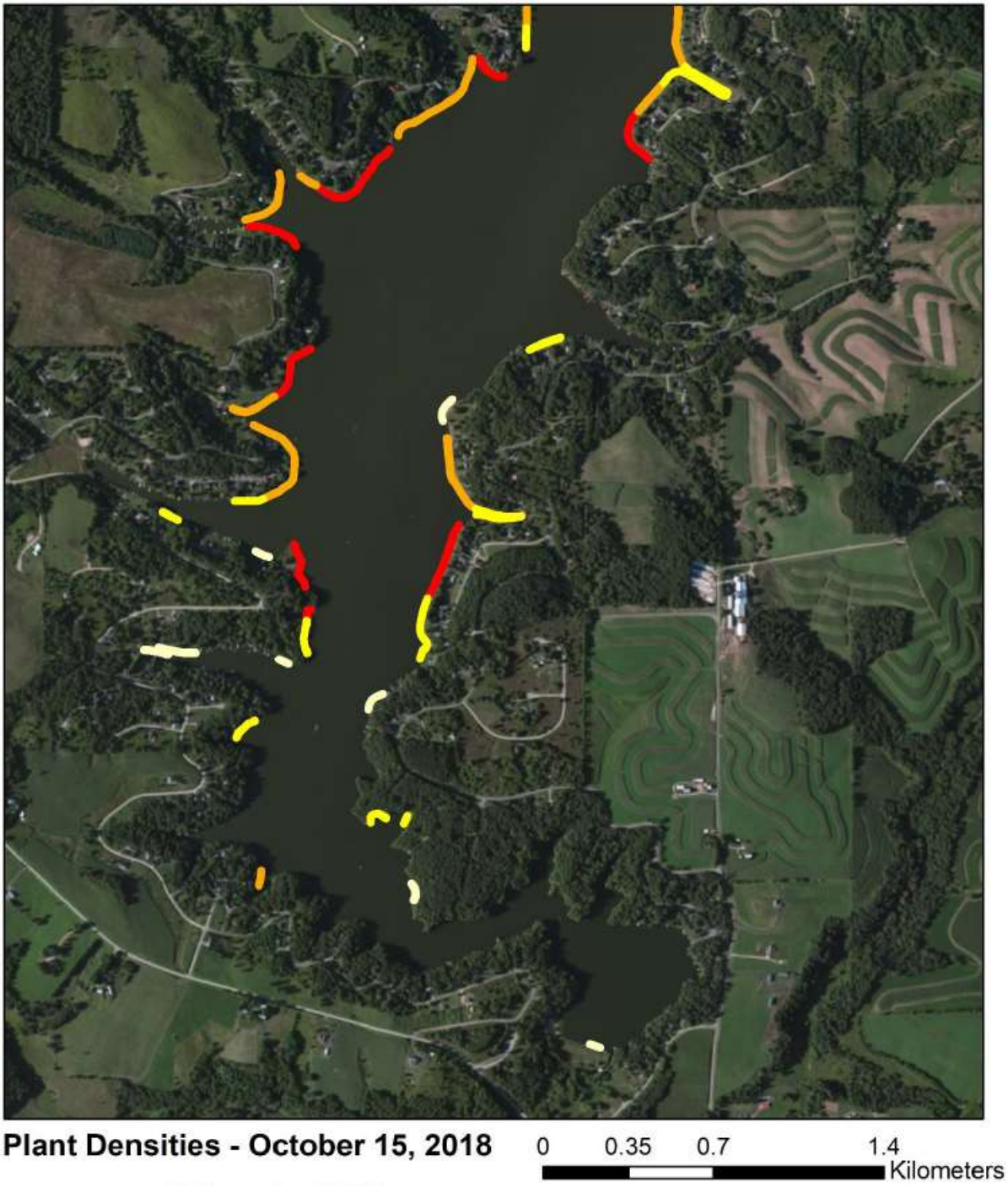

Figure 19 - 2018 Cason and Associates Fall EWM Survey, October 15, 2018 (Cason, 2018)

LRPD volunteers surveyed the lake for Curly-leaf pondweed (CLP) in both 2016 and 2017. Figures 20 and 21 show locations where CLP was found during the early summer surveys. During the 2016, 2017, and 2018 summer PI surveys completed by APHS CLP was found in the following bays, but not necessarily in every year that the bay was surveyed: Eagle, Martin-Meadowlark, Mockingbird, Mourning Dove, Swallow, and Warbler. Except in Swallow Bay, the presence of CLP is limited to a few plants here and there. The concentration of CLP plants in Swallow Bay is more than the other bays, but still sparse.

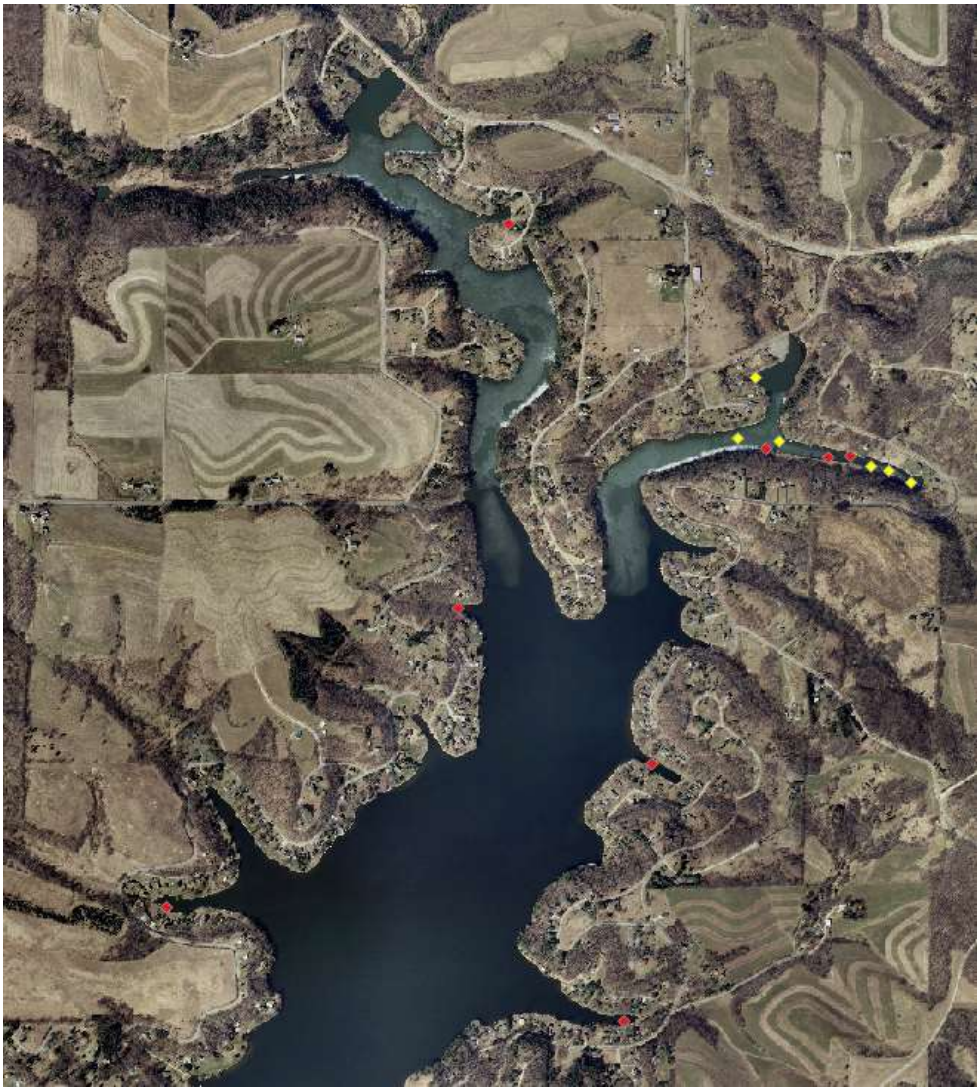

Figure 20 – 2016 (yellow squares) and 2017 (red squares) CLP in the north half of Lake Redstone

Figure 21- 2016 (yellow squares) and 2017 (red squares) CLP in the south half of Lake Redstone

There are no reports of purple loosestrife in any of the surveyed bays.

SUMMER NUISANCE AND NAVIGATION MANGEMENT

Summer nuisance and navigation management by way of chemical herbicides was once again approved for use in Lake Redstone in 2017 and 2018, after in a previous year it had been removed as a management practice. However, no summer nuisance and navigation aquatic plant treatments were completed in 2017 or 2018.

MANUAL REMOVAL EFFORTS

Getting an official manual/physical removal or harvesting program in place on Lake Redstone has been a somewhat difficult task with the LRPD evaluating and trying different scenarios. In 2016, the LRPD put in place a program where a property owner could hire someone to do manual removal and then get reimbursed up to 50% for those costs. A few property owners hired a local man to do physical removal, but only one actually requested 50% reimbursement from the LRPD.

Early in 2017, a private contractor reported he had purchased an aquatic plant harvester and was interested in contracting with the RLPD to do select mechanical harvesting. The Aquatic Plant Management Plan in place in 2017 did not have a recommendation in it for mechanical harvesting due to concern about spread EWM in the lake and the risk of bringing other AIS into the lake if the equipment was not properly decontaminated. The LRPD evaluated the possible use of mechanical harvesting but determined it not to be a management action they wanted to pursue.

At about the same time, a property owner on the lake and his son presented their design for what amounts to a suction harvesting apparatus to be used in Lake Redstone. Suction harvesting involves using a water pump and underwater suction hose to help transport vegetation pulled from the lake bottom to the surface with minimal fragmentation. There was more interest on the part of the LRPD in this method of completing manual removal than there was for mechanical harvesting. Because of this, an addendum to the existing Aquatic Plant Management Plan was completed in 2017 adding a diver aided suction harvesting recommendation to the plan. Unfortunately, the person who was going to build and use the apparatus for physical removal efforts was injured early in 2017 and the project put on hold until he was able to work on it again. By this time though, the window for manual removal had passed and he did not get any jobs. It is believed that he did not pursue the project in 2018.

In 2018, the LRPD allocated up to $6,000.00 for manual removal, but due to aquatic plant growing conditions in 2018, none has been completed or needed.

Physical removal by property owners continues around the lake, but it is not part of any formal physical removal program sponsored by the LRPD.

CLEAN BOATS CLEAN WATERS (CBCW)

According to WDNR CBCW records, 287 hours of watercraft inspection time was put in on three Lake Redstone public accesses. In 2018, 149 hours were completed, but the Section 11 boat landing was shut down much of the season for repairs due to storm and flooding damage caused in 2018. CBCW data has been entered into the WDNR SWIMS database by LRPD volunteers.

LAKE EDUCATION

Several AIS education activities were completed in 2017 and 2018. The biggest was a Lake Fair held on June 3, 2017 at the Dutch Hollow Club House. At least 30 exhibitors that presented information that was educational or focused on recreation and conservation were on display at the Lake Fair. Unfortunately, attendance was down somewhat from previous Lake Fairs. Still it was a good day and provided good information to the public.

The LRPD produced a Shoreland Habitat Improvement Brochure in 2017 high-lighting properties around the lake that already provided the type of habitat and runoff reduction that was hope for from many more property owners. The Brochure was updated again in 2018.

Also in 2017, a Property Owners Survey was sent out to all property owners around the lake. More than 225 surveys were completed and returned, including six pages of comments.

The LRPD creates a newsletter each year. In late 2016, the board looked to do a new design and template for the newsletter. This new design was implemented in both the 2017 Spring Newsletter and the 2018 Spring Newsletter. The newsletter is used as a tool to inform property owners and other interested parties about

what is happening on Lake Redstone. There are multiple references to AIS in each of the newsletters. The newsletter is distributed to every property owner on the lake and made available to others on the webpage. The LRPD maintains a webpage at www.lakeredstonepd.org. The website highlights activities being implemented by the LRPD, updates new and existing projects, and provides information about AIS including new findings of New Zealand Mudsnails in nearby streams. The LRPD also maintains a Facebook page at www.facebook.com/Lakeredstonepd/.

The LRPD holds an annual discussion with local farmers. In 2017, this event was held on July 18 at the Summit Restaurant. The new rainfall simulator that was purchased with support from the LRPD was used to demonstrate how different substrates and land use affect rainfall infiltration. The LRPD also provided a letter of support for Sauk County's application for a new RCPP grant for the Baraboo River Watershed.

Dredging has been a hot topic throughout 2017 and 2018 with LRPD officers continuing to work on what is necessary to get a dredging project underway.

In February 2018, the LRPD applied for Healthy Lakes grant funding from the WDNR to support two shoreland habitat improvement projects on the lake. One was a native plant planting project and the other a rock infiltration project. Both were completed in the summer of 2018.

Three members of the LRPD Board attended the WAL Lake Conference in Steven's Point April 18-20, 2018.

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