Sagittaria, a Native Species That Looks Like Flowering Rush, Is in Forest Lake, July 27, 2021

Flowering Rush Delineation, Treatment, and Assessment for Forest Lake, Washington County, Minnesota, 2021

Pre-Treatment Delineation: *Based on areas of heavy growth from 2020*
1st Treatment: July 26, 2021: 7.67 ac
Post Treatment Assessment and Delineation: *July 27, 2021*
2nd Treatment: August 13, 2021: 3.0 ac
Post Treatment Assessment: *September 9, 2021*
3rd Treatment: September 13, 2021: 3.0 ac
Post Treatment Assessment: *October 18, 2021*

Prepared for:
Washington County and Comfort Lake - Forest Lake Watershed District

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Blue Water Science

December 1, 2021

Flowering Rush Delineation, Control, and Assessment for Forest Lake, Washington County, Minnesota, 2021

Summary

In 2021, the first Forest Lake flowering rush treatment was conducted on July 26, 2021 and consisted of a diquat application over 7.67 acres in delineated treatment areas that were based on flowering rush growth from a July 21, 2020 flowering rush survey.

On July 27, 2021, a flowering rush delineation was conducted and 75 sites of flowering rush covering about 0.6 acres were delineated. The second diquat application was for spot treatment of small individual patches as well as for patches that were grouped closely together. The total application area was approximately 3.0 acres.

The next assessment survey was conducted on September 9, 2021 and new flowering rush sprouts were found at 98 sites with an estimated area of flowering rush coverage of 0.44 acres. A total of 3.0 acres of spot treatments using diquat was conducted on September 13, 2021.

In Forest Lake, the total area of flowering rush has decreased from 7.8 acres in 2014 to 0.13 acres in October of 2021 indicating the flowering rush control program is reducing the distribution and density of flowering rush (Figure S1). Although the estimated total area of flowering rush was around 0.13 acres in October of 2021, flowering rush regrowth is expected in 2022. Continuing to control areas of flowering rush should reduce abundant regrowth but it appears eradication will be a challenge.

The steps for controlling flowering rush in the next few years include the following three methods.

1. Treat large continuous patches of flowering rush with diquat and spot treat small patches.
2. Treating small patches should occur 2 or 3 times/season.
3. Continue to remove flowerheads before seeds are produced which should help reduce new sites of flowering rush colonization.

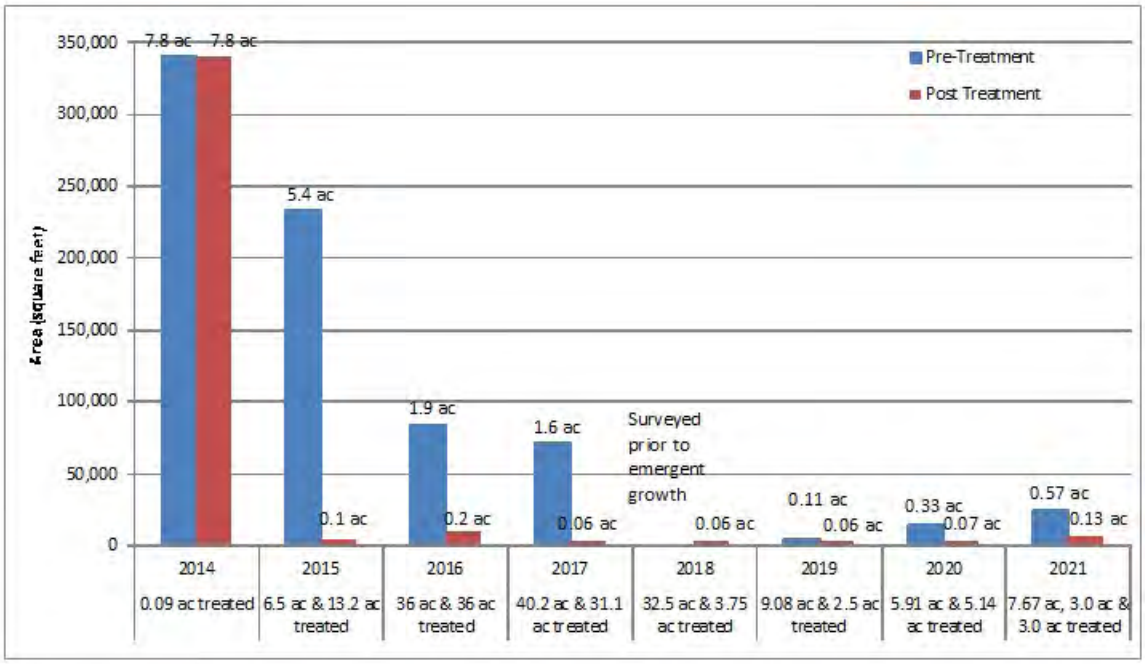


Figure S1. Flowering rush areas from 2014 through 2021 for pre-treatment and post treatment conditions.

Summary of Flowering Rush Treatments and Results for 2014-2021

A summary of flowering rush treatments and results over the previous 8 years are shown in Table S1. Flowering rush has decreased from 7.8 acres in 2014 to 0.13 acres on October 18, 2021 roughly, a decrease of about 99% from 2014. Regrowth in 2021 occurred at a number of persistent areas located in 2nd and 3rd lakes and 62 new sites of colonization were recorded.

At the end of 2021, there have been a total of 373 flowering rush sites identified. Often a flowering rush site is only 10 stems or less. Although large beds of flowering rush of over 1,000 square feet occur, they are rarely found after the second treatment. In 2021, the average size of a flowering rush site at the first delineation was 329 square feet which is more compared to the initial delineations in 2017 (Table S1).

Although a total of 373 flowering rush sites have been identified over the last 8 years, 20% of the sites had flowering rush growth in the July 27, 2021 delineation survey. After 3 treatments, flowering rush was found at 17% of the known sites, with a flowering rush patch averaging 88 square feet per site.

It appears flowering rush does not sprout every year at every site, however, it apparently continues to produce new growth at new sites as the summer progresses. Therefore a delineation in July will not delineate all the flowering rush for the summer. New growth will occur in August and September.

Although new flowering rush sites are found annually, the number of new flowering rush sites per year has averaged 32 sites per year for 2017-2021. The number of new sites found annually have decreased since flowering rush flowerheads have been removed from 2017-2021. Prior to flower and seedhead removal, new flowering rush sites averaged 52 new sites per year in 2015 and 2016.

Table S1. Summary of flowering rush sites and areas for 2014-2021.

	All Known Flowering Rush Sites at Start of the Year	New Sites	Total Known Flowering Rush Sites	Flowering Rush Sites with Plants		Flowering Rush (acres)		Average Size of Flowering Rush Patch (square feet)		Percent of All Previously Recorded Sites with Flowering Rush		Acres of Flowering Rush Treated per Application	Total Acres Treated
				start	end	start	end	start	end	start	end		
2014	--	--	142	--	142	7.8	7.8	--	2393	--	100%	0.9 ac	0.9
2015	142	72	214	107	120	5.4	0.1	2198	36	75%	56%	13.2 ac (2 times)	26.4
2016	214	32	246	182	81	1.9	0.2	455	107	87%	33%	36 ac (2 times)	72.0
2017	246	4	250	159	15	1.6	0.06	438	174	65%	1%	40.2 ac and 30.1 ac	70.3
2018	250	ND	250	ND	108	ND	0.06	ND	24	ND	43%	32.5 ac and 3.8 ac	36.3
2019	250	37	287	83	76	0.11	0.06	58	34	33%	27%	9.1 ac and 2.5 ac	11.6
2020	287	24	311	145	53	0.33	0.07	100	53	47%	17%	5.91 ac and 5.14 ac	11.1
2021	311	62	373	75	65	0.57	0.13	329	88	20%	17%	7.67 ac, 3.0 ac, 3.0 ac	13.7

Additional details of flowering rush in all 3 lake basins are shown in Table S2.

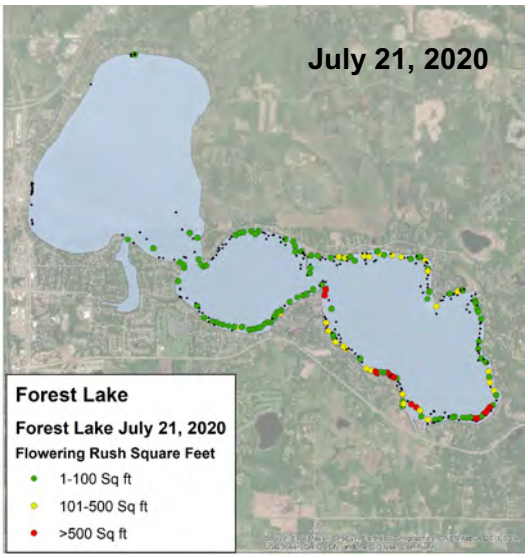
Table S2. Summary of flowering rush sites and areas for 2014 through 2021.

Total Sites	1st Lake		2nd Lake		3rd Lake		Total	
	Number of sites with plants	Area (sf)	Number of sites with plants	Area (sf)	Number of sites with plants	Area (sf)	Number of sites with plants	Area (sf)
July 22, 2014 (Delineation)	0	0	34	3,750	--	336,990 (estimated based on Oct 8 survey)	34+ (not including 3rd lake)	340,740 (estimated) (7.8 ac)
2nd Lake was treated with diquat on 0.09 ac on September 9, 2014								
October 8, 2014 (Assessment)	0	0	26	3,135	116	336,990	142	340,125 (7.8 ac)
July 17, 2015 (Delineation)	0	0	22	2,360	85	230,939	107	233,299 (5.4 ac)
2nd and 3rd Lakes were treated by cutting in July and August; 3rd Lake treated with diquat twice in August, 2015 (13.2 ac)								
September 28, 2015 (Assessment)	11	170	20	237	88	4,004	120	4,411 (0.1 ac)
(new sites compared to 2014)	(11)	--	(13)	--	(25)	--	(49)	--
July 14 and 15, 2016 (Delineation)	4	100	46	33,000	132	50,000	182	83,189 (1.9 ac)
2nd and 3rd Lakes were treated with diquat twice in August, 2016 (36 ac)								
September 21, 2016 (Assessment)	0	0	21	305	60	8,818	81	9,183 (0.2 ac)
(new sites compared to 2015)	(0)	--	(0)	--	(3)	--	(3)	--
August 1, 2017 (Delineation)	4	170	37	1,735	118	69,190	159	71,095 (1.6 ac)
2nd and 3rd Lakes were treated with diquat twice, once in August (40.2) and once in September, 2017 (30.1 ac)								
October 23, 2017 (Assessment)	1	20	4	150	10	2,485	15	2,655 (0.06 ac)
(new sites compared to 2016)	(1)	--	(1)	--	(5)	--	(7)	--
July 5, 2018 (Pre-treatment survey)	no emergent plants observed	--	no emergent plants observed	--	no emergent plants observed	--	no emergent plants observed	--
12 areas, delineated in 2017 totaling 32.5 acres were treated with diquat on July 13, 2018.								
July 25, 2018 (Survey)	0	0	73	2,540	54	1,280	127	3,820 (0.09 ac)
Spot treatment of 125 patches totaling 3.75 acres on August 21, 2018.								
September 19, 2018 (Post treatment assessment)	0	0	54	1,160	54	1,566	108	2,726 (0.06 ac)
July 9, 2019 (Pre-treatment survey)	4		34		43		83 (13 new)	4,990 (0.11 ac)
9.1 acres plus spot treatments on July 31, 2019								
August 12, 2019 (Survey)	11		26				105 (17 new)	18,505 (0.42 ac)
Spot treatment of 105 patches totaling 2.5 acres on August 30, 2019.								
September 30, 2019 (Post treatment assessment)	1		21		54		76 (7 new)	2,790 (0.06 ac)
(new sites compared to 2018)	(5)	--	(22)	--	(10)	--	(37)	--
July 21, 2020 (Pre-treatment survey)	7		44		94		145 (21 new)	14,562 (0.33 ac)
5.91 acres plus spot treatments on August 6, 2020.								
August 26, 2020 (Survey)	5		43		83		131 (0 new)	26,330 (0.60 ac)
5.14 ac spot treatments on September 2, 2020								
October 12, 2020 (Post treatment assessment)	0		7		46		53 (3 new)	3,200 (0.07 ac)
(new sites compared to 2019)	(3)	--	(10)	--	(11)	--	(24)	--

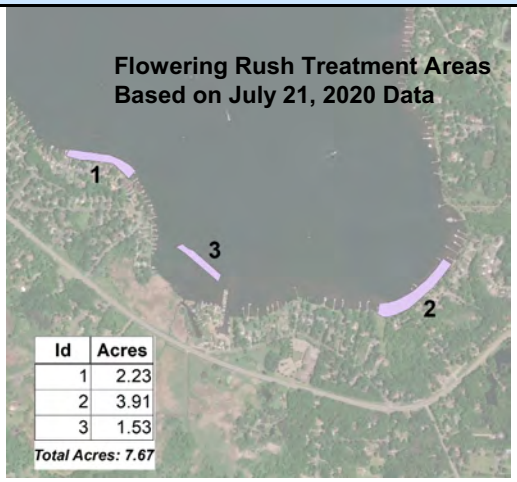
Table S2. Summary of flowering rush sites and areas for 2014 through 2021.

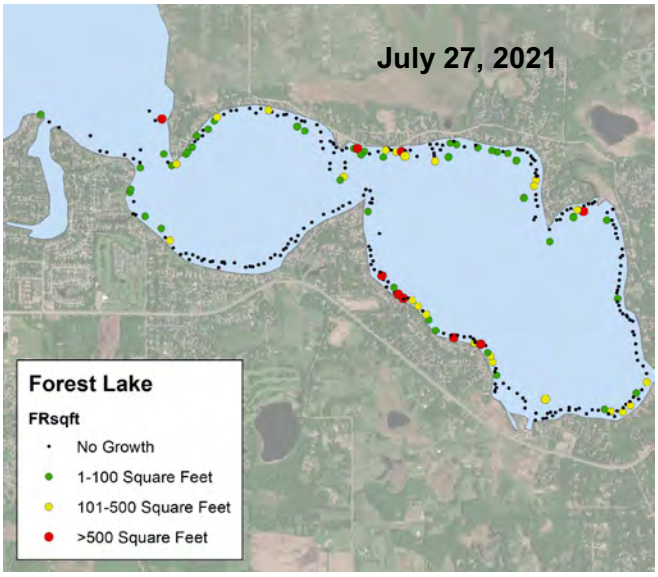
Total Sites	1st Lake		2nd Lake		3rd Lake		Total	
	Number of sites with plants	Area (sf)	Number of sites with plants	Area (sf)	Number of sites with plants	Area (sf)	Number of sites with plants	Area (sf)
7.67 acres plus spot treatments on July 26, 2021.								
July 27, 2021 (Pre-treatment survey)	4	1,640	20	1,295	53	2,190	75 (14 new)	24,695 (0.57 ac)
3.0 acres of spot treatments on August 13, 2021.								
September 9, 2021 (Survey)	26	1,923	26	4,540	51	14,169	98 (46 new)	19,082 (0.44 ac)
3.0 ac of spot treatments on September 13, 2021.								
October 18, 2021 (Post treatment assessment)	11	825	19	1,490	35	3,415	65 (2 new)	5,695 (0.13 ac)
(new sites compared to 2020)	(18)	--	(29 less)	--	(84 less)	--	(62)	--

Flowering Rush Delineations, Treatments, and Assessments in 2021

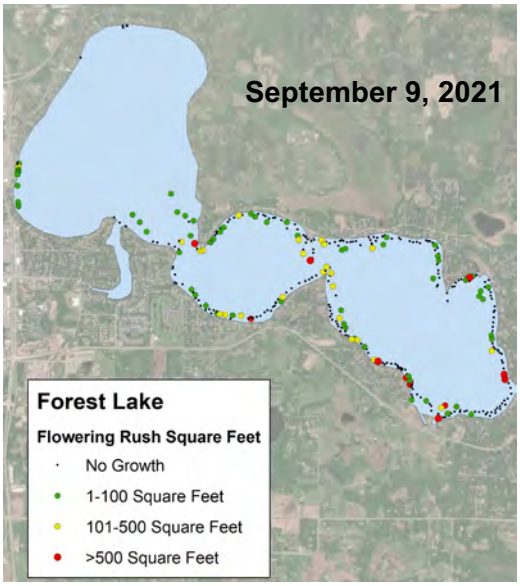


Polygon Treatments
July 26, 2021 (7.67 ac)

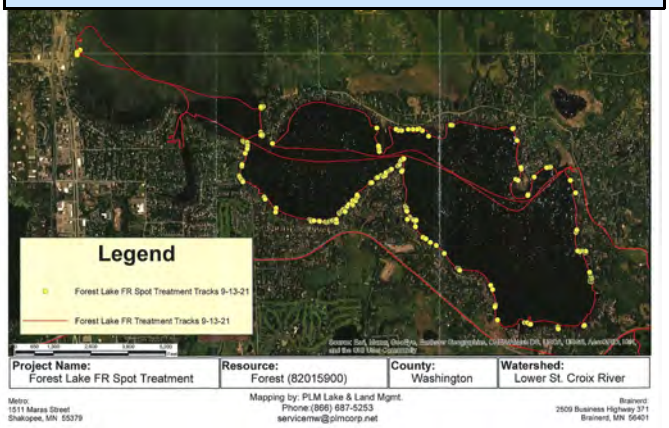




Spot Treatments
August 13, 2021 (3.0 ac)



Spot Treatments
September 13, 2021 (3.0 ac)



Flowering Rush Status After Final Treatments from 2014-2021

At the middle of October 2021, the area of flowering rush was about 99% less compared to 2014. The number of sites, usually less than 88 square feet per site, also declined slightly compared to 2014. Maps of flowering rush assessments for 2014-2021 are shown in Figure S2.

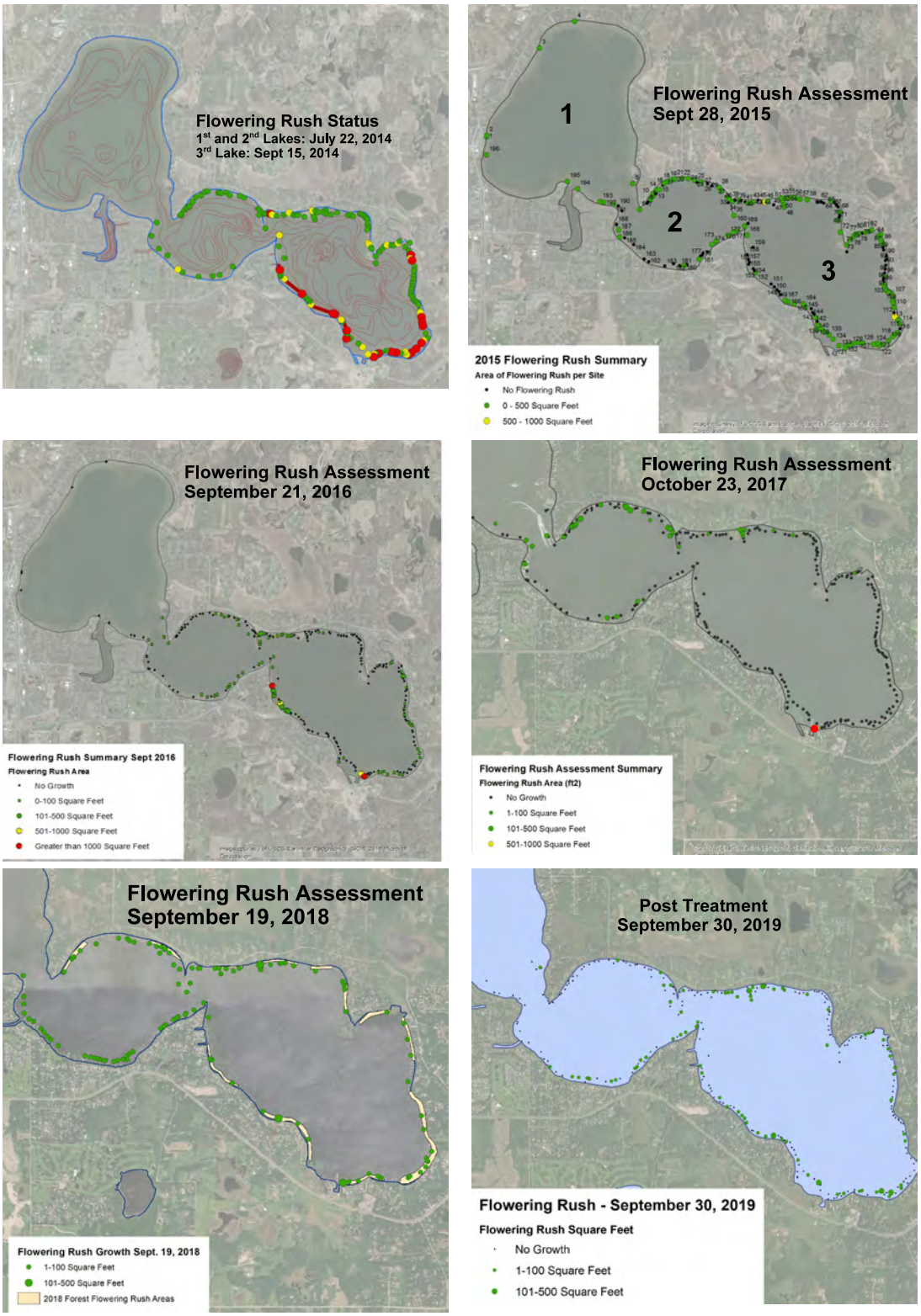
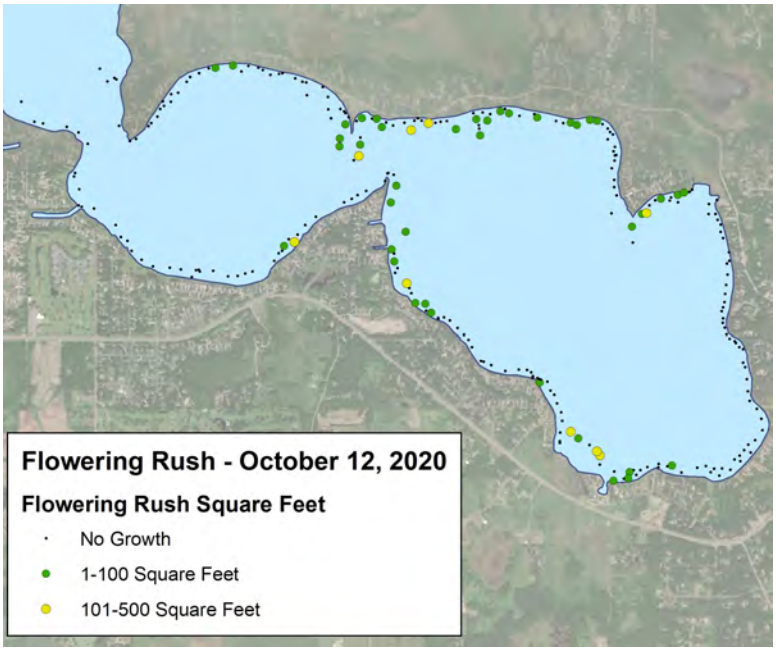


Figure S2. Estimated flowering rush coverage. [top-left] Sept 2014: 340,125 square feet (sf)(only 0.09 acres were treated). [top-right] Sept 2015: 4,411 sf. [middle-left] Sept 2016: 9,183 sf. [middle-right] October 2017: 2,655 sf. [bottom-left] Sept 2018: 2,726 sf. [bottom-right] Sept 2019: 2,790 sf.

Flowering Rush Status After Final Treatments from 2014-2021 (Concluded)



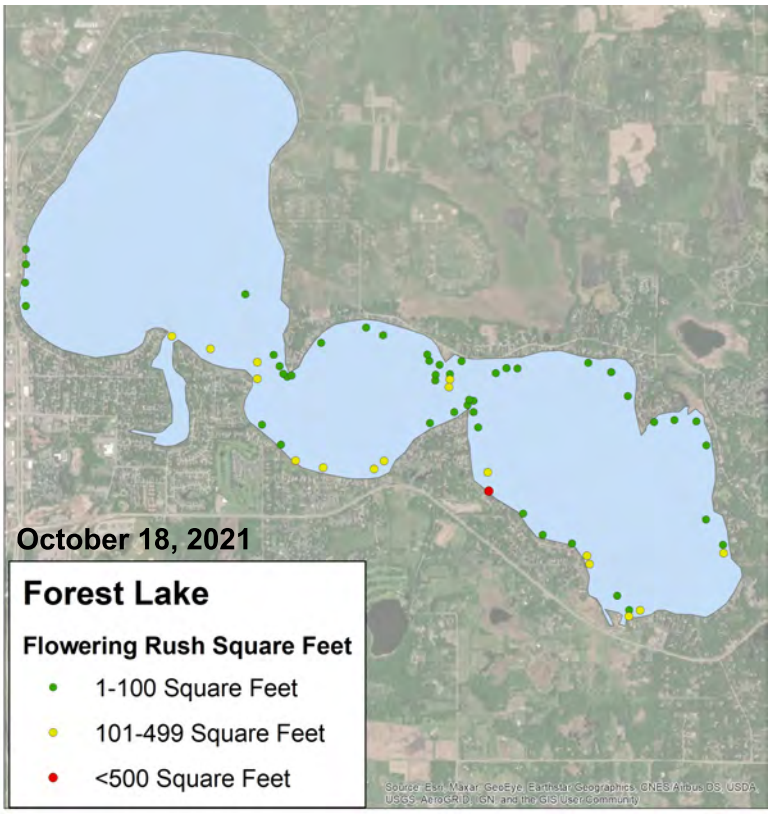


Figure S2 concluded. Estimated flowering rush coverage. [top] October 2020, 3,200 square feet (sf). [bottom] October 2021, 5,695 sf.

ADDITIONAL INFORMATION

Flowering Rush Delineation, Control, and Assessment for Forest Lake, Washington County, Minnesota, 2021

Overview: Flowering rush (*Butomus umbellatus*) is an invasive species and is actively expanding in the United States. It has spread from a limited area around the Great Lakes and the St. Lawrence river to sporadic appearances in the northern U.S. and southern Canada. Populations in the eastern U.S. produce seeds. Only one Minnesota population (Forest Lake, Washington County) produces viable seeds. Otherwise, flowering rush reproduces by vegetative spread from its rootstock in the form of rhizome buds. Both seeds and rhizome buds are dispersed by water current.

Flowering rush competes with native shoreland vegetation and is on the DNR prohibited invasive species list in Minnesota.

A management and control program for flowering rush in Forest Lake was initiated in 2014 and has continued through 2021.

Methods: In 2021 emergent flowering rush in 1st (Upper), 2nd (Middle), and 3rd (Lower) Lakes was delineated with meandering surveys. After treatments, meandering surveys were conducted to evaluate treatment effectiveness. For the delineation and assessment, 2 observers in a boat traveled the entire lake nearshore area and searched for emergent flowering rush stems. A record of the occurrence of all lowering rush sites since 2014 has been recorded by GPS and was placed on the lake map of the Lowrance HDS7 sonar unit. During the survey, a flowering rush occurrence was either associated with a previous point or was assigned a new GPS point if it had not previously been observed at that location. For each flowering rush observation site, an estimated square footage of emergent growth was recorded. In 2021, the pre-treatment delineation was based on areas of heavy growth from 2020. The post treatment assessment and delineation was conducted on July 27 and the assessments were conducted on September 9 and October 18. A summary of surveys and treatments from 2014 through 2021 is shown in Table 1.

Table 1. Surveys and treatments in 2014 through 2021.

2014 - Year 1
Delineation of 1st and 2nd Lakes: July 22, 2014
Delineation of 3rd Lake: September 15, 2014
Herbicide Treatment in 2nd Lake: September 9, 2014 (0.09 ac)
Assessment of 2nd Lake: September 28, 2014

2015 - Year 2
Delineation of 1st, 2nd, and 3rd Lakes: July 17, 2015
Cutting in 2nd and 3rd Lakes: July and August, 2015
Herbicide Treatments in 3rd Lake: August 4 (6.5 ac) and 26 (13.2 ac), 2015
Assessment of 1st, 2nd, and 3rd Lakes: September 28, 2015

2016 - Year 3
Delineation of 1st, 2nd, and 3rd Lakes: July 14 and 15, 2016
Herbicide Treatments in 3rd Lake: August 3 (36 ac) and 31 (36 ac), 2016
Assessment of 1st, 2nd, and 3rd Lakes: September 21, 2016

2017 - Year 4
Delineation of 1st, 2nd, and 3rd Lakes: August 1,2017
Herbicide Treatments in 2nd and 3rd Lake: August 14 (40.2 ac) and September 27 (31.1 ac), 2017
Assessment of 1st, 2nd, and 3rd Lakes: October 23, 2017

2018 - Year 5
Pre-treatment point intercept survey: July 5, 2018
Treatment: July 13, 2018 (32.5 ac)
Point Intercept Survey Combined with a Meandering Survey: July 25, 2018
Spot Treatments in 2nd and 3rd Lake: August 21, 2018 (3.75 ac)
Post Treatment Assessment: September 19, 2018

2019 - Year 6
Delineation of 1st, 2nd, and 3rd Lakes: July 9, 2019
Spot Herbicide Treatments in 2nd and 3rd Lake: July 31, 2019 (9.08 ac)
Assessment of 1st, 2nd, and 3rd Lakes: August 12, 2019
Spot Herbicide Treatments in 2nd and 3rd Lake: August 30, 2019 (2.5 ac)
Assessment of 1st, 2nd, and 3rd Lakes: September 30, 2019

2020 - Year 7
Delineation of 1st, 2nd, and 3rd Lakes: July 21, 2020
Spot Herbicide Treatments in 2nd and 3rd Lake: August 2, 2020 (5.91 ac)
Assessment of 1st, 2nd, and 3rd Lakes: August 26, 2020
Spot Herbicide Treatments in 2nd and 3rd Lake: September 2, 2020 (5.14 ac)
Assessment of 1st, 2nd, and 3rd Lakes: October 12, 2020

2021 - Year 8
Delineation of 1st, 2nd, and 3rd Lakes: Based on areas of heavy growth from 2020
Spot Herbicide Treatments: July 26, 2021 (7.67 ac)
Assessment and Delineation of 1st, 2nd, and 3rd Lakes: July 27, 2021
Spot Herbicide Treatments in 2nd and 3rd Lake: August 13, 2021 (3.0 ac)
Assessment of 1st, 2nd, and 3rd Lakes: September 9, 2021
Spot Herbicide Treatments in 2nd and 3rd Lake: September 13, 2021 (3.0 ac)
Assessment of 1st, 2nd, and 3rd Lakes: October 18, 2021

Figure 1. The 3 basins in Forest Lake.

Flowering Rush Delineation Based on Areas of Heavy Growth from 2020 and Treatment

Sites of flowering rush that were observed on July 21, 2020 are shown in Figure 2. Based on this delineation, control efforts on July 26, 2021 were implemented using diquat and treating pre-emergent flowering rush in 3 areas totaling 7.67 acres (Figure 2).

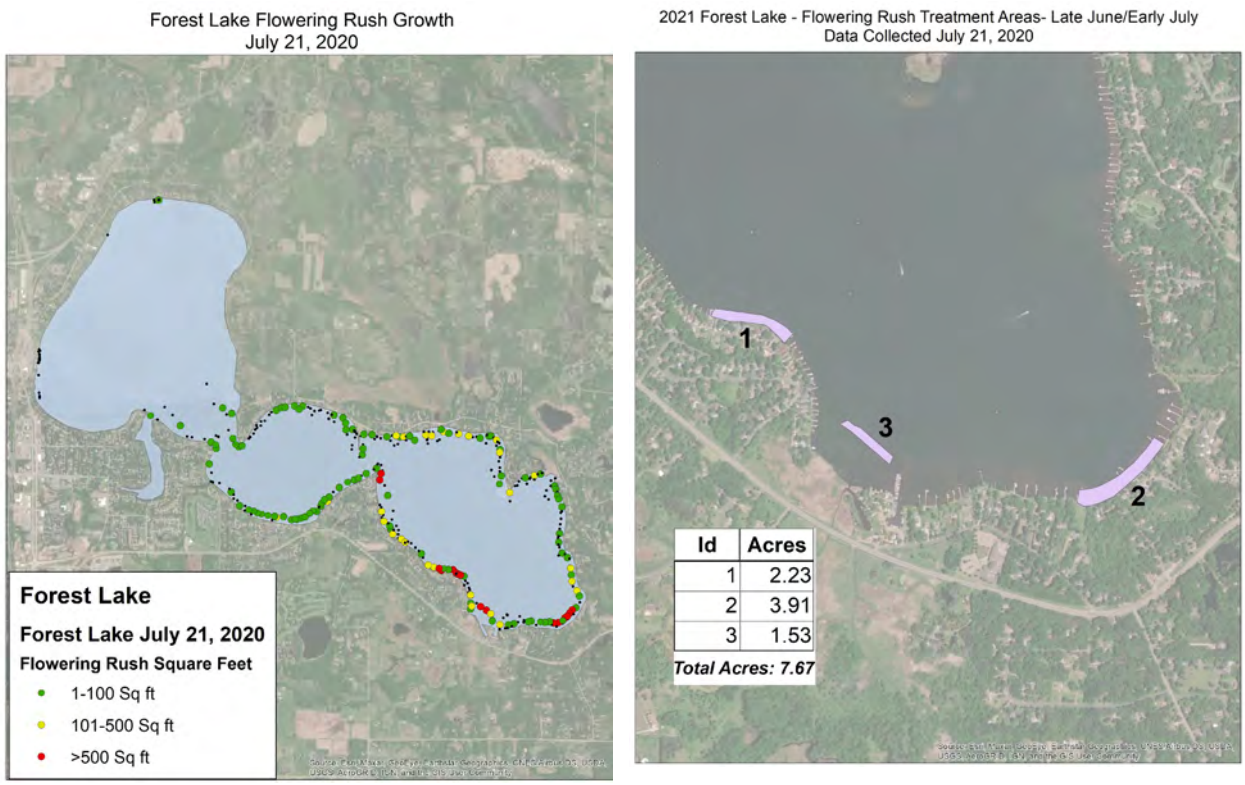


Figure 2. [left] Flowering rush delineation on July 21, 2020. Flowering rush locations are shown with colored dots and green polygons indicate continuous beds of flowering rush. Black dots indicate flowering rush was not observed in 2020 but was observed in previous years.
[right] Flowering rush treatment area for July 26, 2021 using diquat (Tribune).

Flowering Rush Assessment and Delineation on July 27, 2021

All flowering rush sites that were delineated in 2014 through 2020 were checked on July 27, 2021. Areas that were treated on July 26, 2021 were assessed. If new occurrences were spotted then a new waypoint was made. Sites of flowering rush that were observed on July 27, 2021 are shown in Figure 3. Based on this delineation, control efforts were implemented using diquat with spot treatments for individual patches. Diquat applications were also used over larger areas with scattered patches relatively close together or on large beds that were delineated.

A pre-treatment delineation is shown in Figure 3. A total of 75 flowering rush sites were observed with a total areas of 3.0 acres. In addition, small patches of flowering rush were treated as well. The treatment map is shown in Figure 4.

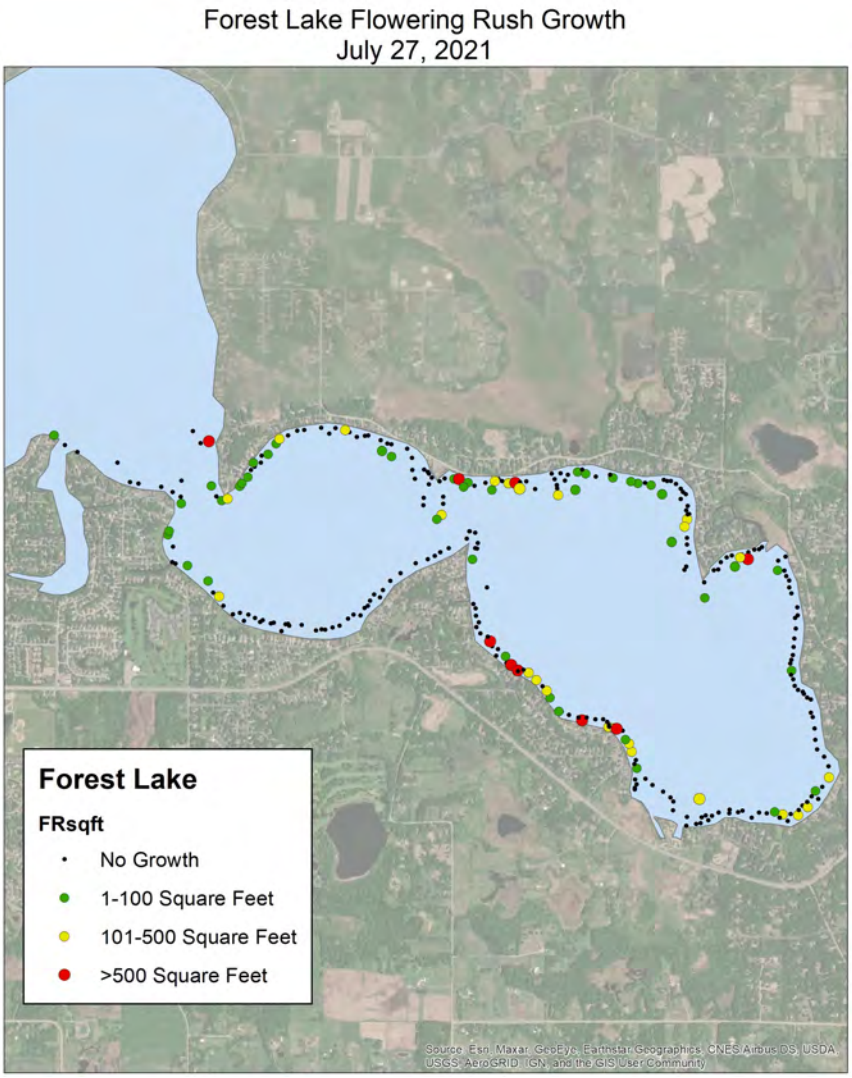


Figure 3. Flowering rush assessment and delineation on July 27, 2021. Flowering rush locations are shown with colored dots. Black dots indicate flowering rush was not observed in 2021 but was observed in previous years.

Forest Lake Flowering Rush Herbicide Treatment, August 13, 2021

On August 13, 2021 a total of 3.0 acres were treated with diquat (Brand name Tribune) at a dose of 2 gallons per acre (Figure 4). The average depth used in the treatment areas was 4 feet.

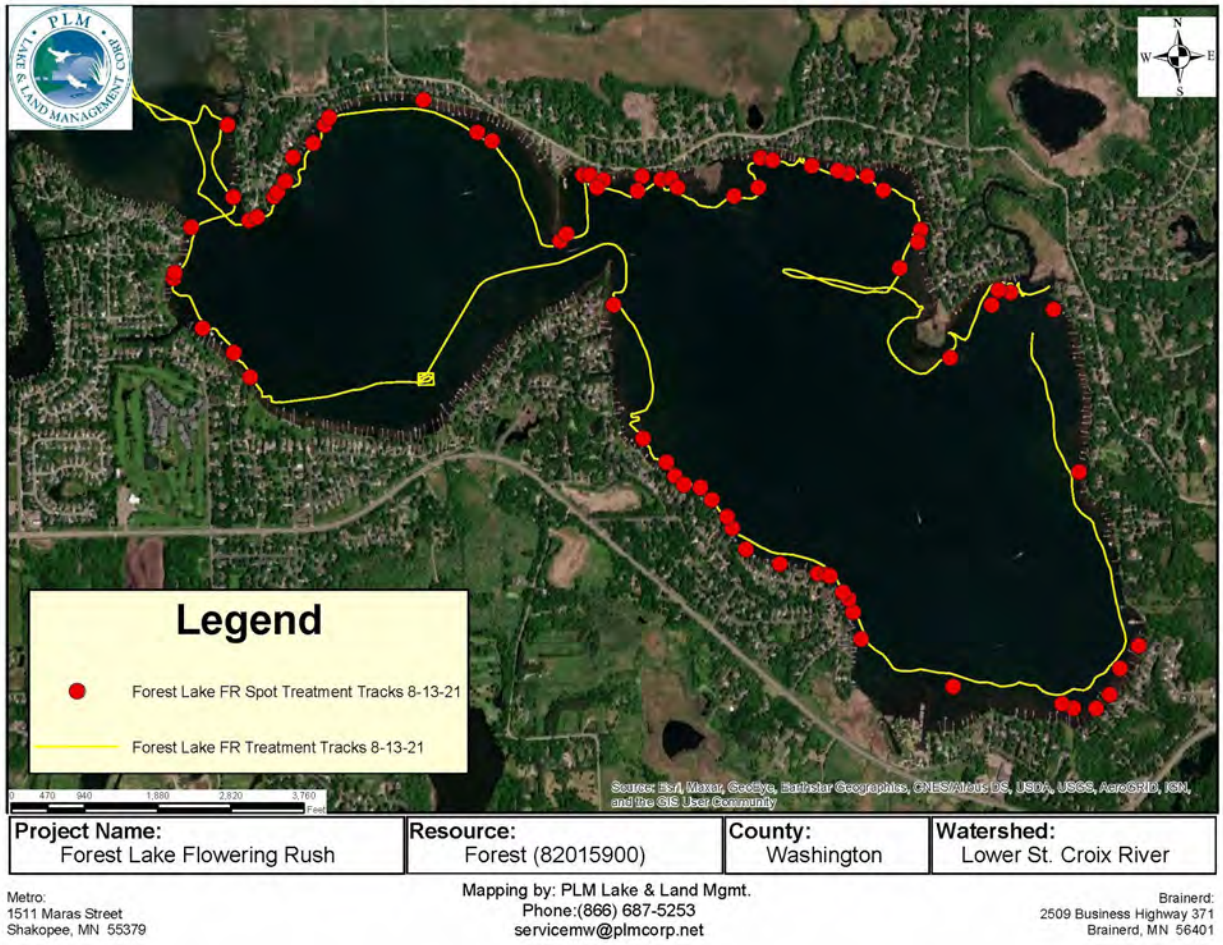


Figure 4. Flowering rush treatment area for August 13, 2021 using diquat (Tribune).

Flowering Rush Assessment on September 9, 2021

At a number of sites where flowering rush was treated, there was very good control based on the assessment survey on September 9, 2021. Also there was very good control in the large delineated flowering rush beds that were treated. Most of the remaining flowering rush that was observed consisted of small, discrete patches that likely sprouted after the July 27 delineation (Figure 5). The September 9, 2021 survey also served as a delineation for the second treatment. A total of 98 sites with a total area of 3.0 acres were delineated for treatment (Figure 5).

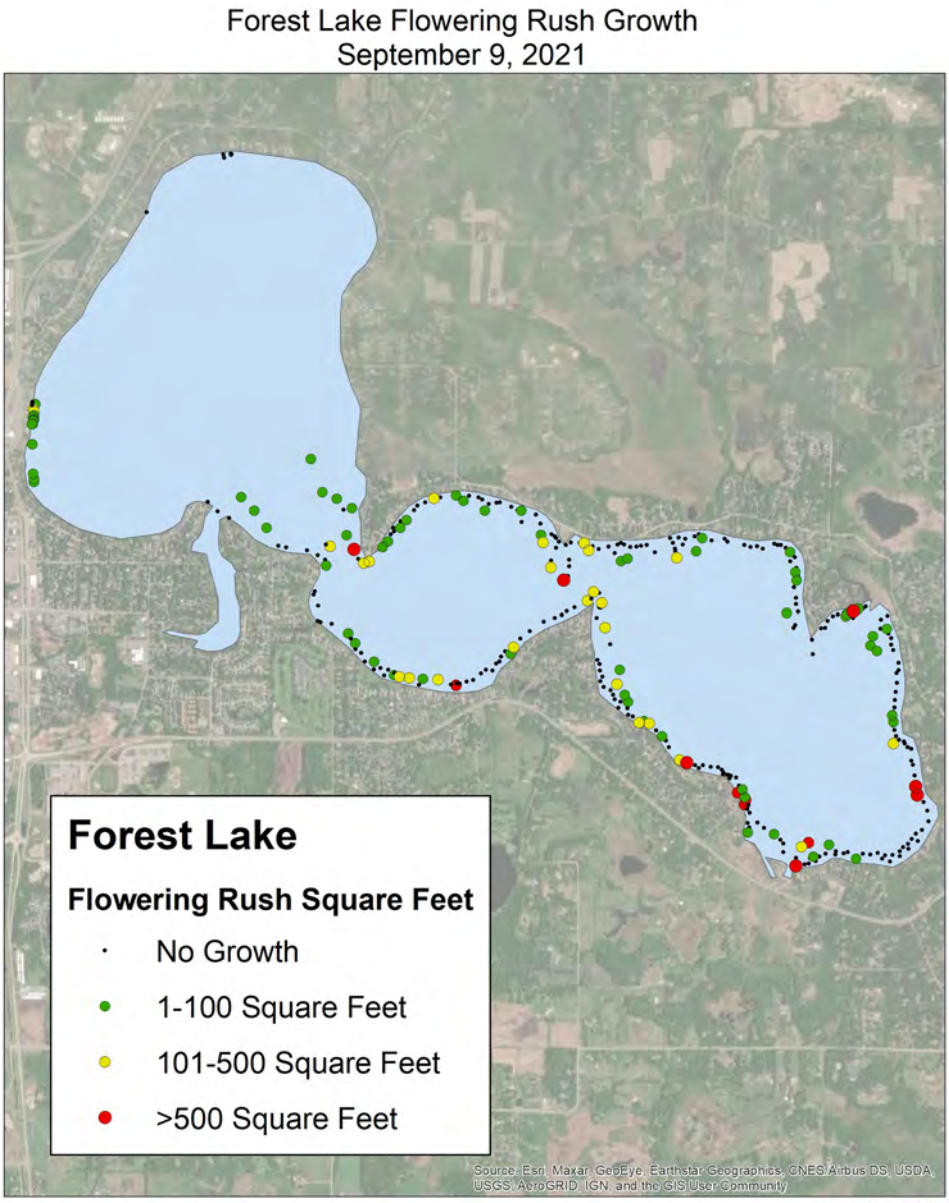
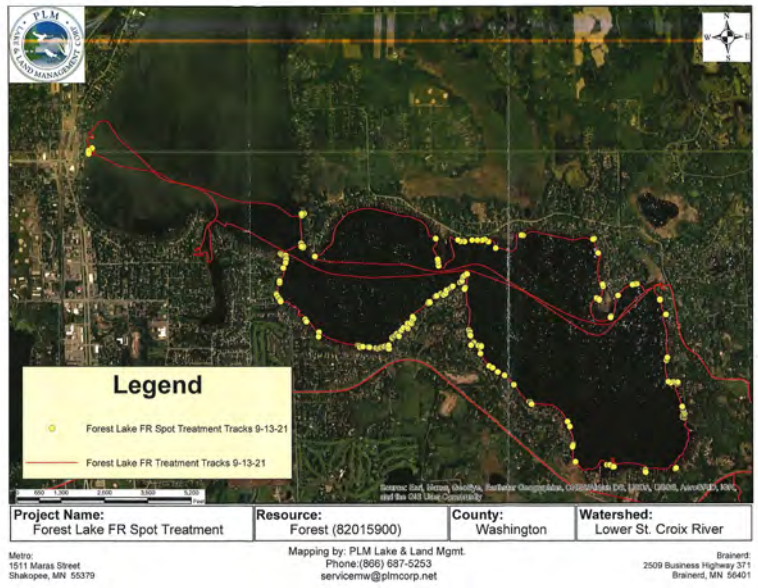


Figure 5. Flowering rush September 9, 2021 treatment of 3.0 acres.

Flowering Rush Second Treatment on September 13, 2021 and Assessment on October 18, 2021

On the second diquat treatment, spot treatments and polygon treatments on September 13, 2021 covered 3.0 acres of flowering rush (Figure 6).

On October 18, 2021, a final assessment was conducted. Overall flowering rush control was good. Flowering rush was observed at 65 out of 373 known sites recorded over the previous 8 years totaling 0.13 acres.



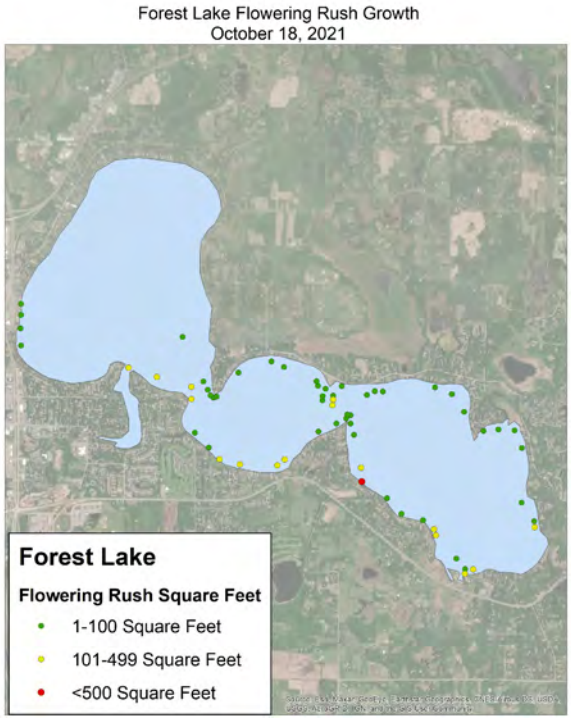


Figure 6. [top] Flowering rush September 13, 2021 treatment of 3.0 acres.
[bottom] Flowering rush occurrence from the October 18, 2021 meandering survey after the second treatment.

Summary of Flowering Rush Treatments and Results for 2014-2021

A summary of flowering rush treatments and results over the previous 8 years are shown in Table S1. Flowering rush has decreased from 7.8 acres in 2014 to 0.13 acres on October 18, 2021 roughly, a decrease of about 99% from 2014. Regrowth in 2021 occurred at a number of persistent areas located in 2nd and 3rd lakes and 62 new sites of colonization were recorded.

At the end of 2021, there have been a total of 373 flowering rush sites identified. Often a flowering rush site is only 10 stems or less. Although large beds of flowering rush of over 1,000 square feet occur, they are rarely found after the second treatment. In 2021, the average size of a flowering rush site at the first delineation was 329 square feet which is more compared to the initial delineations in 2017 (Table 2).

Although a total of 373 flowering rush sites have been identified over the last 8 years, 20% of the sites had flowering rush growth in the July 27, 2021 delineation survey. After 3 treatments, flowering rush was found at 17% of the known sites, with a flowering rush patch averaging 88 square feet per site.

It appears flowering rush does not sprout every year at every site, however, it apparently continues to produce new growth at new sites as the summer progresses. Therefore a delineation in July will not delineate all the flowering rush for the summer. New growth will occur in August and September.

Although new flowering rush sites are found annually, the number of new flowering rush sites per year has averaged 32 sites per year for 2017-2021. The number of new sites found annually have decreased since flowering rush flowerheads have been removed from 2017-2021. Prior to flower and seedhead removal, new flowering rush sites averaged 52 new sites per year in 2015 and 2016.

Table 2. Summary of flowering rush sites and areas for 2014-2021.

	All Known Flowering Rush Sites at Start of the Year	New Sites	Total Known Flowering Rush Sites	Flowering Rush Sites with Plants		Flowering Rush (acres)		Average Size of Flowering Rush Patch (square feet)		Percent of All Previously Recorded Sites with Flowering Rush		Acres of Flowering Rush Treated per Application	Total Acres Treated
				start	end	start	end	start	end	start	end		
2014	--	--	142	--	142	7.8	7.8	--	2393	--	100%	0.9 ac	0.9
2015	142	72	214	107	120	5.4	0.1	2198	36	75%	56%	13.2 ac (2 times)	26.4
2016	214	32	246	182	81	1.9	0.2	455	107	87%	33%	36 ac (2 times)	72.0
2017	246	4	250	159	15	1.6	0.06	438	174	65%	1%	40.2 ac and 30.1 ac	70.3
2018	250	ND	250	ND	108	ND	0.06	ND	24	ND	43%	32.5 ac and 3.8 ac	36.3
2019	250	37	287	83	76	0.11	0.06	58	34	33%	27%	9.1 ac and 2.5 ac	11.6
2020	287	24	311	145	53	0.33	0.07	100	53	47%	17%	5.91 ac and 5.14 ac	11.1
2021	311	62	373	75	65	0.57	0.13	329	88	20%	17%	7.67 ac, 3.0 ac, 3.0 ac	13.7

Summary of Flowering Rush Response to Treatments from 2014-2021

Summary of flowering rush areas before and after treatments for 2014 through 2021 are shown in Tables 3 and 4.

Table 3. Summary of flowering rush treatments and resulting flowering rush remaining at the end of the summer from 2014-2021.

	Initial Flowering Rush Area (acres)	TREATMENTS				End of Season		
		1st Treatment (ac)	2nd Treatment (ac)	3rd Treatment (ac)	Total Acres Treated	Flowering Rush Area (acres)	Flowering Rush Sites	Flowering Rush Average Individual Size (sf)
2014	7.8	0.09	--		0.09	7.8*	142	2,392
2015	5.4	6.5	13.2		19.7	0.1	120	37
2016	1.9	36	36		72	0.2	81	113
2017	1.6	40.2	31.1		71.3	0.06**	15	177**
2018	no emergent FR	32.5	3.75		36.25	0.06	108	25
2019	0.11	9.08	2.5		11.58	0.06	76	37
2020	0.33	5.91	5.14		11.05	0.07	53	60
2021		7.67	3.0	3.0	13.67	0.13	65	87

*Treatment was a trial on a small area to test herbicide effectiveness.
**One flowering rush bed in 3rd lake was 2,000 sf (0.05 ac) which accounted for much of the FR acreage in 2017.

Figure 7. Examples of flowering rush observed on September 30, 2019.

Table 4. Summary of flowering rush sites and areas for 2014 through 2021.

Total Sites	1st Lake		2nd Lake		3rd Lake		Total	
	Number of sites with plants	Area (sf)	Number of sites with plants	Area (sf)	Number of sites with plants	Area (sf)	Number of sites with plants	Area (sf)
July 22, 2014 (Delineation)	0	0	34	3,750	--	336,990 (estimated based on Oct 8 survey)	34+ (not including 3rd lake)	340,740 (estimated) (7.8 ac)
2nd Lake was treated with diquat on 0.09 ac on September 9, 2014								
October 8, 2014 (Assessment)	0	0	26	3,135	116	336,990	142	340,125 (7.8 ac)
July 17, 2015 (Delineation)	0	0	22	2,360	85	230,939	107	233,299 (5.4 ac)
2nd and 3rd Lakes were treated by cutting in July and August; 3rd Lake treated with diquat twice in August, 2015 (13.2 ac)								
September 28, 2015 (Assessment)	11	170	20	237	88	4,004	120	4,411 (0.1 ac)
(new sites compared to 2014)	(11)	--	(13)	--	(25)	--	(49)	--
July 14 and 15, 2016 (Delineation)	4	100	46	33,000	132	50,000	182	83,189 (1.9 ac)
2nd and 3rd Lakes were treated with diquat twice in August, 2016 (36 ac)								
September 21, 2016 (Assessment)	0	0	21	305	60	8,818	81	9,183 (0.2 ac)
(new sites compared to 2015)	(0)	--	(0)	--	(3)	--	(3)	--
August 1, 2017 (Delineation)	4	170	37	1,735	118	69,190	159	71,095 (1.6 ac)
2nd and 3rd Lakes were treated with diquat twice, once in August (40.2) and once in September, 2017 (30.1 ac)								
October 23, 2017 (Assessment)	1	20	4	150	10	2,485	15	2,655 (0.06 ac)
(new sites compared to 2016)	(1)	--	(1)	--	(5)	--	(7)	--
July 5, 2018 (Pre-treatment survey)	no emergent plants observed	--	no emergent plants observed	--	no emergent plants observed	--	no emergent plants observed	--
12 areas, delineated in 2017 totaling 32.5 acres were treated with diquat on July 13, 2018.								
July 25, 2018 (Survey)	0	0	73	2,540	54	1,280	127	3,820 (0.09 ac)
Spot treatment of 125 patches totaling 3.75 acres on August 21, 2018.								
September 19, 2018 (Post treatment assessment)	0	0	54	1,160	54	1,566	108	2,726 (0.06 ac)
July 9, 2019 (Pre-treatment survey)	4		34		43		83 (13 new)	4,990 (0.11 ac)
9.1 acres plus spot treatments on July 31, 2019								
August 12, 2019 (Survey)	11		26				105 (17 new)	18,505 (0.42 ac)
Spot treatment of 105 patches totaling 2.5 acres on August 30, 2019.								
September 30, 2019 (Post treatment assessment)	1		21		54		76 (7 new)	2,790 (0.06 ac)
(new sites compared to 2018)	(5)	--	(22)	--	(10)	--	(37)	--
July 21, 2020 (Pre-treatment survey)	7		44		94		145 (21 new)	14,562 (0.33 ac)
5.91 acres plus spot treatments on August 6, 2020.								
August 26, 2020 (Survey)	5		43		83		131 (0 new)	26,330 (0.60 ac)
5.14 ac spot treatments on September 2, 2020								
October 12, 2020 (Post treatment assessment)	0		7		46		53 (3 new)	3,200 (0.07 ac)
(new sites compared to 2019)	(3)	--	(10)	--	(11)	--	(24)	--

Table 4. Summary of flowering rush sites and areas for 2014 through 2021.

Total Sites	1st Lake		2nd Lake		3rd Lake		Total	
	Number of sites with plants	Area (sf)	Number of sites with plants	Area (sf)	Number of sites with plants	Area (sf)	Number of sites with plants	Area (sf)
7.67 acres plus spot treatments on July 26, 2021.								
July 27, 2021 (Pre-treatment survey)	4	1,640	20	1,295	53	2,190	75 (14 new)	24,695 (0.57 ac)
3.0 acres of spot treatments on August 13, 2021.								
September 9, 2021 (Survey)	26	1,923	26	4,540	51	14,169	98 (46 new)	19,082 (0.44 ac)
3.0 ac of spot treatments on September 13, 2021.								
October 18, 2021 (Post treatment assessment)	11	825	19	1,490	35	3,415	65 (2 new)	5,695 (0.13 ac)
(new sites compared to 2020)	(18)	--	(29 less)	--	(84 less)	--	(62)	--