

Noxon Rapids Reservoir and Cabinet Gorge Reservoir Herbicide Pretreatment Survey Report 2024 Season

Prepared for: The Sanders County Aquatic Invasive Plants Task Force

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THE **OUTSIDE** IS IN US ALL.

Craig R McLane

Montana Fish, Wildlife, & Parks

1420 E 6th Ave, Helena, MT 59601

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Overview

Montana Fish, Wildlife, & Parks (FWP) partnered with The Sanders County Aquatic Invasive Plants Task Force since 2018 to survey multiple plots within Noxon Rapids Reservoir and Cabinet Gorge Reservoir. This effort guides annual treatment of Eurasian watermilfoil (EWM) within the reservoirs. In 2024, FWP staff surveyed 18 EWM plots under consideration for treatment and seven untreated, control plots June 17-21, 2024. In 2024, crews sampled these waters about 1 month earlier than typical to try and treat these reservoirs earlier than the typical treatments that occur in August. Those locations, noted in Figure 1, cover the length of both reservoirs.

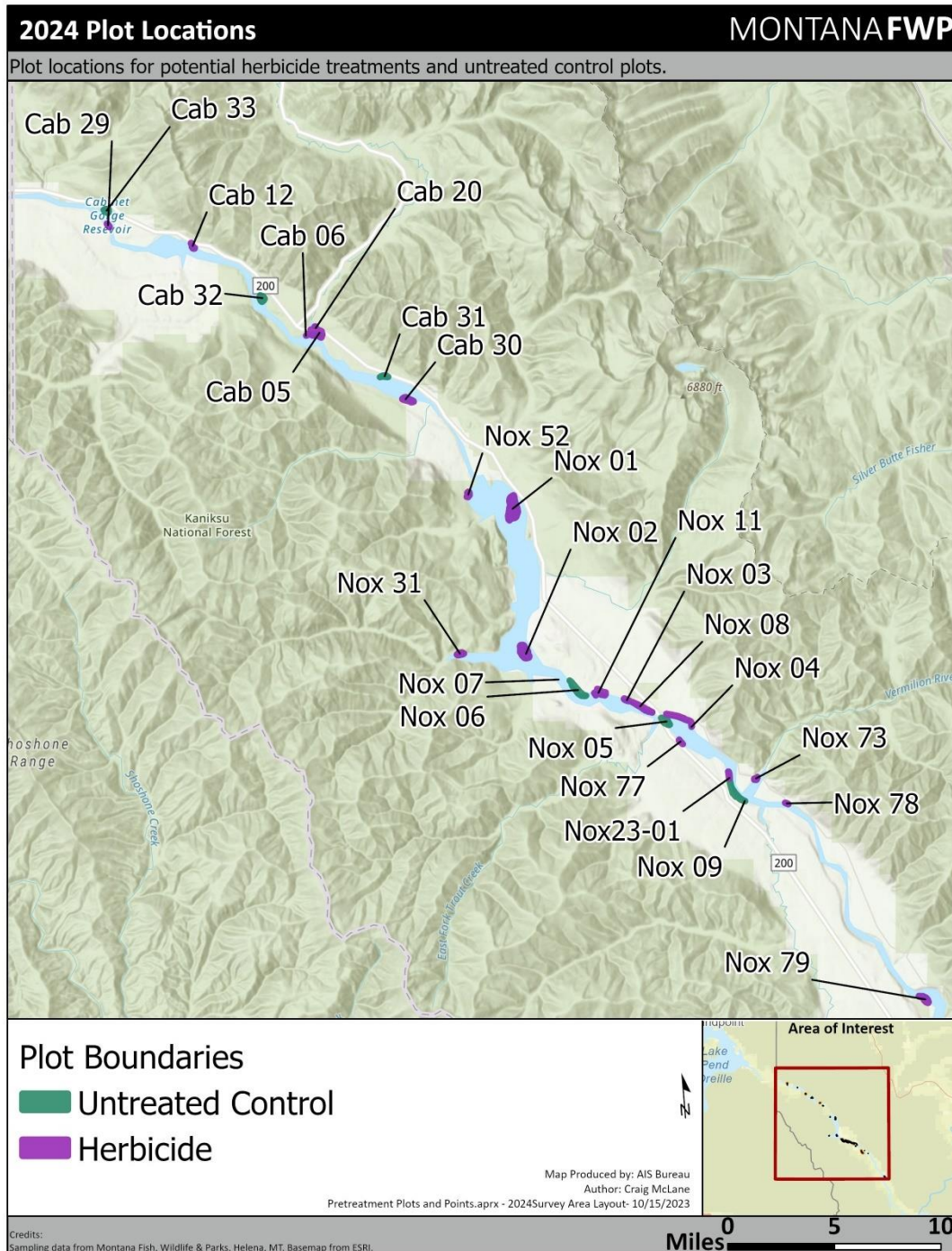


Figure 1. Locations of Survey Plots on Noxon Rapids and Cabinet Gorge Reservoirs, 2024.

Sampling Methods:

In each assigned area, FWP picked a certain number of random points. Table 1 shows the details of each area, its size, and the points sampled by FWP in 2024. The sizes of these areas were decided based on past surveys, and changes were made if more points were needed. The number of points in each area depended on its size, with bigger areas needing more points. If the shape was complicated, more points were used.

In 2020, three control areas were added for each reservoir (one more additional plot on Noxon Reservoir in 2023) to check for changes in abundance due to environmental changes like water temperature and clarity. FWP plans to keep sampling both control and treatment areas into the future.

The first task was to determine a suitable method to estimate the amount of plants at each plot. Density looks at the number of plants in a defined area (e.g., 2 plants/m²). Density would be too labor intensive to determine so is not used since this would require intensive sampling methods such as scuba divers. Estimating plant abundances seemed easier to accomplish. Visual estimations of abundance at a plot level can be inaccurate (e.g. plants in plots are patchy with dense and sparse areas, reduced water clarity, etc.). Canopy cover is often used in terrestrial settings to quantitatively estimate plant abundances, so FWP adapted its use in an aquatic setting.

Canopy cover is the amount (as a percentage) of area a plant species covers if looking at it from above or below (2-dimensional). A plant with a canopy cover value of 80% suggests that 80% of that area is covered by this plant species. Because plants can be under other plants, they are treated independent of other plants, so it is possible to have 100% coverage for more than one species. To complete canopy cover estimates the goal is to sample the same amount of area at each point to make the points comparable. A 1m² quadrat to estimate canopy cover is often used but seeing to the bottom of the lake is hard or impossible for technicians due to turbidity, plant growth on the surface, or wave/surface glare. Short of using divers to accomplish this, FWP decided to utilize rakes attached to long poles to collect plant samples from the lake bottom.

Table 1. List of plots surveyed and their approximate surveyed areas and number of sample points.

Plot	Potentially Treat/ Control	Approx. Plot Size (ac)	#Sample Points
C05	Potential Treat	21.4	28
C06	Potential Treat	7.8	22
C12	Potential Treat	3.7	23
C20	Potential Treat	3.2	15
C29	Potential Treat	1.9	16
C30	Potential Treat	16.1	52
C31	Control	4.4	20
C32	Control	9.6	18
C33	Control	8.0	19
N01	Potential Treat	98.3	99
N02	Potential Treat	50.9	55
N03	Potential Treat	3.3	26
N04	Potential Treat	8.7	55
N05	Control	16.8	12
N06	Control	22.4	32
N08	Potential Treat	14.4	55
N09	Control	16.8	20
N11	Potential Treat	21.1	63
N23-01	Control	3.3	14
N31	Potential Treat	7.7	33
N52	Potential Treat	5.4	19
N73	Potential Treat	1.3	15
N77	Potential Treat	1.6	22
N78	Potential Treat	0.65	13
N79	Potential Treat	15.3	36

Table 2. Cover class and range used during coverage sampling efforts for all years after 2019.

Cover Class	Range of Coverage	Midpoint of Range
0	0%	0.0%
1	1% to 2%	1.5%
2	3% to 5%	3.6%
3	6% to 15%	10.1%
4	16% to 25%	20.1%
5	26% to 40%	32.6%
6	41% to 60%	50.1%
7	61% to 75%	67.6%
8	76% to 85%	80.1%
9	86% to 95%	90.1%
10	96%-100%	97.6%

Technicians collected a sample on both sides the boat at each point using the rakes. This provides a consistent sample area at each point. After a 720-degree spin on the lakebed, technicians estimated the percentage of rake fullness for each species. This rake fullness was used to assign each species at each point a canopy cover by averaging both technicians' results. These canopy covers were then averaged within the whole plot to get a plot-level canopy cover for each species. Like the Daubenmire Method of estimating canopy cover, FWP used predetermined canopy cover classes and the associated midpoints for the coverage calculations (shown in Table 2) (Coulloudon et al, 1999). Treatment areas were then identified based on Eurasian watermilfoil plot-level canopy cover in the result maps. Results were also compared across different years to try to identify any trends.

Results:

The following subsections with this results section are as follows:

- Table showing acreage and canopy cover abundance for Eurasian watermilfoil for each plot (2019-2024)6
- Table showing acreage and canopy cover abundance for curlyleaf pondweed for each plot (2019-2024)7
- Species level differences among plots from 2019 – 20248
- Plot-level percent change of canopy cover in last year (2023-2024) and since 2019 (6 years)10
- Percent canopy cover abundances for each year from 2019-2024...13

Table 3. Survey results showing acreage of Eurasian watermilfoil and canopy cover abundances within the potential treatment areas and untreated control plots since 2019.

		Eurasian watermilfoil (<i>Myriophyllum spicatum</i>)												Plot Location
Plot	Years Treated	2024		2023		2022		2021		2020		2019		
		Acres	Canopy Cover (%)	Acres	Canopy Cover (%)	Acres	Canopy Cover (%)	Acres	Canopy Cover (%)	Acres	Canopy Cover (%)	Acres	Canopy Cover (%)	
Cab-05	'23; '19	0	0	4.4	7	<0.1	2	4.0	11	1.8	0.1	12.1	7	SE of Bull River Bridge on Hwy 200
Cab-06	'23; '20; '19	<0.1	<1	5.7	12	<0.1	2	<0.1	3	3.7	1	4.2	3	SW of Bull River Bridge on Hwy 200
Cab-12	'24; '20; '19	1.6	4	0.3	1	<0.1	2	<0.1	1	0.3	1	1.7	5	Big Eddy Campground
Cab-20		0.1	<1	0.12	2	<0.1	<1	<0.1	2	0.0	0	0.	0	Bull River Campground
Cab-29	'24; '19	0.7	2	1.1	12	<0.1	2	<0.1	0.2	1.2	1	0.5	1	Heron Boat Ramp
Cab-30	'23; '20; '19	1.8	1	6.3	7	2.3	2	<0.1	0.1	2.1	1	2.3	2	Noxon Community Park
Cab-31 (Untreated Control)		1.4	5	2.7	10	0.7	1	1.9	10	1.9	4	-	-	Northwest of Noxon Bridge
Cab-32 (Untreated Control)		1.75	3	0.5	7	0	0	4.0	6	2.9	19	-	-	Powerline downstream of Bull River
Cab-33 (Untreated Control)		0.3	<1	0	0	0	0	0	0	0	0	-	-	North of Heron Boat Ramp
Nox-01	'23; '22; '21; '19	1.0	<1	60.7	14	41.2	9	35.2	10	0	0	34.0	33	Near Rock Island - Mid Lake
Nox-02	'23; '21; '19	0	0	37.5	7	0	0	32.2	20	25.6	1	21.3	26	Mid Lake entrance to Marten Creek Bay
Nox-03	'23; '22; '21; '20; '19	0.1	<1	4.0	7	1.7	2	1.3	15	1.2	3	1.4	1	North Shore Campground
Nox-04	'24; '23; '22; '21; '20; '19	6.0	10	6.0	7	5.9	18	1.3	3	5.9	5	7.7	5	North Shore Shoreline E of Hwy 200 Bridge
Nox-05 (Untreated Control)		8.0	22	9.2	41	12.4	37	3.6	15	1.2	5	-	-	South Shoreline E of Hwy 200 Bridge
Nox-06 (Untreated Control)		13.3	37	12.9	27	13.6	42	10.4	25	1	27	-	-	North Shoreline West of Train Bridge
Nox-08	'23; '22; '21; '19	3.00	0	13.3	24	0.9	<1	8.5	22	0.3	<1	8.2	2	North Shore Shoreline W of Hwy 200 Bridge
Nox-09 (Untreated Control)		3.5	3	0	0	<0.1	0.1	-	-	0	0	-	-	South Shoreline across from Vermillion Bay
Nox-11	'22; '19	21.1	34	2.8	3	15.9	44	13.5	19	0.1	0	9.6	26	West of Train Bridge on N side
Nox-23-01 (Untreated Control)		0.5	6	<0.1	1	-	-	-	-	-	-	-	-	Private docks W side downstream of Vermillion Bay
Nox-31	'24; '23; '22; '20; '19	3.1	2	3.6	8	2.5	10	<0.1	2	2.1	2	3.7	4	Marten Creek Campground
Nox-52	'24; '22; '19	2.9	2	<0.1	1	2.8	10	<0.1	2	0	0	0.8	1	South Shore Campground
Nox-73	'23	0.1	<1	1.4	9	0	<1	0.5	7	<0.1	<1	0.6	26	Vermillion Bay Boat Ramp
Nox-77	'22	0.1	<1	0.2	2	0.4	19	<0.1	3	0.2	3	0.4	3	Trout Creek Boat Ramp
Nox-78	'23	0.1	1	0.1	3	<0.1	0.2	0	-	0.0	0	0.1	6	Kirby Gulch Boat Ramp
Nox-79		0.2	1	<0.1	1	0	0	-	-	<0.1	0.1	0.7	0.3	Finley Flats Campground

Table 4. Survey results showing acreage of curlyleaf pondweed and canopy cover abundances within the potential Eurasian watermilfoil treatment areas and untreated control plots since 2019. No curlyleaf pondweed has been targeted with herbicide treatments.

Plot	Years Treated	Curlyleaf pondweed (<i>Potamogeton crispus</i>)										Plot Location
		2024		2023		2022		2021		2020		
		Acres	Canopy Cover (%)	Acres	Canopy Cover (%)	Acres	Canopy Cover (%)	Acres	Canopy Cover (%)	Acres	Canopy Cover (%)	
Cab-05	'23; '19	2.3	7	6.3	16	8.9	12	9.0	12	8.1	15	SE of Bull River Bridge on Hwy 200
Cab-06	'23; '20; '19	0.3	1	0	0	0	0	0.0	0	3.7	1	SW of Bull River Bridge on Hwy 200
Cab-12	'24; '20; '19	0	0	0	0	0	<1	0.0	3	1.1	1	Big Eddy Campground
Cab-20		0	0	0	4	0	0	0.0	0	0.4	11	Bull River Campground
Cab-29	'24; '19	0	0	0	0	0	0	0.0	0	0	0	Heron Boat Ramp
Cab-30	'23; '20; '19	0.2	<1	0	0	0	0	0.0	<1	0.4	0	Noxon Community Park
Cab-31 (Untreated Control)		0	0	0	0	0.9	4	0.0	0	0.6	1	Northwest of Noxon Bridge
Cab-32 (Untreated Control)		0	0	4.2	8	5.1	20	0.8	0	0.0	0	Powerline downstream of Bull River
Cab-33 (Untreated Control)		0	0	0	0	0.1	1	0.0	0	0.0	0	North of Heron Boat Ramp
Nox-01	'23; '22; '21; '19	1.6	<1	10.8	1	0	1	11.5	1	17.8	1	Near Rock Island - Mid Lake
Nox-02	'23; '21; '19	0	0	0.5	0	9.6	1	9.0	<1	17.4	2	Mid Lake entrance to Marten Creek Bay
Nox-03	'23; '22; '21; '20; '19	0	0	0.6	3	1.7	4	0.2	3	1.2	4	North Shore Campground
Nox-04	'24; '23; '22; '21; '20; '19	0.8	3	3.6	10	3.3	3	4.9	6	5.9	6	North Shore Shoreline E of Hwy 200 Bridge
Nox-05 (Untreated Control)		0	0	2.0	6	0.5	4	0.5	1	0	0	South Shoreline E of Hwy 200 Bridge
Nox-06 (Untreated Control)		0	0	14.6	9	7.4	18	4.9	10	1.4	1	North Shoreline West of Train Bridge
Nox-08	'23; '22; '21; '19	1.1	10	5.4	7	5.4	16	7.9	17	7.9	11	North Shore Shoreline W of Hwy 200 Bridge
Nox-09 (Untreated Control)		0	0	0	0	0	3	-	-	0	0	South Shoreline across from Vermillion Bay
Nox-11	'22; '19	0.7	<1	9.4	4	0	3	6.1	19	5.8	9	West of Train Bridge on N side
Nox-23-01 (Untreated Control)		0	0	0.2	1	-	-	-	-	-	-	Private docks W side downstream of Vermillion Bay
Nox-31	'24; '23; '22; '20; '19	0.5	7	4.3	6	3.6	13	3.9	27	4.4	21	Marten Creek Campground
Nox-52	'24; '22; '19	0	0	0	1	0	<1	0.0	1	0.1	1	South Shore Campground
Nox-73	'23	<0.1	2	0.4	8	0.6	17	0.6	4	0.6	4	Vermillion Bay Boat Ramp
Nox-77	'22	0	0	0	1	0	0.3	0.0	0	0.1	0.2	Trout Creek Boat Ramp
Nox-78	'23	0	0	0	0	0	0	-	-	0.0	0	Kirby Gulch Boat Ramp
Nox-79		0	0	0	1	0	2	-	-	0.1	0.1	Finley Flats Campground

Species level differences among plots since 2019

The following six figures show the calculated percent canopy cover abundances for each plot since 2019. The grouped bars represent the cumulative total cover including native species, Eurasian watermilfoil, curlyleaf pondweed, and flowering rush within each plot. These graphs allow comparison among plots for each year. Plots where herbicide treatments occurred that year are outlined in light blue boxes.

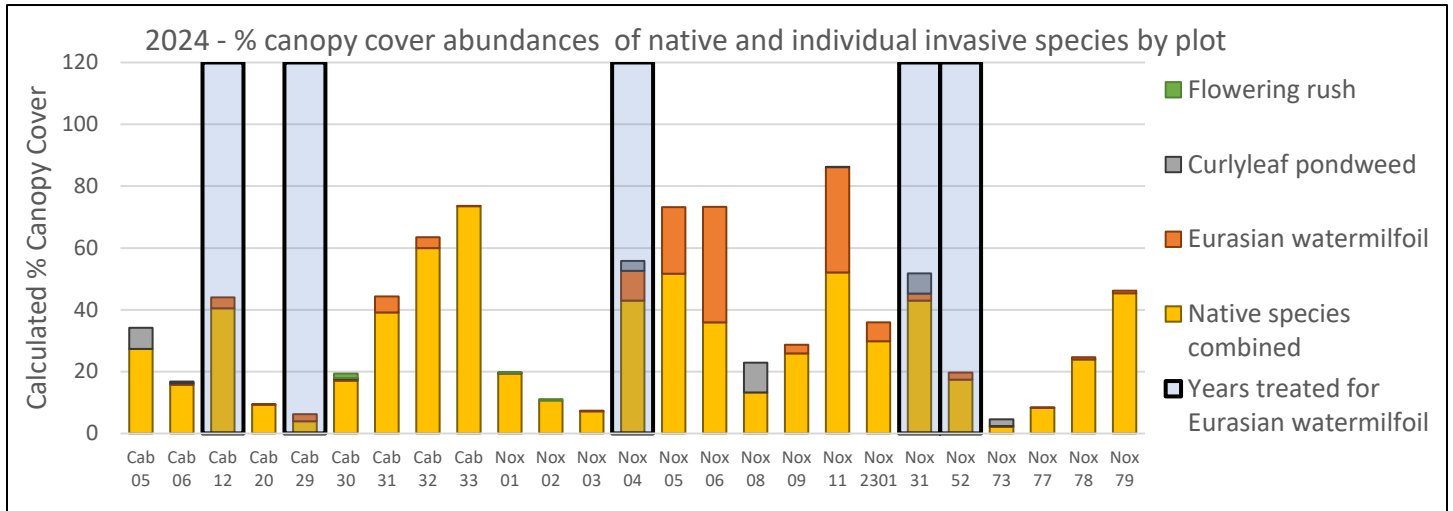


Figure 2. Calculated Canopy Cover (as a %) – 2024

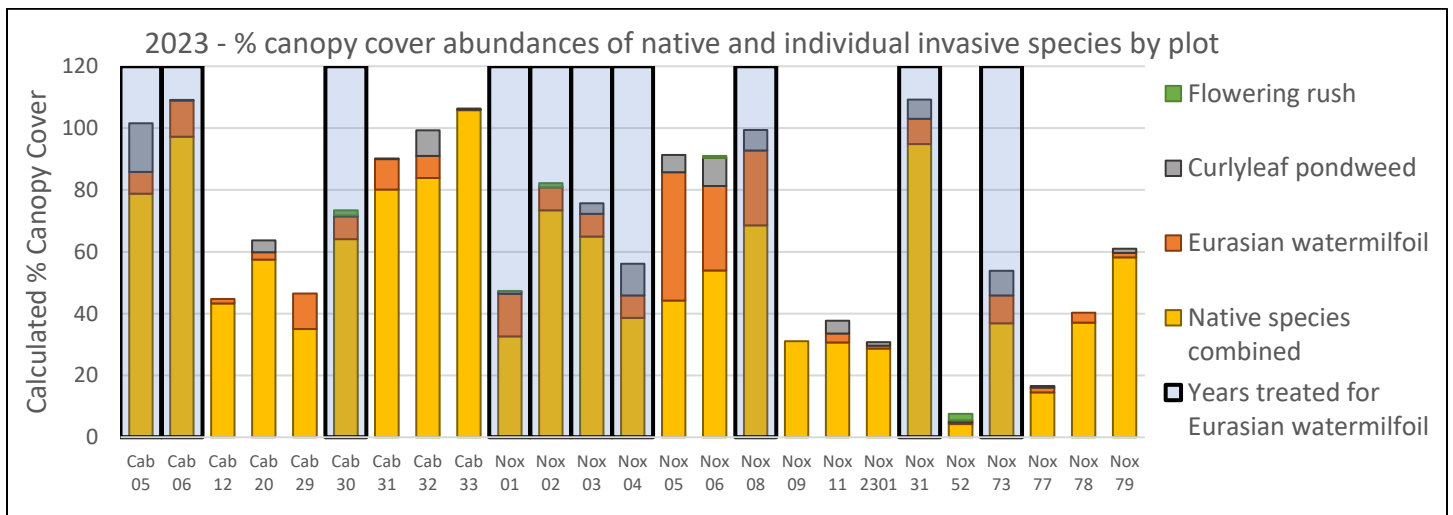


Figure 3. Calculated Canopy Cover (as a %) – 2023

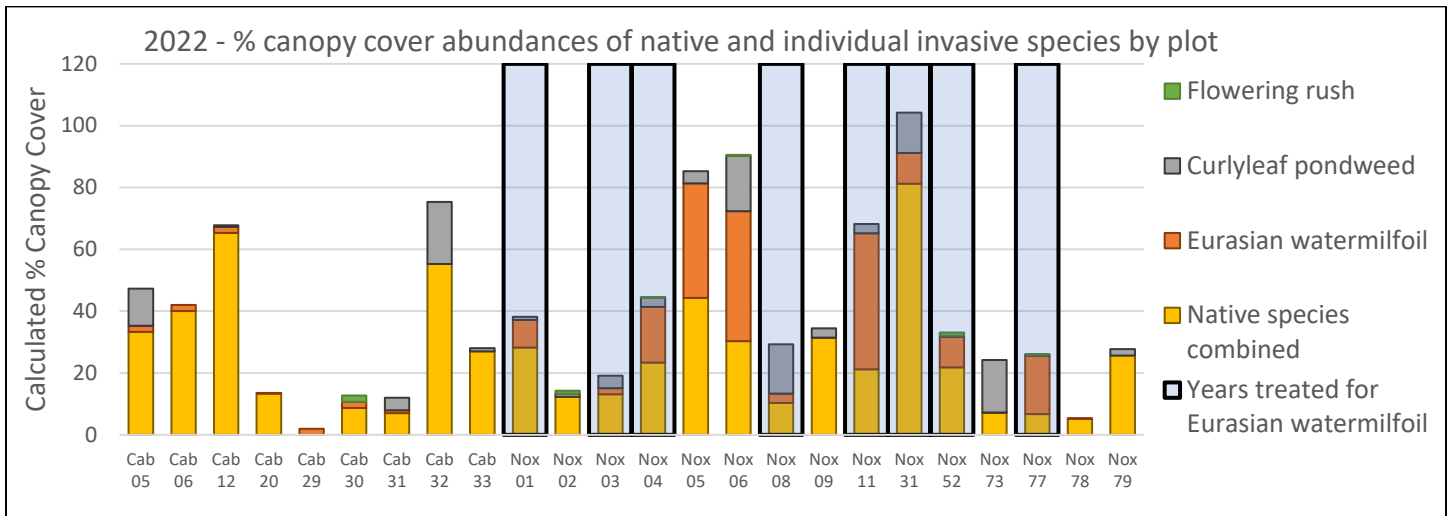


Figure 4. Calculated Canopy Cover (as a %) - 2022.

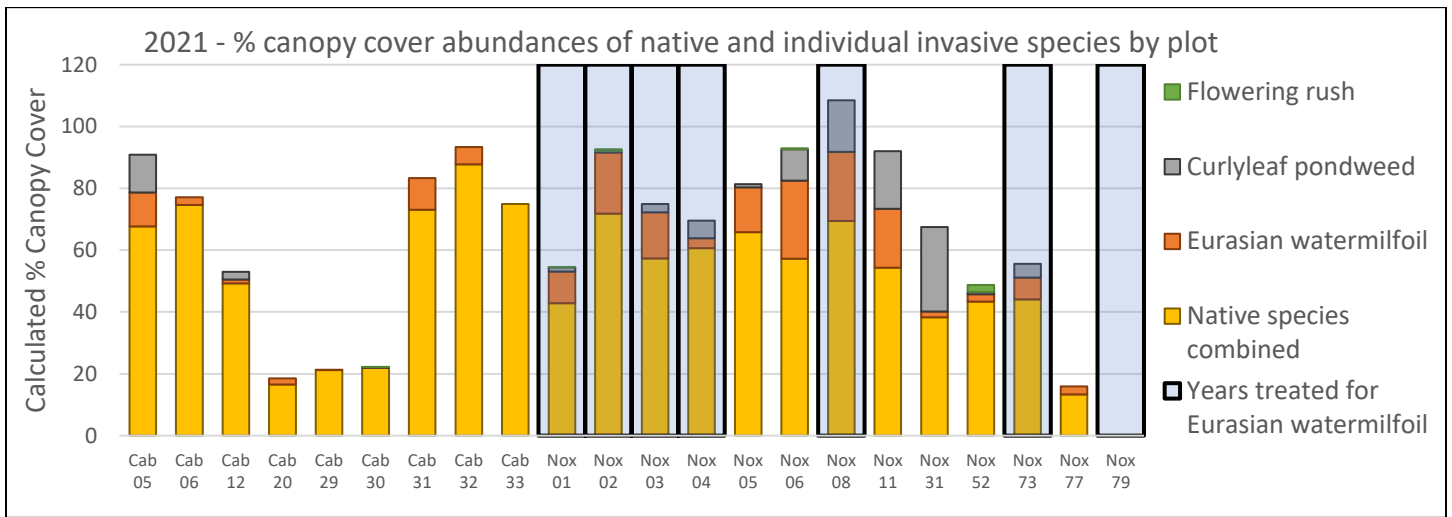


Figure 5. Calculated Canopy Cover (as a %) - 2021.

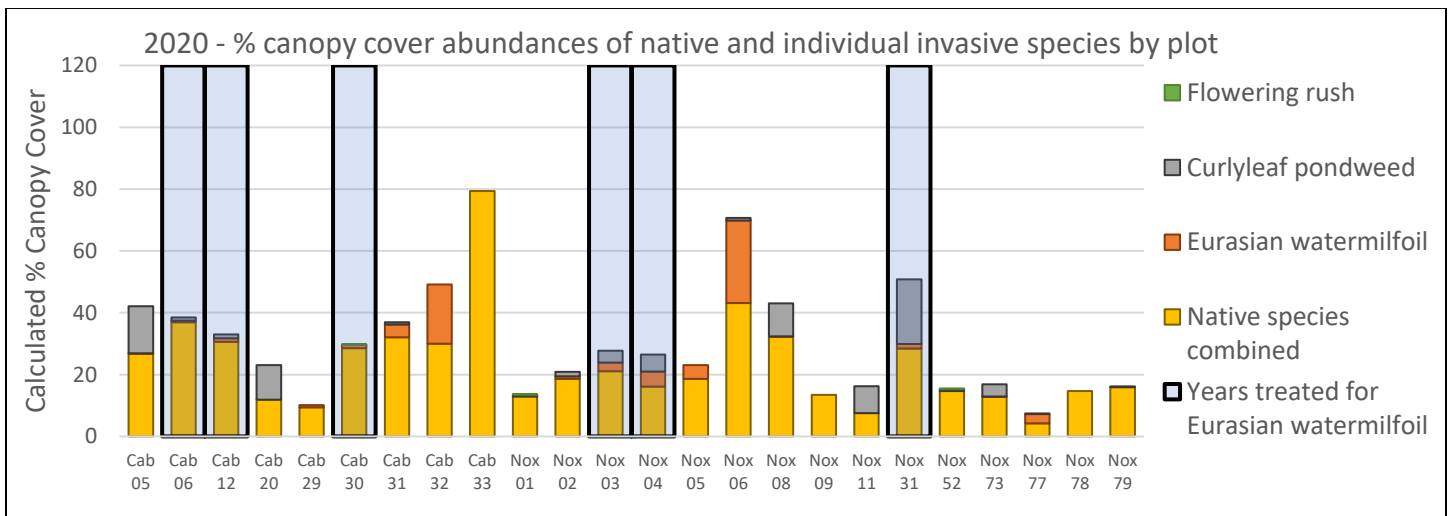


Figure 6. Calculated Canopy Cover (as a %) - 2020.

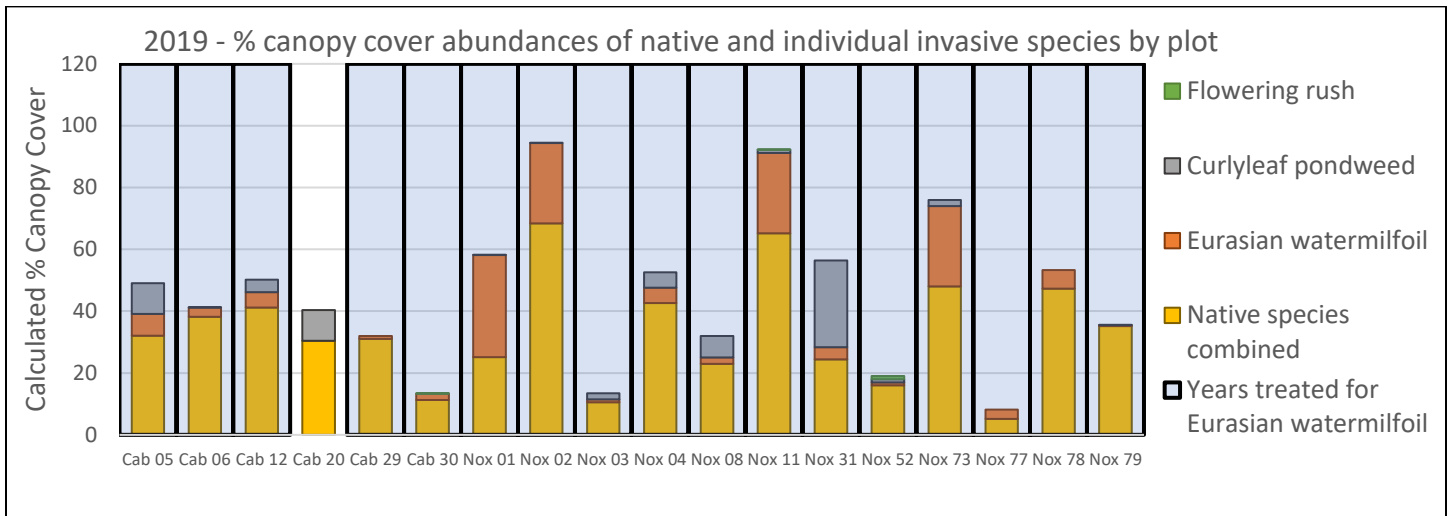


Figure 7. Calculated Canopy Cover (as a %) - 2019.

Percent change of canopy cover in last year (2023-2024) and since 2019 (6 years)

Percent change of canopy cover abundances among years were calculated and results are in the tables below for each species. Table 5 shows the percent change of 2024 compared to 2023 (1-year change) and Table 6 shows the percent change of 2024 compared to 2019 (5-year change). The cells are colored with a gradient of yellow (large decrease) to blue (large increase) depending on the percent change values. Appendix 2 shows tables with the % canopy cover for each species and corresponding 1-year and 6-year percent changes for each plot.

Table 5. Canopy cover percent change over last year (2023-2024).

Canopy cover % change over a year (2023-2024)													
Plot ID	Eurasian Watermilfoil	Curlyleaf Pondweed	Flowering Rush	Coontail	Muskgrass species	Waterweed species	Northern watermilfoil	Naiad species	White-stemmed pondweed	Richardson's pondweed	Other Native Pondweed species	White water-buttercup	
Cabinet Gorge Plots	C05	-100	-57	0	-52	-100	-92	0	0	0	0	-67	
	C06	-96	211	0	-96	0	-85	Up 0.2	0	0	0	-68	
	C12	153	0	0	-42	0	242	Up 0.9	0	0	0	-100	
	C20	-96	-100	0	-53	928	-97	Up 1.7	0	0	-100	-55	
	C29	-81	0	0	0	0	-89	Up 0.2	0	0	0	0	
	C30	-91	-26	-14	-91	-77	-79	0	0	0	-60	-48	Up 0.8
	C31 ^c	-48	-100	0	-27	0	-63	0	0	0	0	0	0
	C32 ^c	-51	-100	0	-38	0	-76	Up 6.0	0	0	0	0	-12
	C33 ^c	-58	-100	0	-25	0	-40	Up 0.2	0	0	0	0	0
Noxon Rapids Plots	N01	-98	-87	-66	-55	-94	-79	30255	-100	-100	-63	-53	-59
	N02	-100	-100	-67	-93	-83	-98	-55	0	Up 3.0	172	-73	-100
	N03	-98	-100	0	-93	-95	-96	0	0	Up 0.1	-38	-11	-76
	N04	32	-69	0	-11	69	191	Up 0.2	-100	Up 1.7	-69	-86	-13
	N05 ^c	-48	-100	0	36	-100	205	0	0	0	Up 0.3	-89	142
	N06 ^c	37	-100	-100	-37	0	-41	0	0	Up 1.1	Up 0.1	-100	137
	N08	-100	44	0	-96	-98	-98	0	0	Up 3.4	0	-15	-100
	N09 ^c	Up 2.8	0	0	12	-100	272	Up 0.2	0	0	0	11	-87
	N11	1087	-97	0	65	-63	433	0	0	Up 0.1	-44	-47	-68
	N2301	536	-100	0	-82	0	47	0	0	0	Up 0.1	-62	145
	N31	-72	4	0	-51	Up 1.0	-79	Up 1.0	0	Up 1.0	Up 2.0	-100	Up 0.2
	N52	310	-100	-100	15	571	Up 3.5	Up 4.2	0	Up 1.1	0	250	0
	N73	-97	-73	0	-99	-100	-86	-79	0	0	-87	237	-89
	N77	-90	-100	0	-22	-89	-82	0	0	0	-43	-19	-27
N78	-76	0	0	-50	0	-15	-100	0	0	0	-100	-100	
N79	-41	-100	0	-1	-90	1	-99	0	0	0	-94	-27	
Plot ID	Eurasian Watermilfoil	Curlyleaf Pondweed	Flowering Rush	Coontail	Muskgrass species	Waterweed species	Northern watermilfoil	Naiad species	White-stemmed pondweed	Richardson's pondweed	Other Native Pondweed species	White water-buttercup	

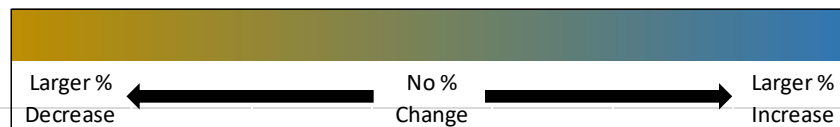
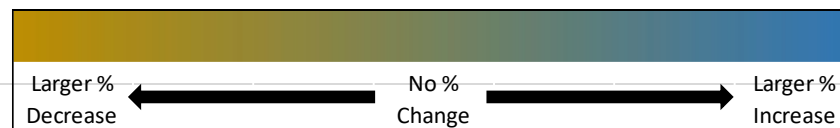


Table 6. Canopy cover percent change over time (2019-2024).

		Canopy cover % change from 2019-2024											
Plot ID		Eurasian Watermilfoil	Curlyleaf Pondweed	Flowering Rush	Coontail	Muskgrass species	Waterweed species	Northern watermilfoil	Naiad species	Other Native Pondweed species	White-stemmed pondweed	Richardson's pondweed	White water-buttercup
Cabinet Gorge Plots	C05	-100	-32	0	-11	-100	-83	0	0	-100	0	0	69
	C06	-87	425	0	-91	0	-68	Up 0.2	0	-100	0	0	73
	C12	-33	-100	0	24	-100	-26	Up 0.9	0	0	0	0	-100
	C20	Up 0.1	-100	0	124	0	-95	Up 1.7	0	0	0	-100	Up 3.3
	C29	156	0	0	0	0	-88	Up 0.2	0	0	0	0	0
	C30	-65	Up 0.2	1881	-2	-39	16	0	-100	198	0	-52	Up 0.8
	C31 ^c	26	-100	0	-29	0	325	0	0	0	0	0	0
	C32 ^c	-82	0	0	268	0	-79	Up 6.0	0	0	0	0	84
	C33 ^c	Up 0.1	0	0	-30	0	199	Up 0.2	0	0	0	0	0
Noxon Rapids Plots	N01	-99	237	Up 0.1	-64	681	-78	0	0	-22	0	285	-95
	N02	-100	-100	Up 0.4	-96	368	-98	0	0	141	1897	Up 1.9	-100
	N03	-74	-100	0	-69	Up 0.1	296	0	0	665	Up 0.1	Up 0.9	Up 0.4
	N04	104	-33	0	-36	1325	-11	Up 0.2	0	1255	Up 1.7	Up 0.1	1931
	N05 ^c	378	0	0	153	0	737	-100	0	-83	-100	Up 0.3	Up 0.7
	N06 ^c	40	-100	0	1	0	-63	0	0	-100	12	Up 0.1	Up 1.4
	N08	-100	46	0	-95	9	-90	0	0	938	1436	-70	-100
	N09 ^c	Up 2.8	0	0	-33	0	40	Up 0.2	0	463	0	0	Up 0.1
	N11	31	-86	-100	-35	256	51	-100	0	-3	Up 0.1	-2	-80
	N2301	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	N31	-46	-77	0	158	Up 1.0	-50	Up 1.0	0	-100	Up 1.0	Up 2.0	Up 0.2
	N52	185	-100	-100	-82	230	595	Up 4.2	0	214	Up 1.1	-100	0
	N73	-99	8	0	-99	0	-96	Up 0.1	0	Up 0.3	0	Up 0.7	-80
	N77	-95	0	0	164	Up 0.2	-81	0	0	Up 0.9	0	1721	-86
N78	-86	0	0	118	0	-46	0	0	-100	0	0	-100	
N79	183	-100	0	71	66	36	0	0	-99	0	-100	281	
Plot ID		Eurasian Watermilfoil	Curlyleaf Pondweed	Flowering Rush	Coontail	Muskgrass species	Waterweed species	Northern watermilfoil	Naiad species	Other Native Pondweed species	White-stemmed pondweed	Richardson's pondweed	White water-buttercup



Percent canopy cover abundances since 2019

The following collection of graphs include canopy cover abundances of different species-types (i.e. Eurasian watermilfoil, curlyleaf pondweed, and native species) since 2019 for each reservoir divided into untreated control plots and treated control plots. Within each plot's graph, years with some level of herbicide treatment are outlined with black boxes. Trendlines and the respective R^2 values are included for each species-type group within each graph. The R^2 values closer to a value of one suggest a strong correlation with time. Overall, the R^2 values show no or weak correlations with time. This suggests that in many plots there is no clear increase or decrease in abundances that can be explained by time. Overall plots in 2024 showed less abundant aquatic vegetation for native and invasives species alike. This is likely attributed to the timing of the pretreatment surveys, which occurred about a month earlier than normal to accommodate earlier treatment efforts based on peak river runoff projections. Appendix 1 includes canopy cover abundance graphs for each plot, as well as maps showing individual sample points with their respective canopy cover abundance of Eurasian watermilfoil in 2024.

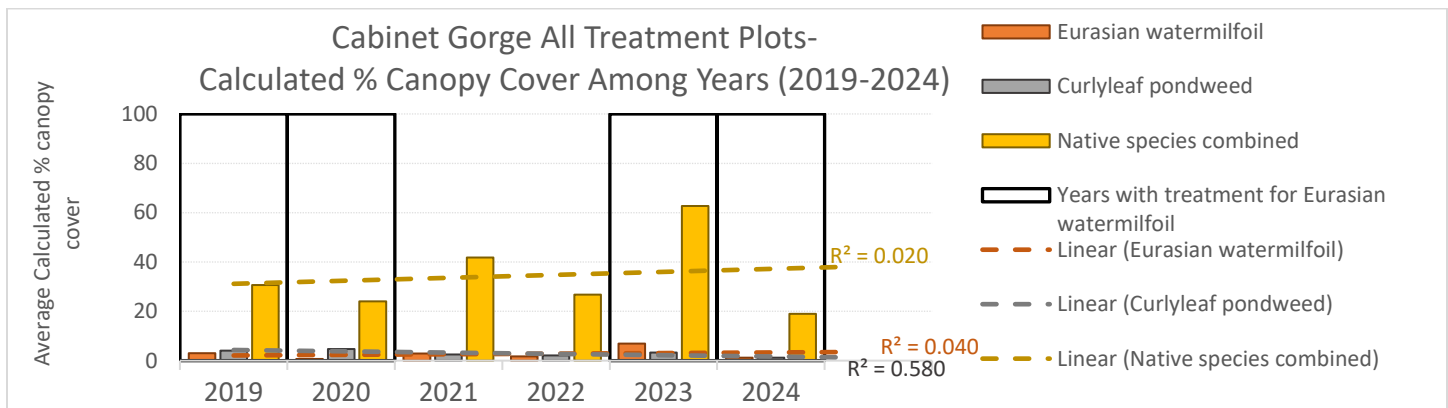


Figure 8. Calculated % canopy cover among years (2019-2024) for all treatment plots on Cabinet Gorge Reservoir.

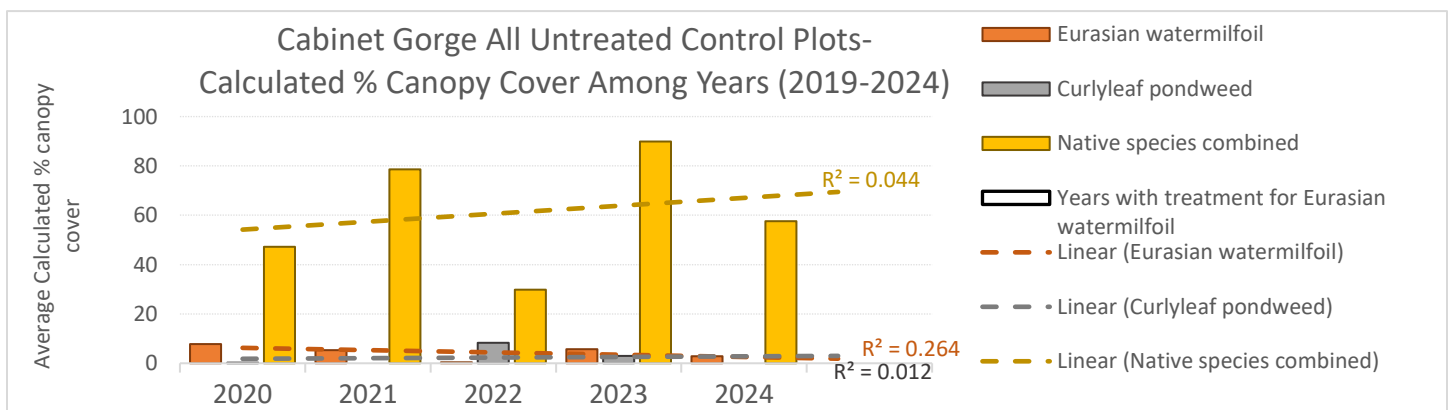


Figure 9. Calculated % canopy cover among years (2019-2024) for all untreated control plots on Cabinet Gorge Reservoir.

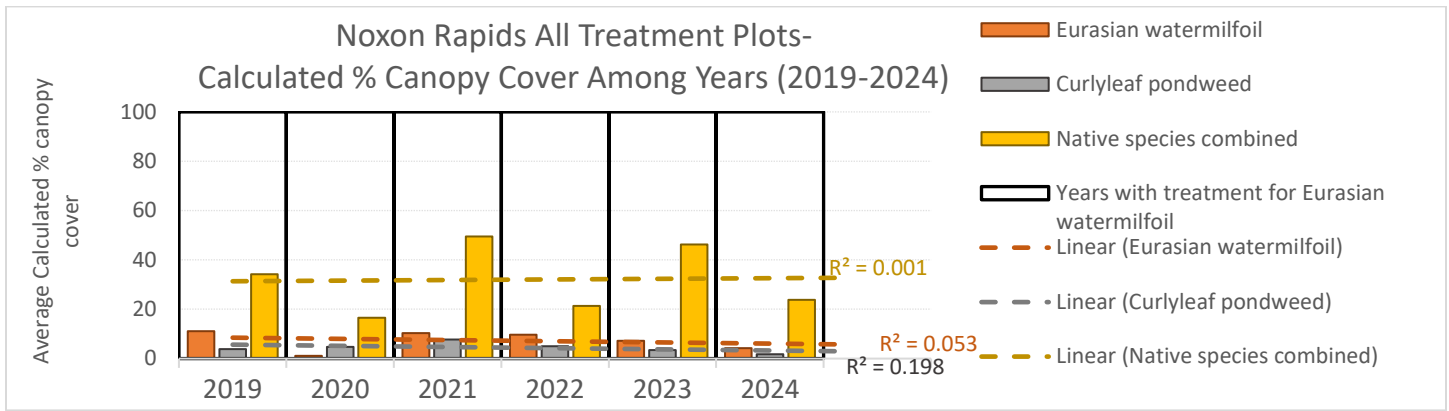


Figure 10. Calculated % canopy cover among years (2019-2024) for all treatment plots on Noxon Rapids Reservoir.

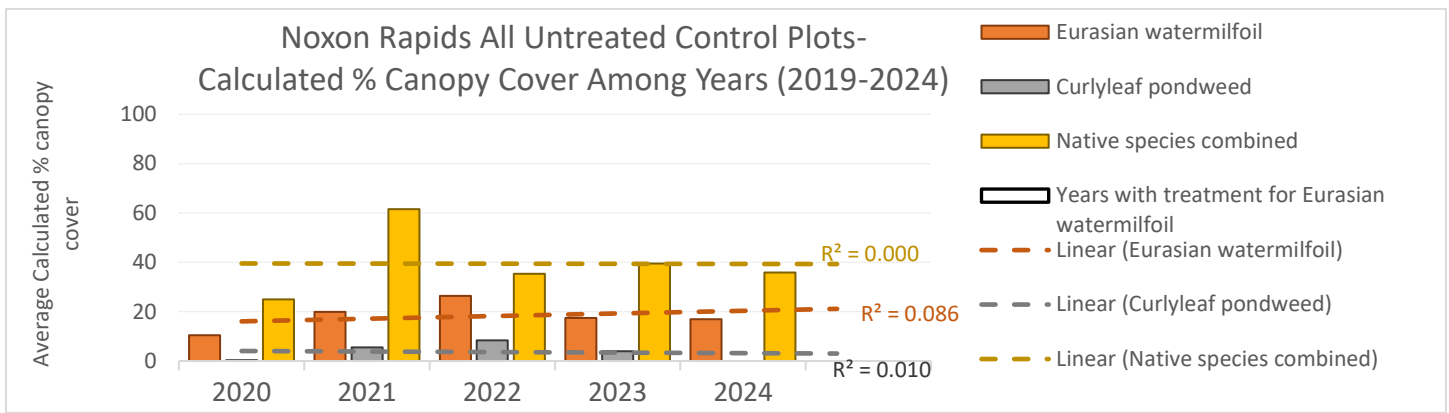


Figure 11. Calculated % canopy cover among years (2019-2024) for all untreated control plots on Noxon Rapids Reservoir.

Conclusion

Sample Method Efficacy

Using the pole-attached rake appears to reduce bias in sampling but may provide underestimations. This method allows a consistent sampled area for each sample. The pole-attached rake implemented in 2019 helped improve repeatability of the sample area. A rope attached rake can have variations in sampled area due to distance the rake was tossed, the depth of the water (thus changing the angle of retrieval), and the rate of retrieval. In general, the pole-attached method appears more precise, but anecdotal evidence suggests it underestimates plant cover at the plot level. Subsequent consistent sampling among years will improve the overall sampling effort's precision but accuracy needs to be further evaluated. Even if the rake-pole sampling method underestimates cover, current years' canopy cover and inference of variations among years can still be made in the future. Additionally, the current sampling method and number of sample points within each plot allows sampling technicians to complete sampling within a few days or one week, which does not pose too much time commitment for FWP at current staffing levels.

Changes in Canopy Cover for 2024

It is difficult to make much inference of canopy cover change due to herbicide treatments alone as multiple factors could contribute to said changes. Natural environmental variations such as water flows, temperatures, and hybridization strains could cause significant localized macrophyte community variations or responses to herbicide among years. In 2024, there is clearly reduced macrophyte abundances during the pretreatment survey compared to 2023 within treatment plots and untreated control plots. Lower levels of all species in all

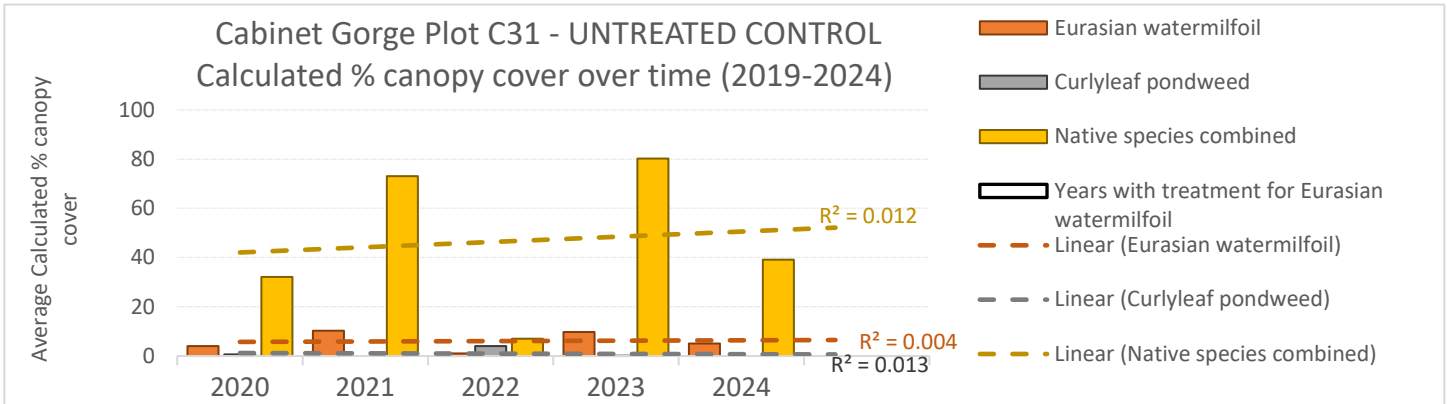
plots suggest this is tied to the earlier timing of the survey in June compared to July. This may have made comparing vegetation levels among years more difficult and made delineating treatment areas difficult to impossible depending on local water conditions. However, if earlier applications of herbicide show longer-term control or reductions of Eurasian watermilfoil within treatment area, FWP would recommend continuing with earlier surveys (and treatments) even with the added survey difficulties. Earlier treatments within the year should provide more within year localized control and potentially provide more control in following years due to reduced biomass and vegetative propagules available during auto fragmentation later in the season or from boats entering the plant beds.

With the current management strategy there is no expectation that herbicide control with contact herbicides will have any long-term reductions of Eurasian watermilfoil with the plots. The goal is to maintain access and reduce the risk of boat moving the invasive species to another waterbody. There seems to be clear evidence that there are no large upswings in Eurasian watermilfoil cover in any of the treatment plots overtime. This suggests that treatments looking to keep these Eurasian watermilfoil infestations at bay may be meeting established goals. With many of the treatment plots there is anecdotal evidence that the following year after treatment Eurasian watermilfoil abundances drop to much lower levels. This may suggest that there are some residual effects of treatments into the following year, though populations appear to rebound or likely rebound at some point during the growing season. Implementation of systemic herbicides where possible and economically feasible could lead to more effective, longer-term control within treatment plots. This in turn, could lead to lower overall annual expenses to control Eurasian watermilfoil in Noxon Rapids and Cabinet Gorge Reservoirs even if costs are more expensive per acre. This cost reduction could be gained if treatments within plots would not need to occur annually.

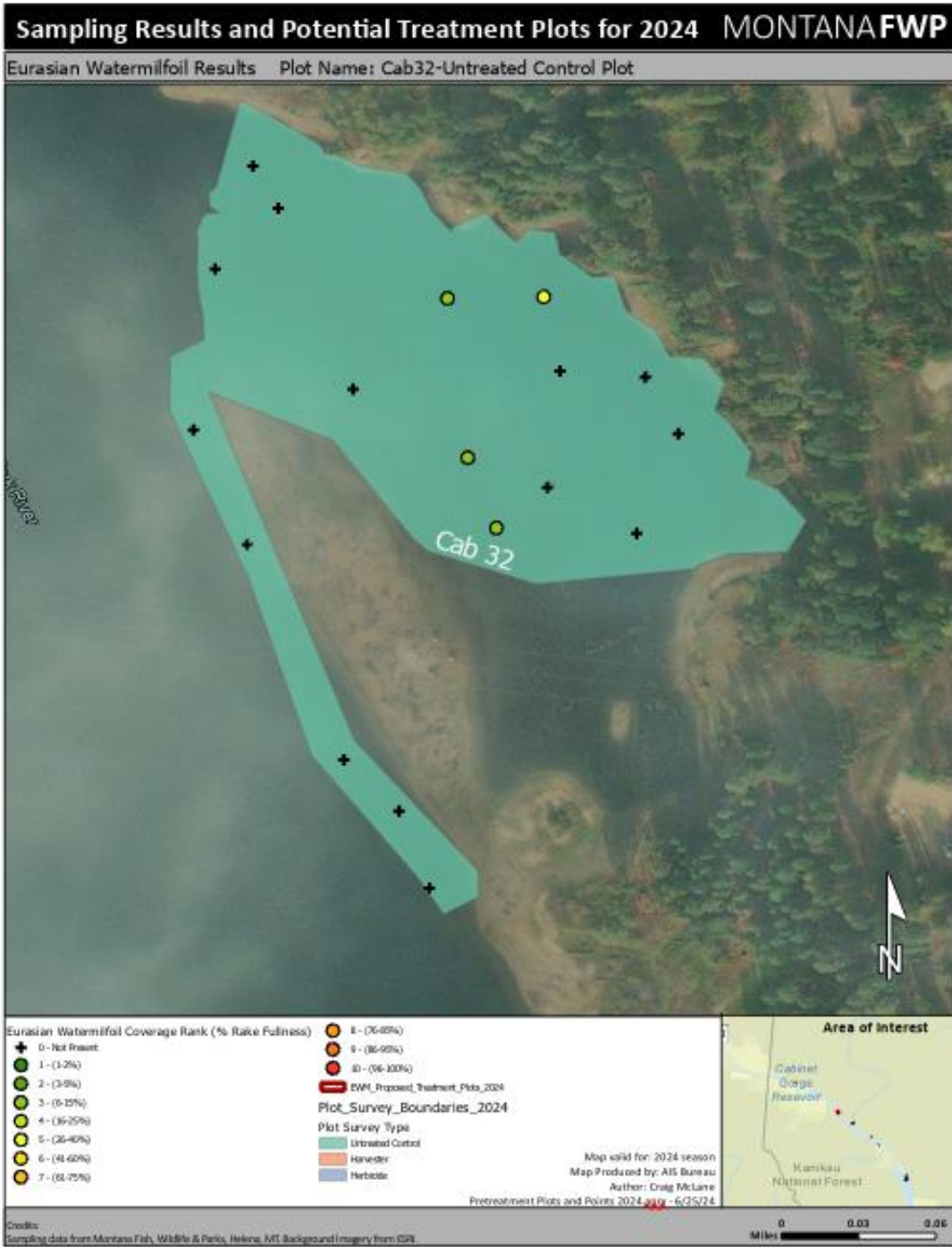
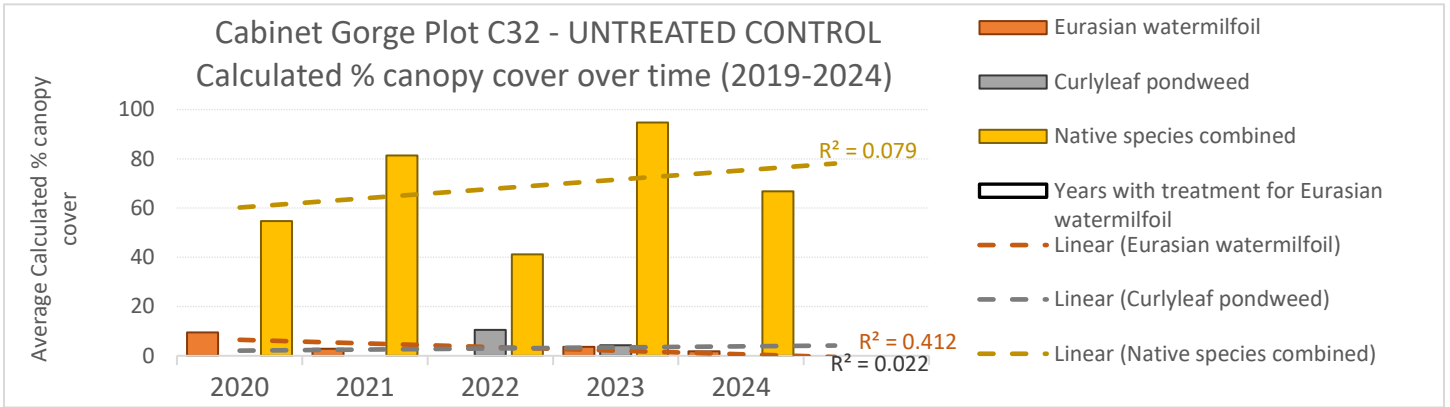
Appendix 1. Individual plot maps and graphs (% canopy cover 2019 – 2024).

Appendix 1 includes Red polygons with hatch marks suggest the approximate area with higher canopy cover abundance of Eurasian watermilfoil that could be considered for treatment that year if treated. Green polygons represent untreated control plots; purple polygons represent plots being considered for herbicide treatments and any orange polygons are plots that were evaluated in 2022 for a harvester control project. Additional details of canopy cover for each species within each plot separated by year since 2019 can be found in Appendix 3.

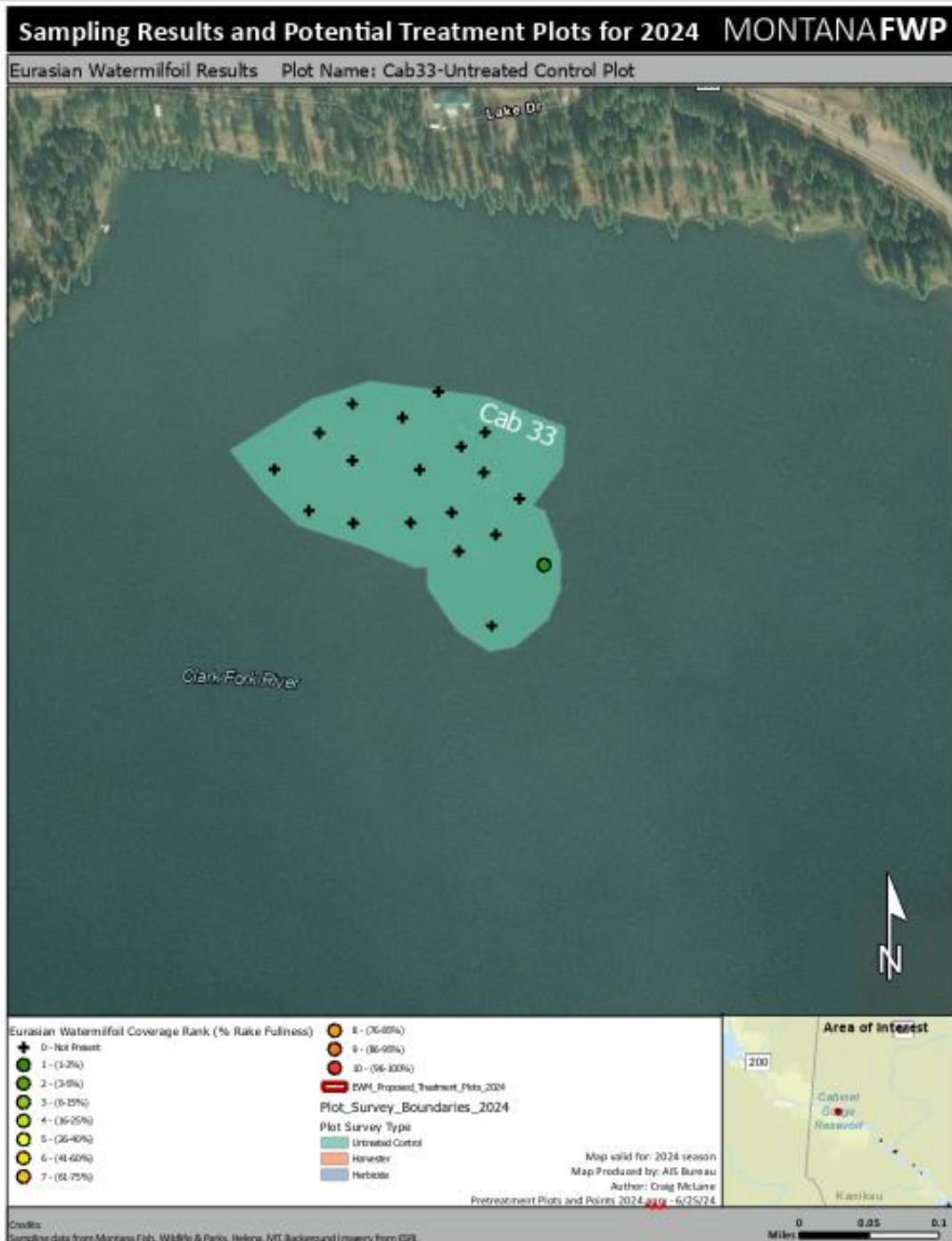
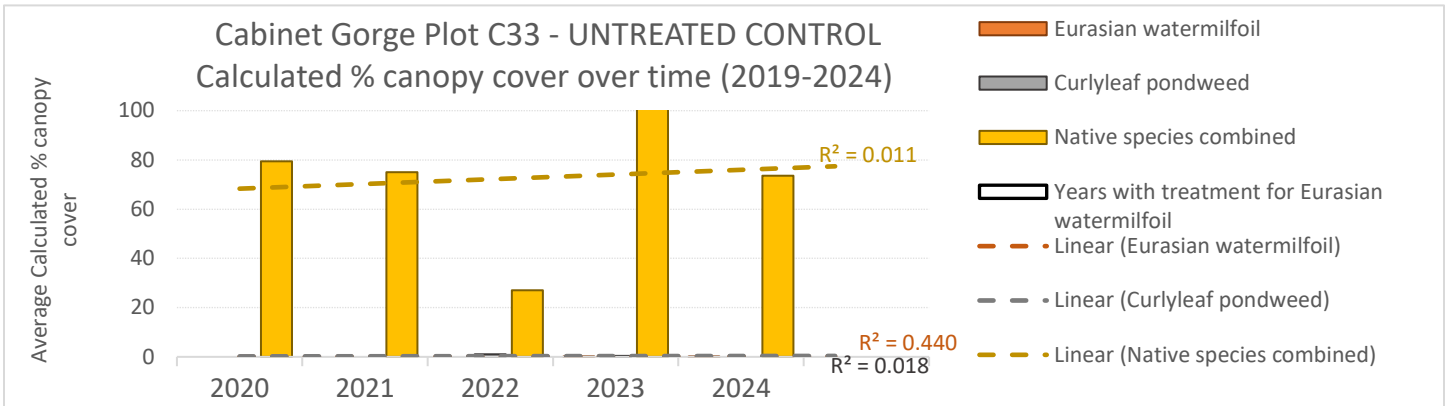
Cab-31 – Untreated Control Plot



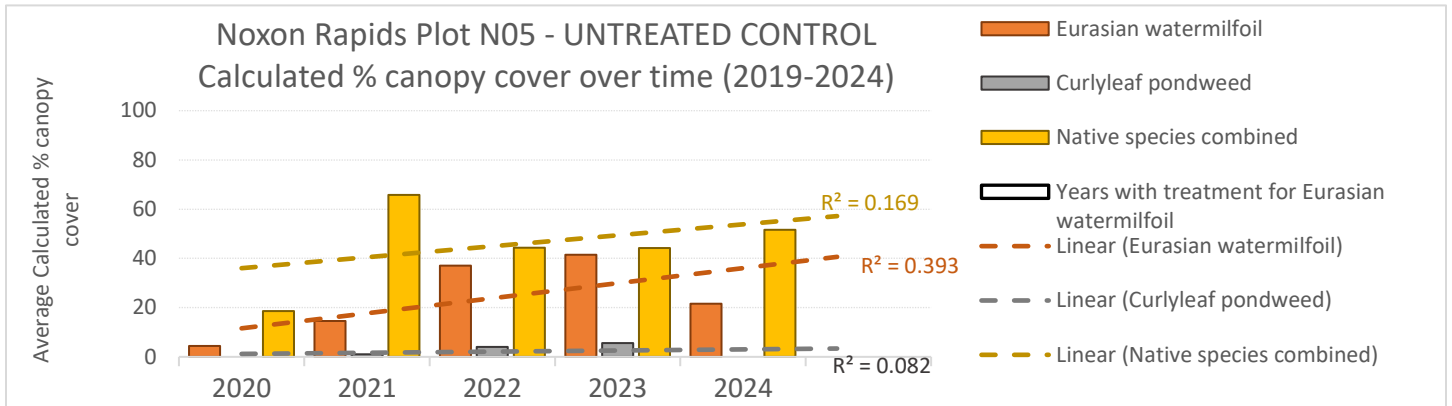
Cab-32 – Untreated Control Plot



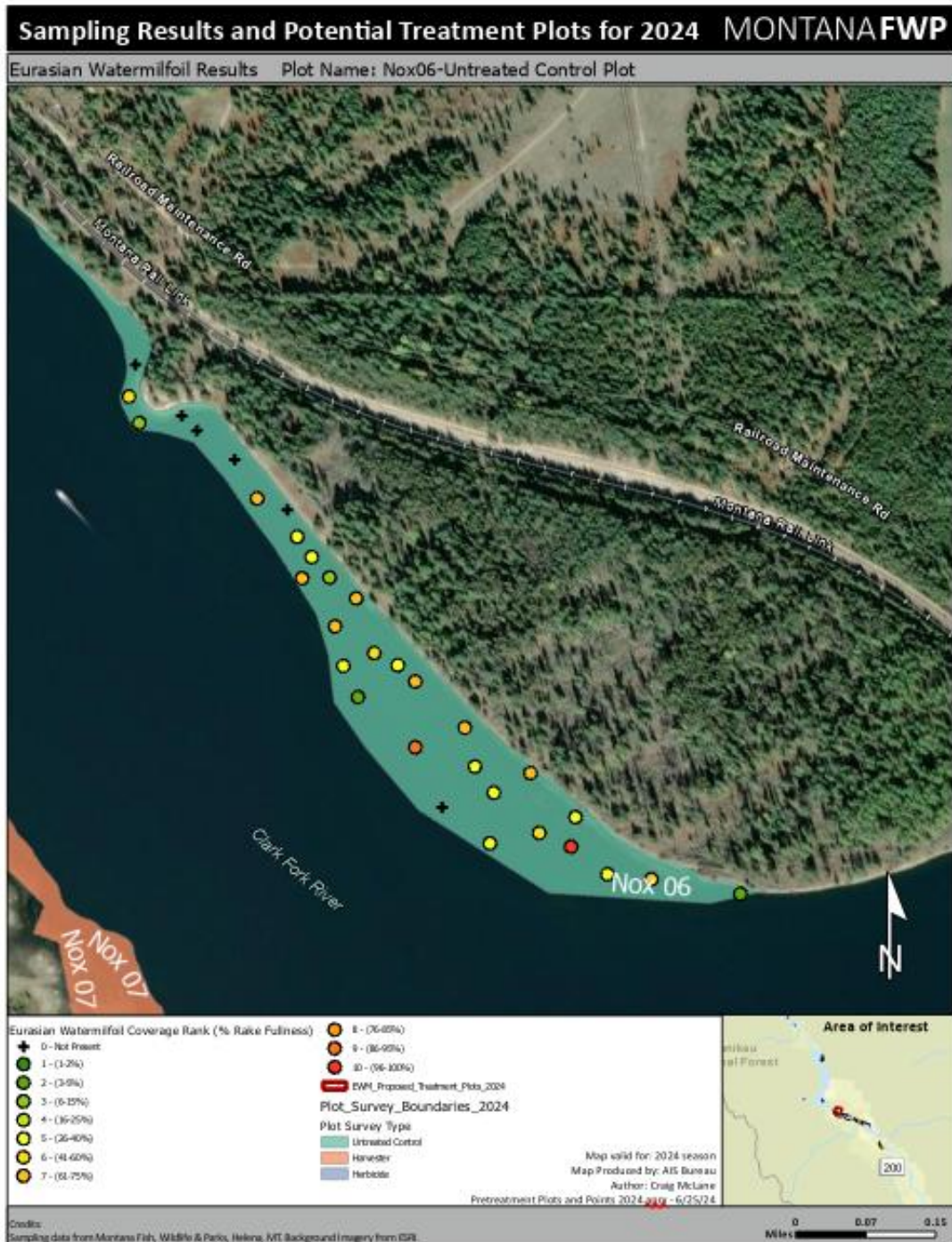
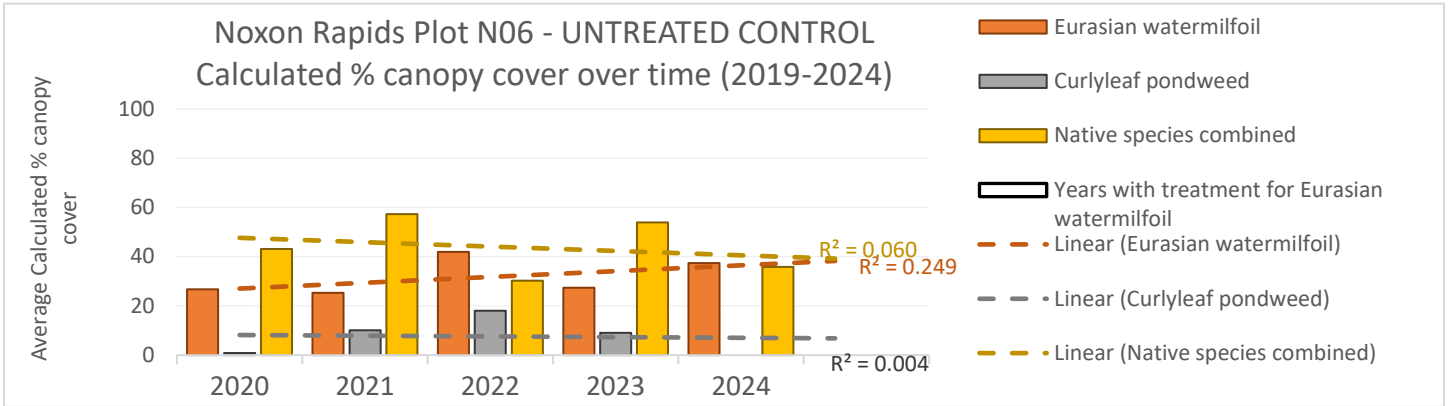
Cab-33 – Untreated Control Plot



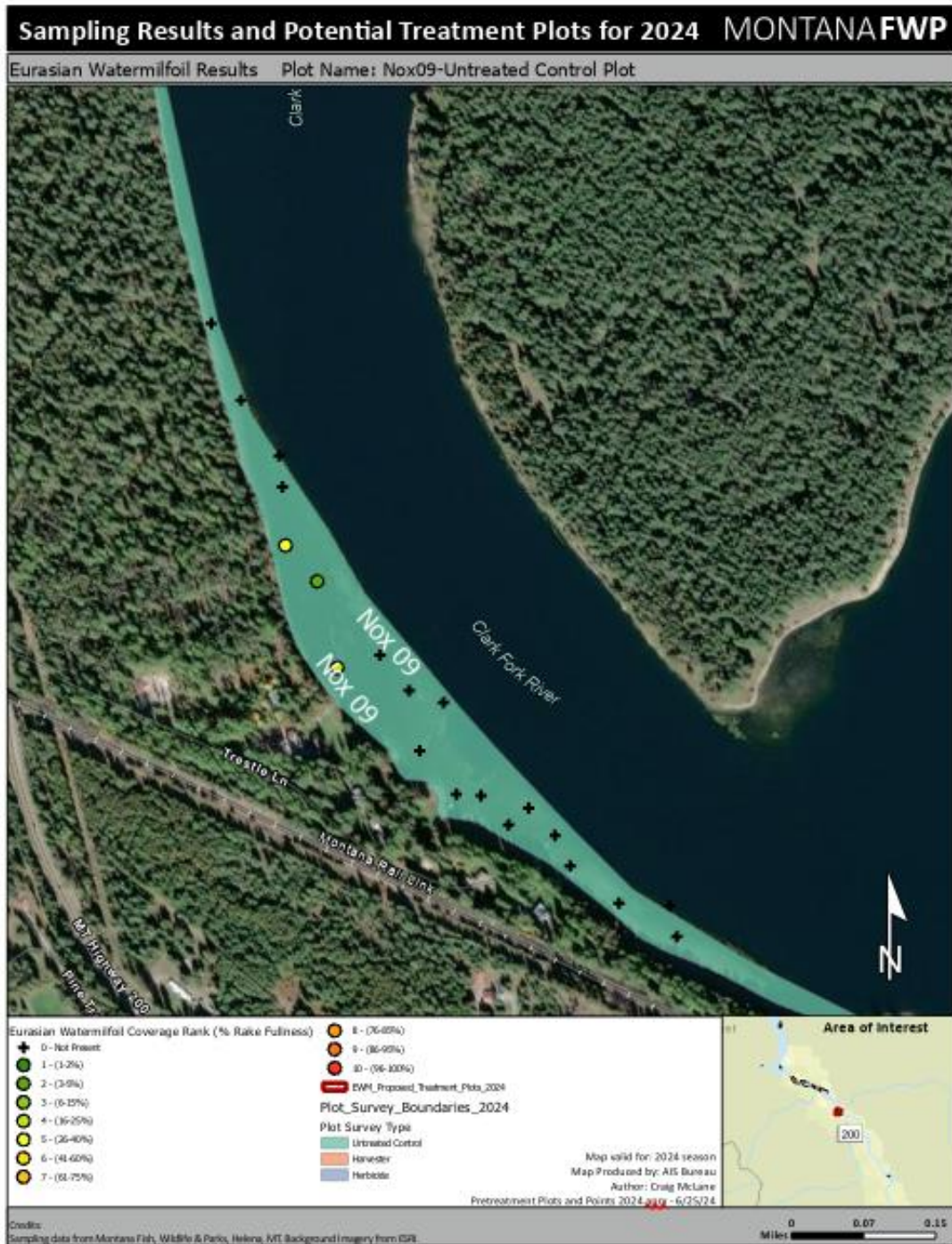
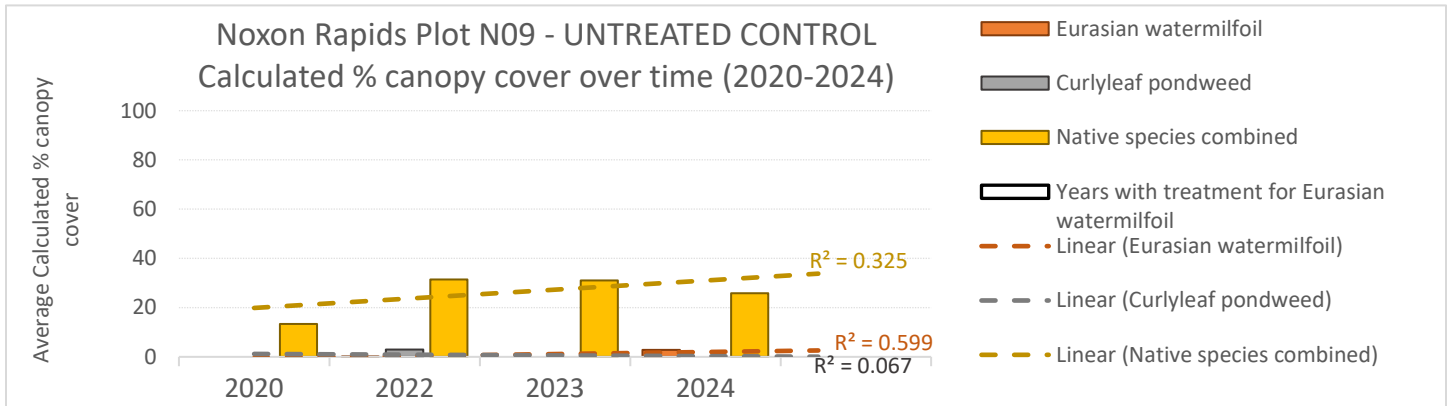
Nox-05 – Untreated Control Plot



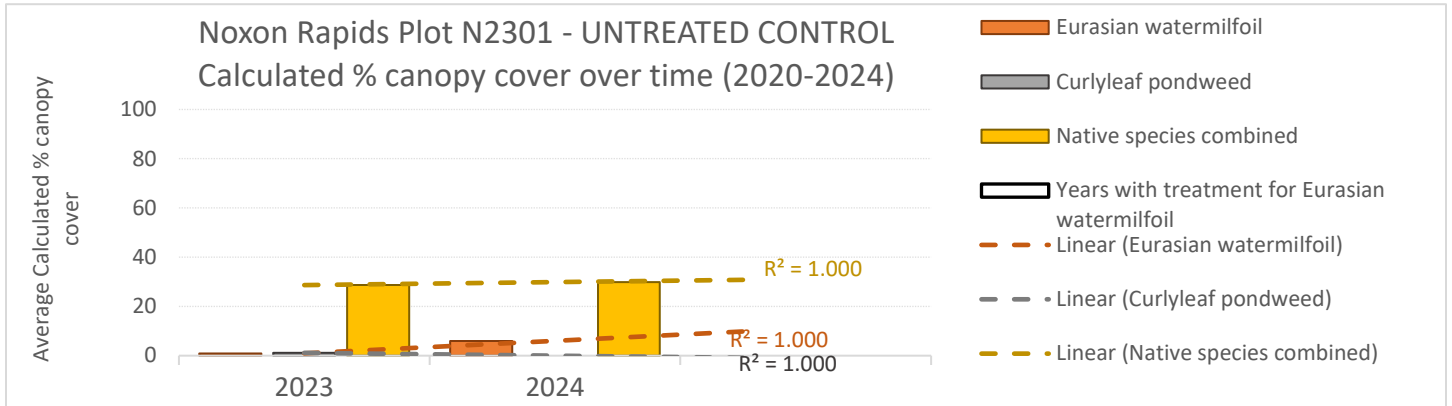
Nox-06 – Untreated Control Plot



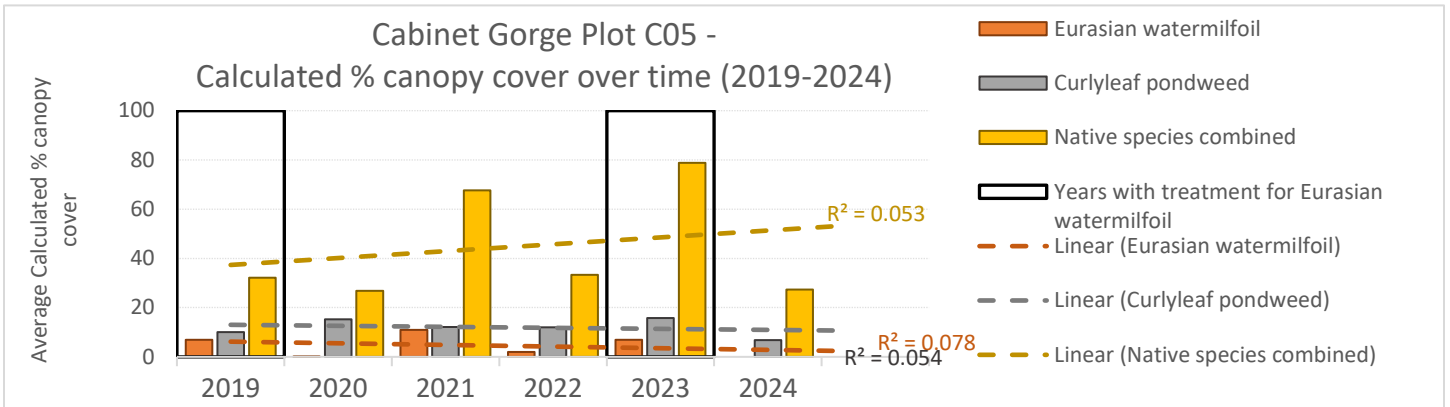
Nox-09 – Untreated Control Plot



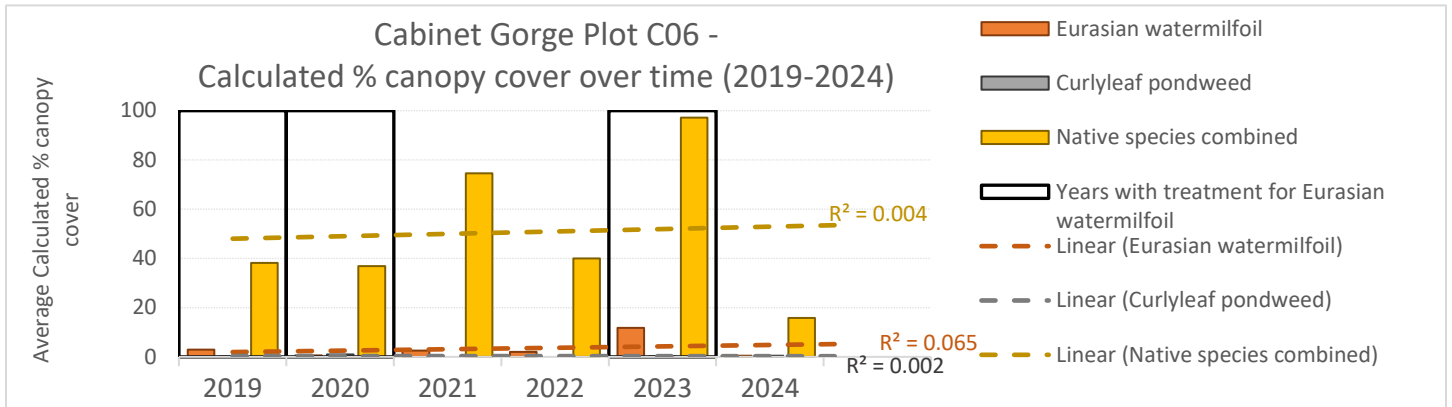
Nox-2301 – Untreated Control Plot



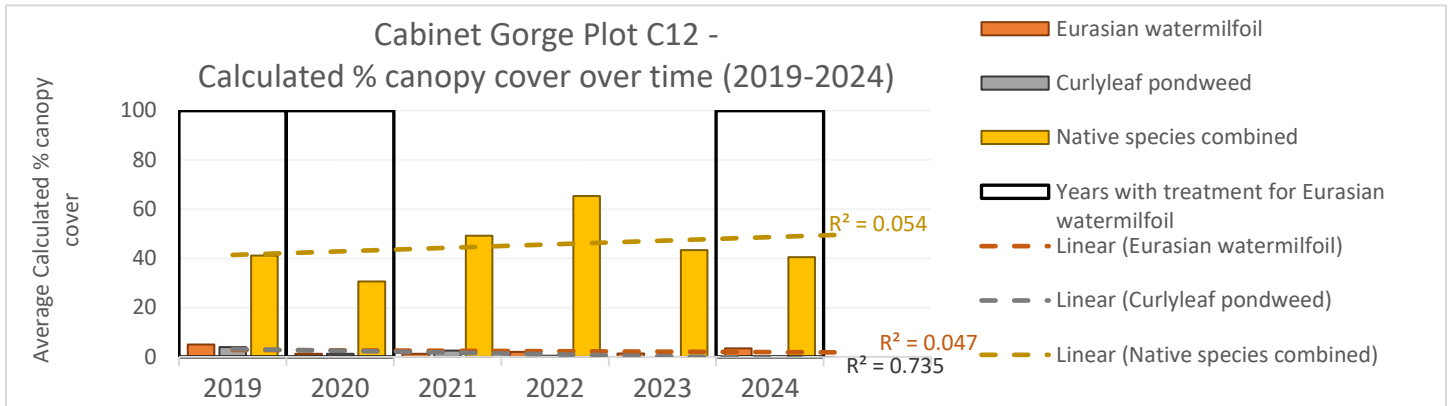
Cab-05 – Potential Treatment Plot



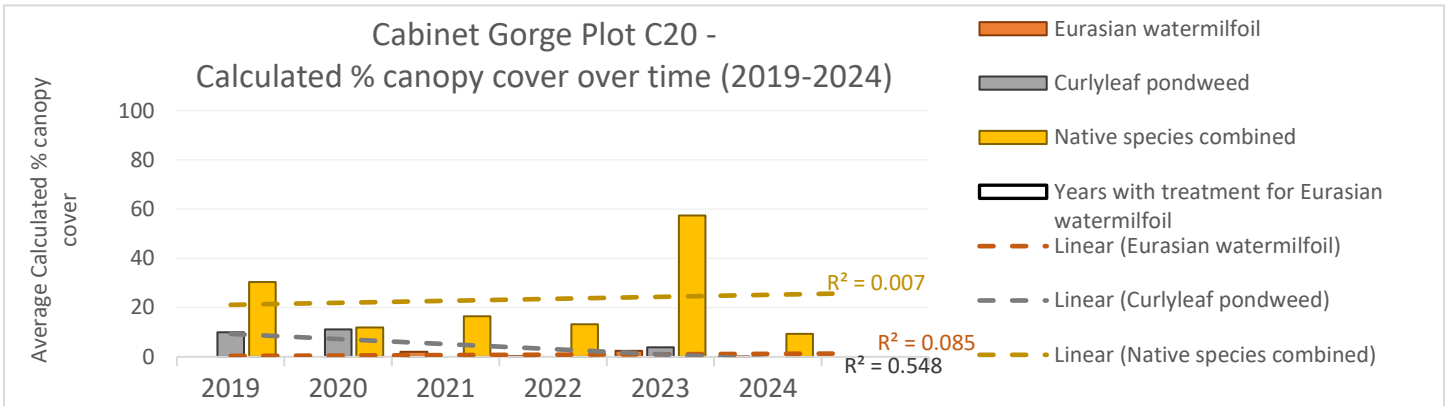
Cab-06 – Potential Treatment Plot



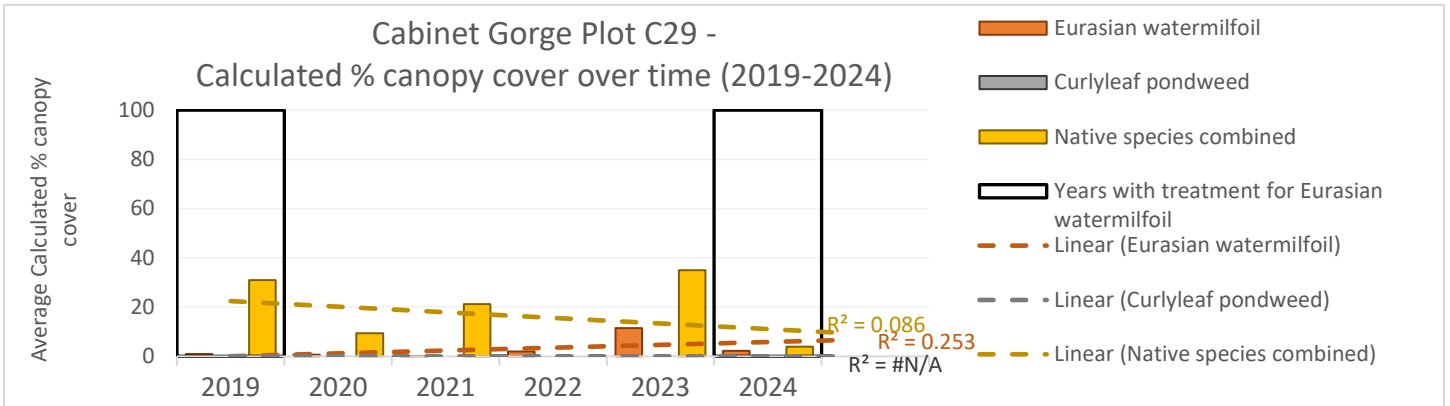
Cab-12 – Potential Treatment Plot



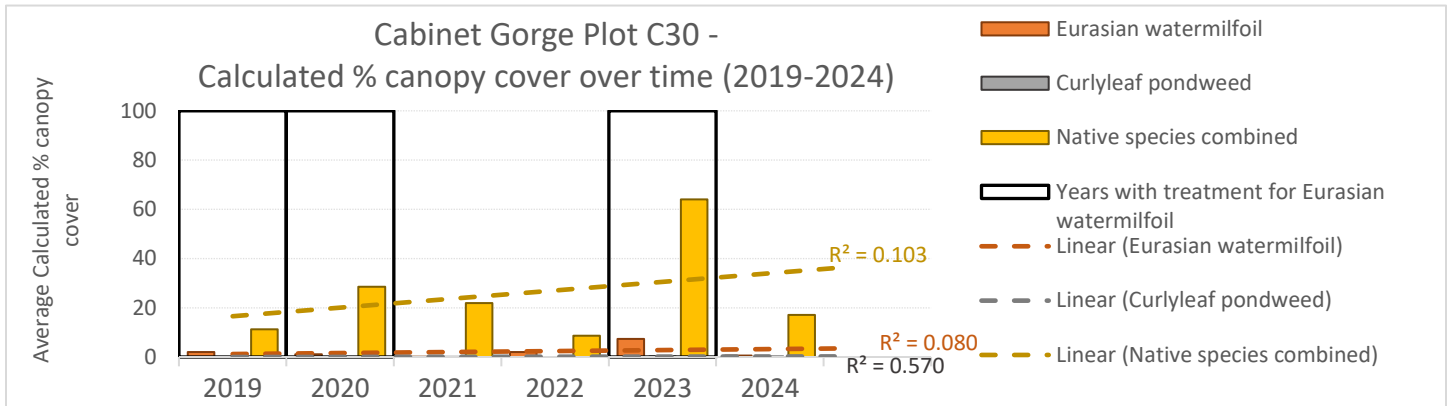
Cab-20 – Potential Treatment Plot



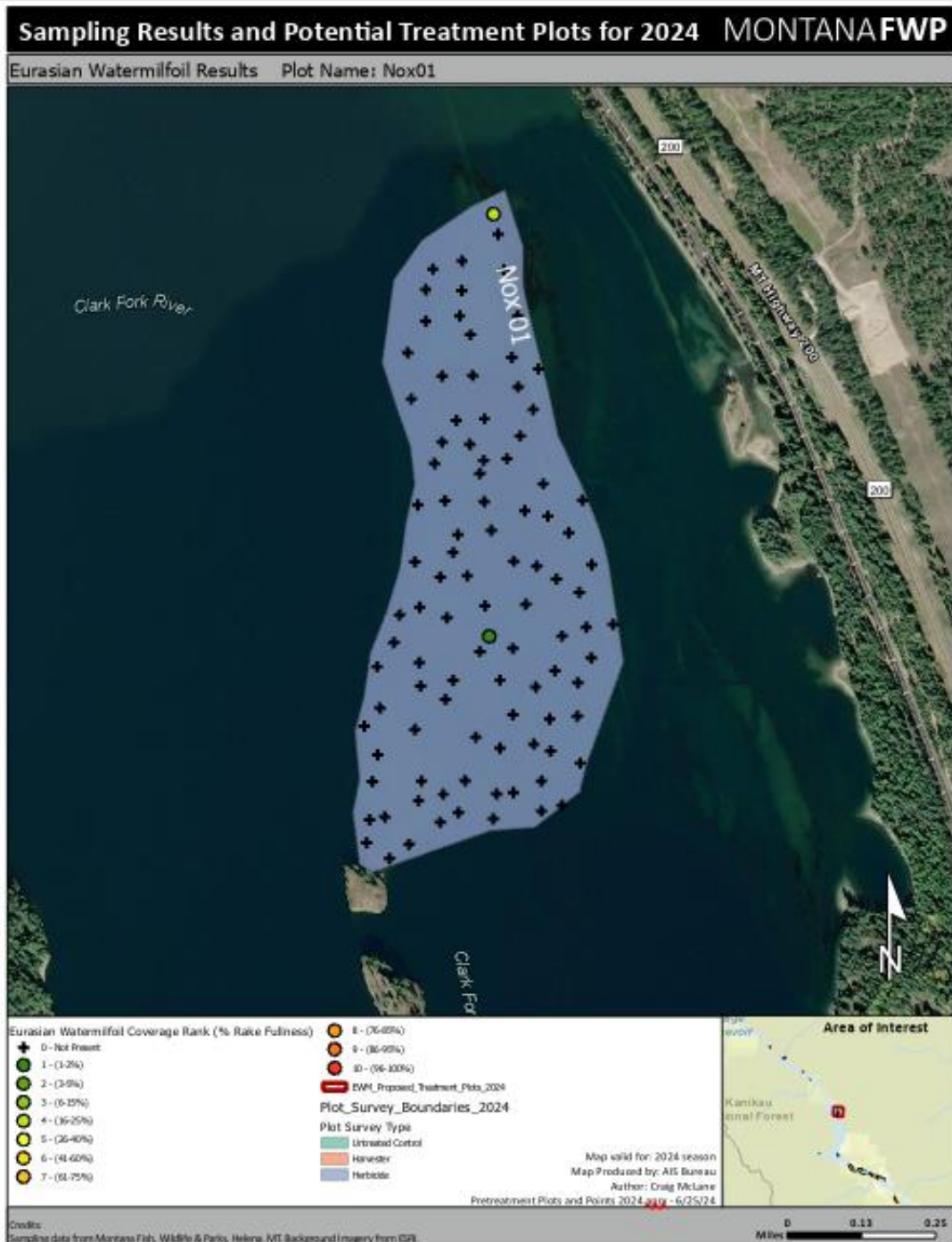
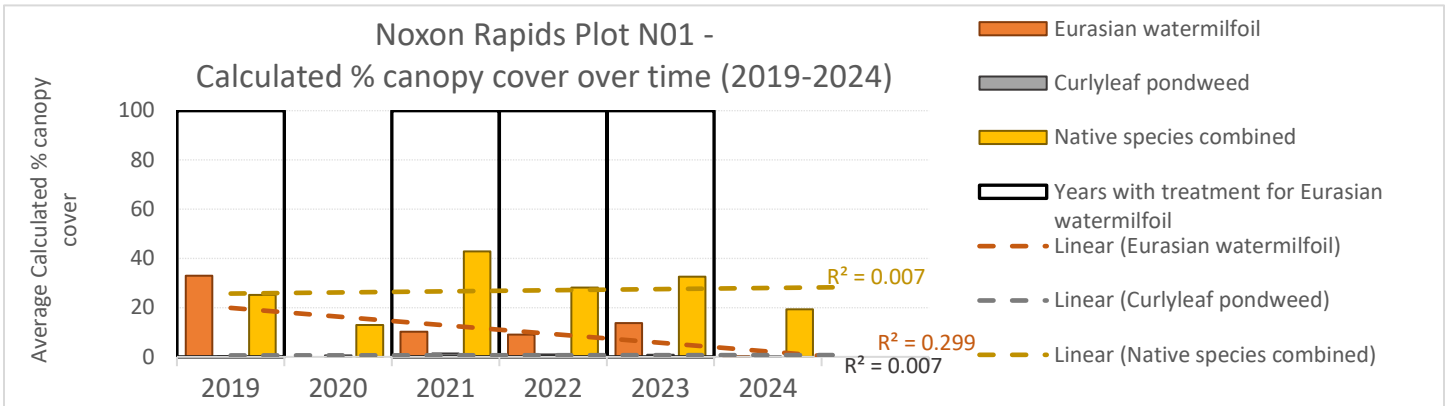
Cab-29 – Potential Treatment Plot



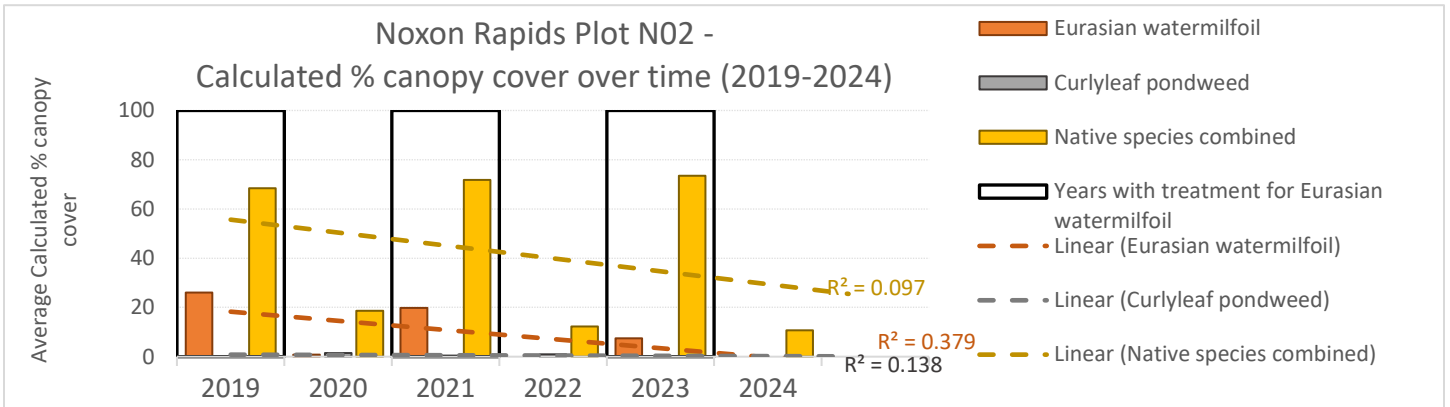
Cab-30 – Potential Treatment Plot



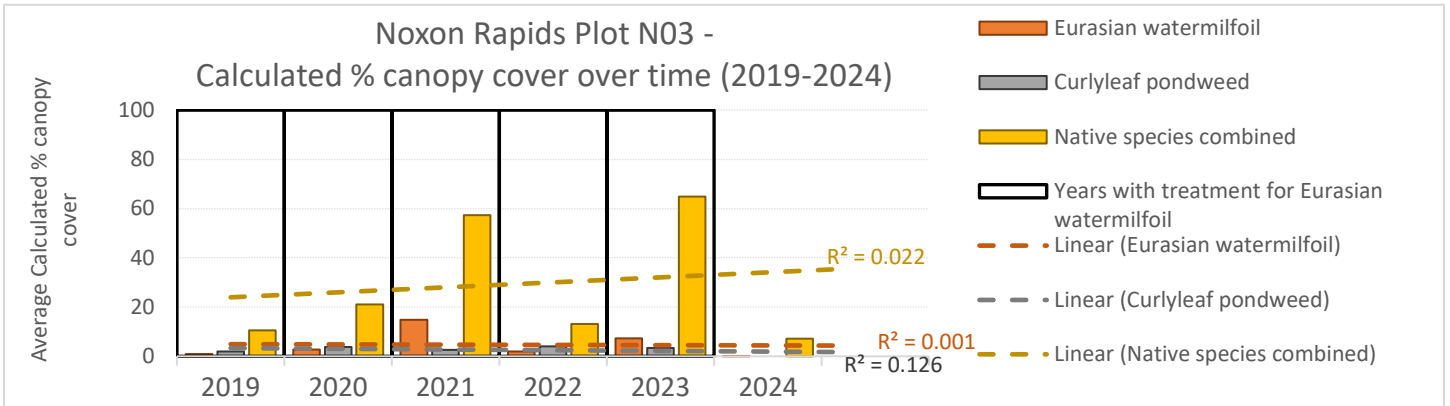
Nox-01 – Potential Treatment Plot



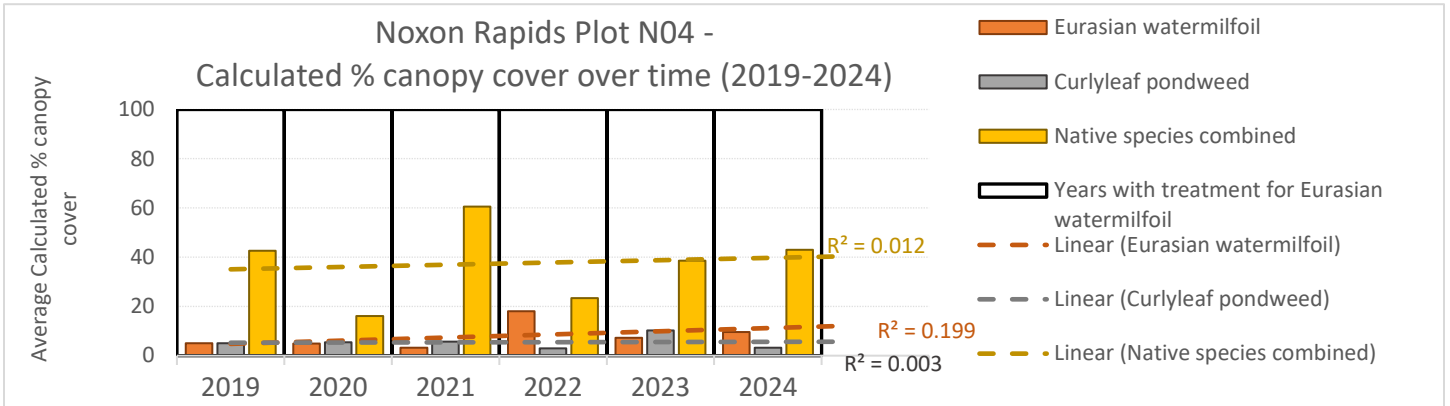
Nox-02 – Potential Treatment Plot



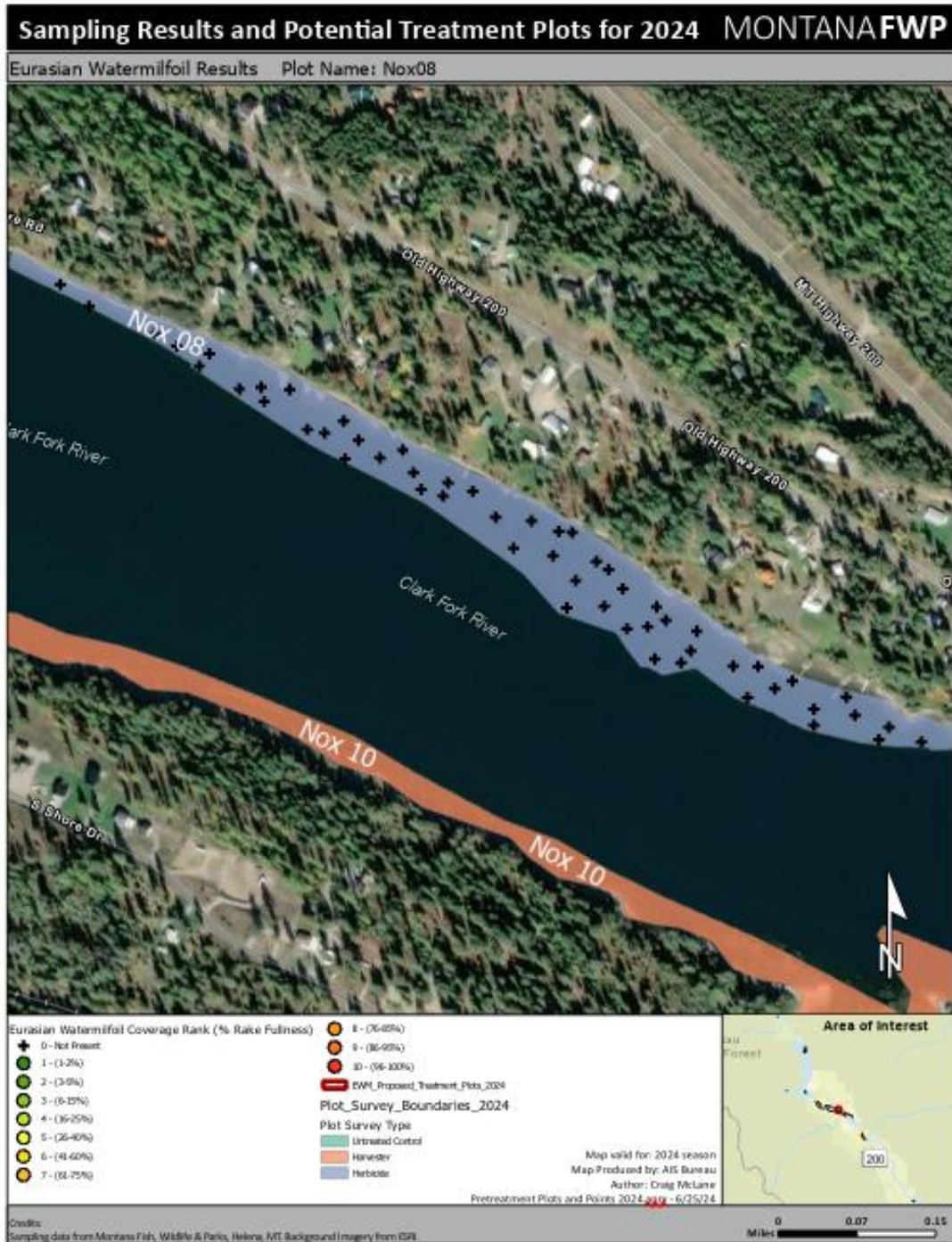
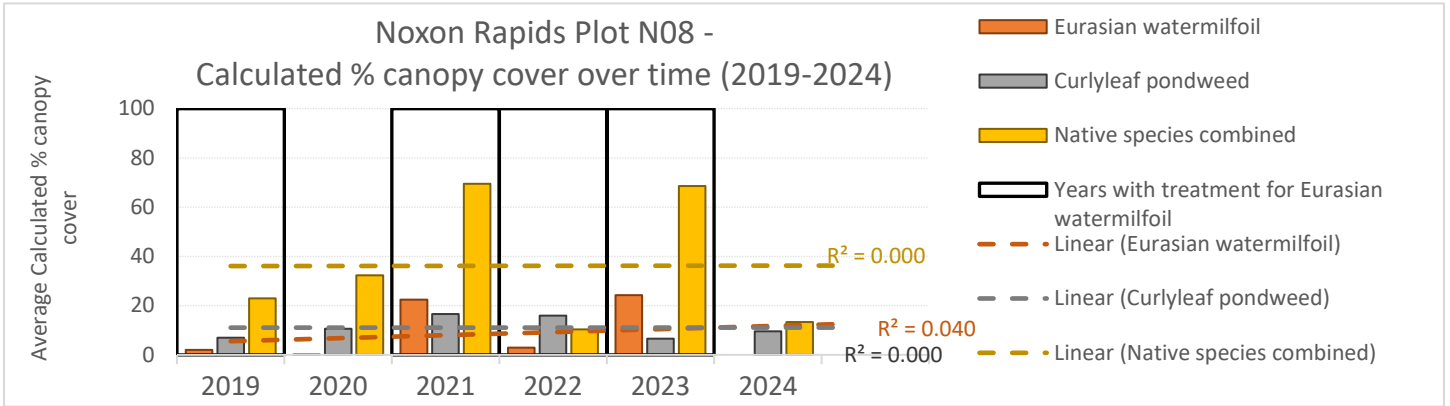
Nox-03 – Potential Treatment Plot



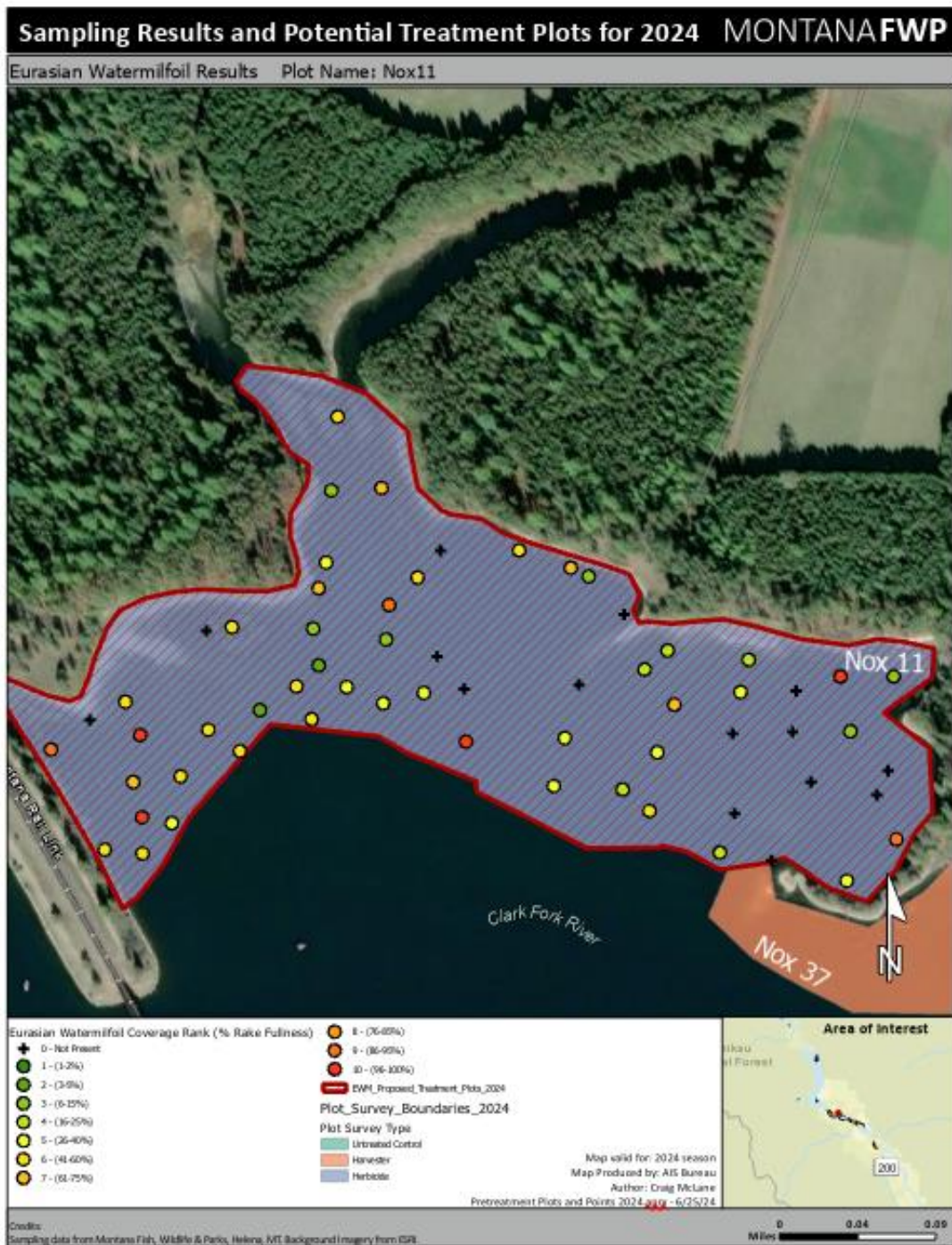
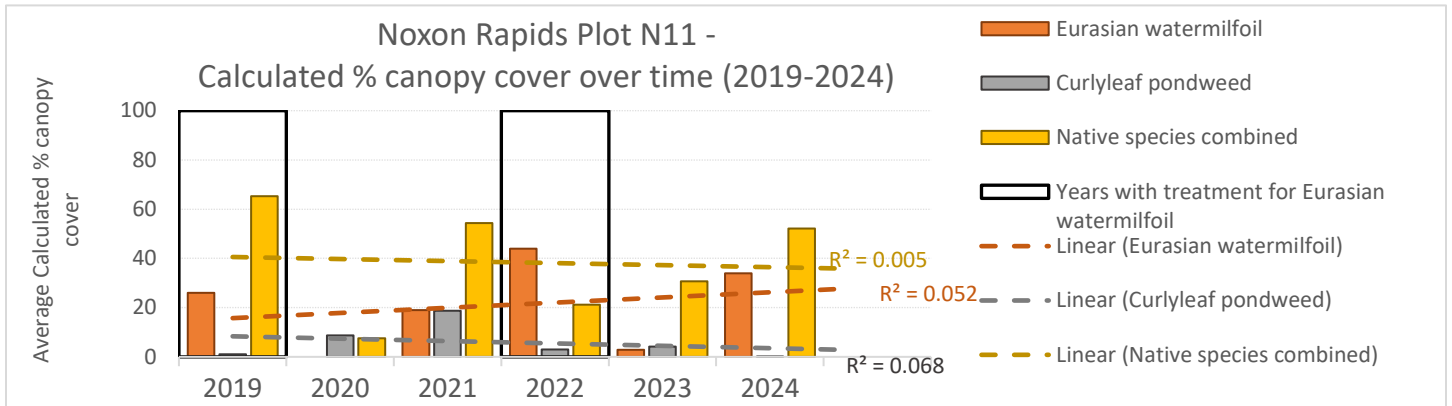
Nox-04 – Potential Treatment Plot



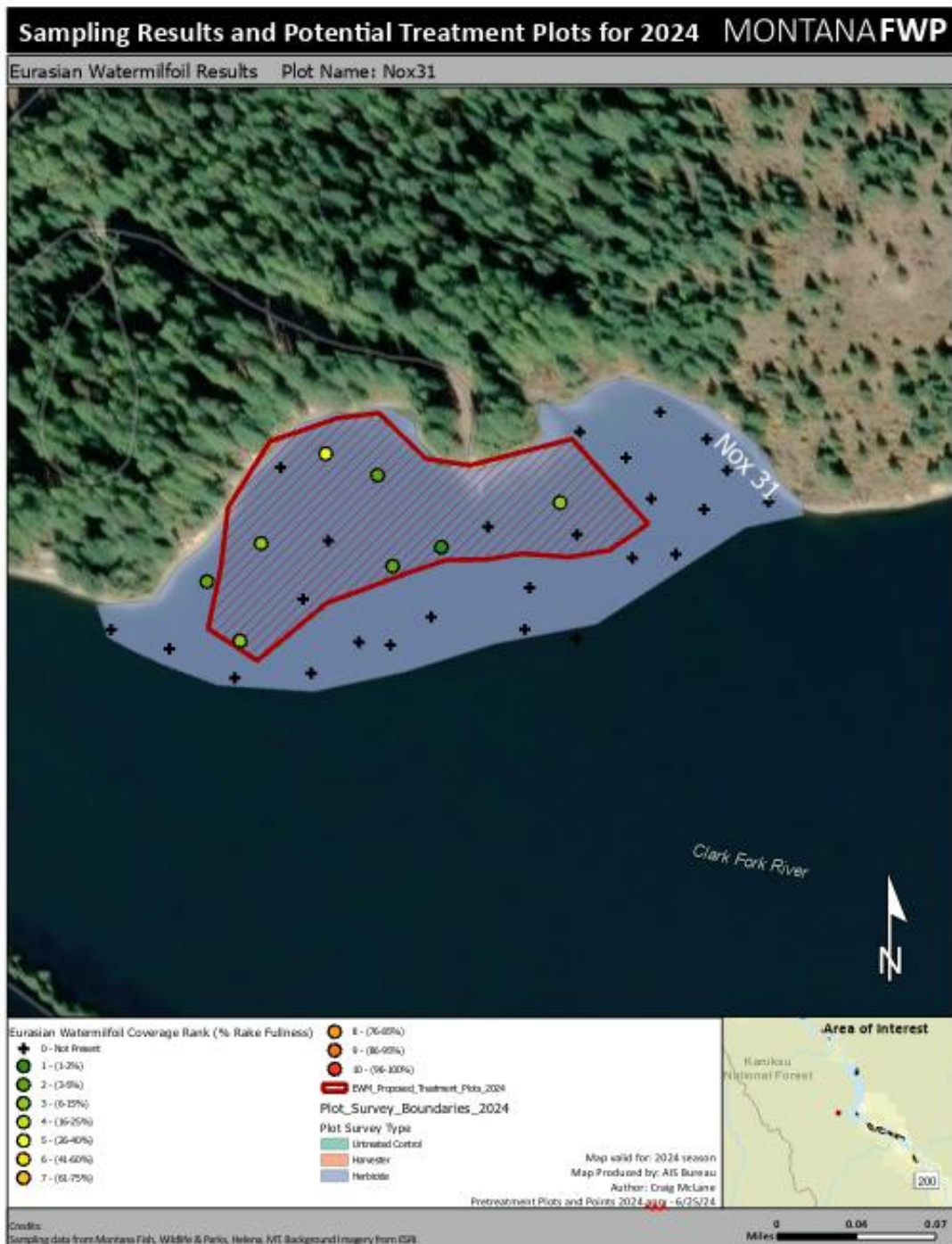
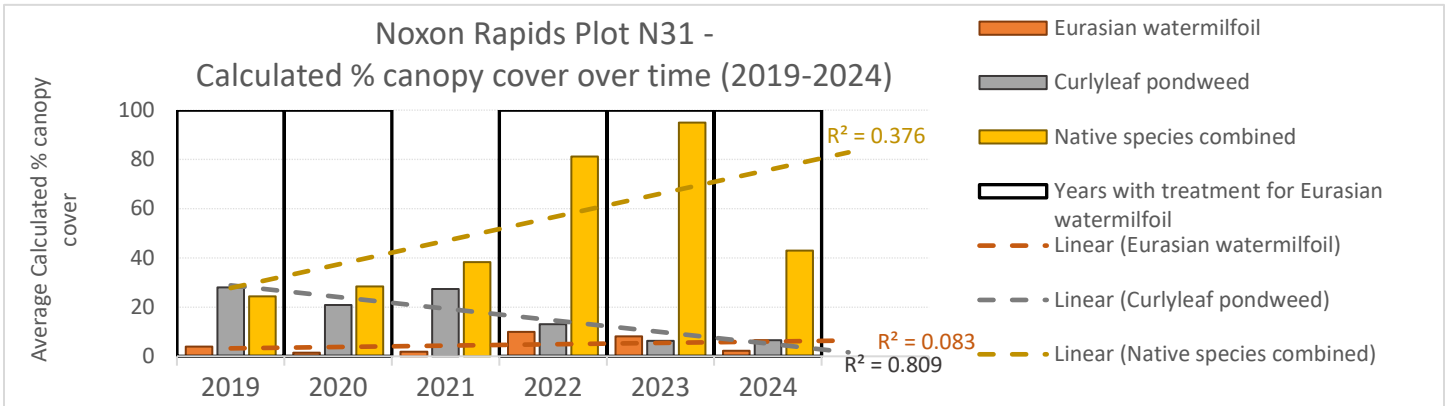
Nox-08 – Potential Treatment Plot



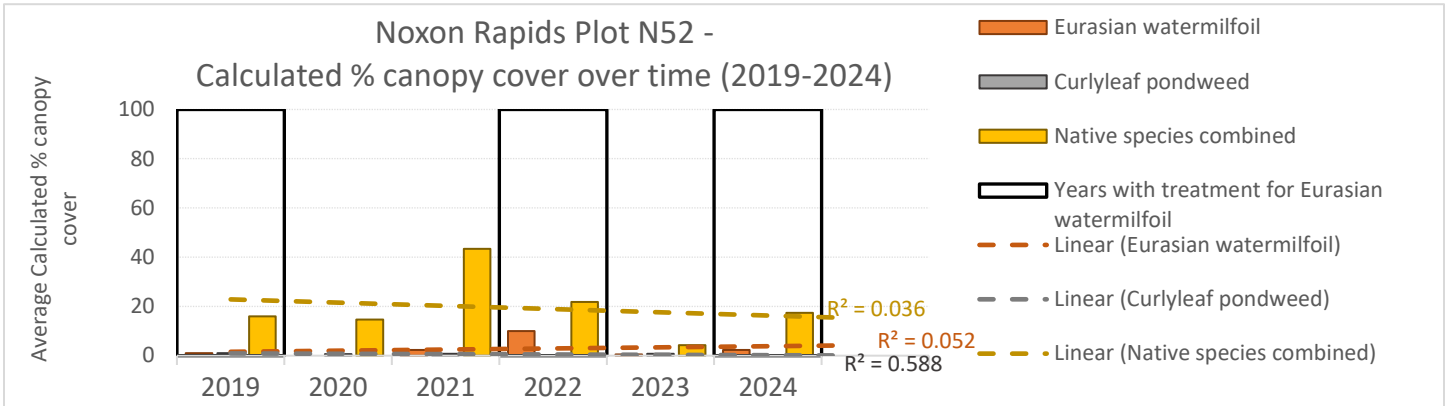
Nox-11 – Potential Treatment Plot



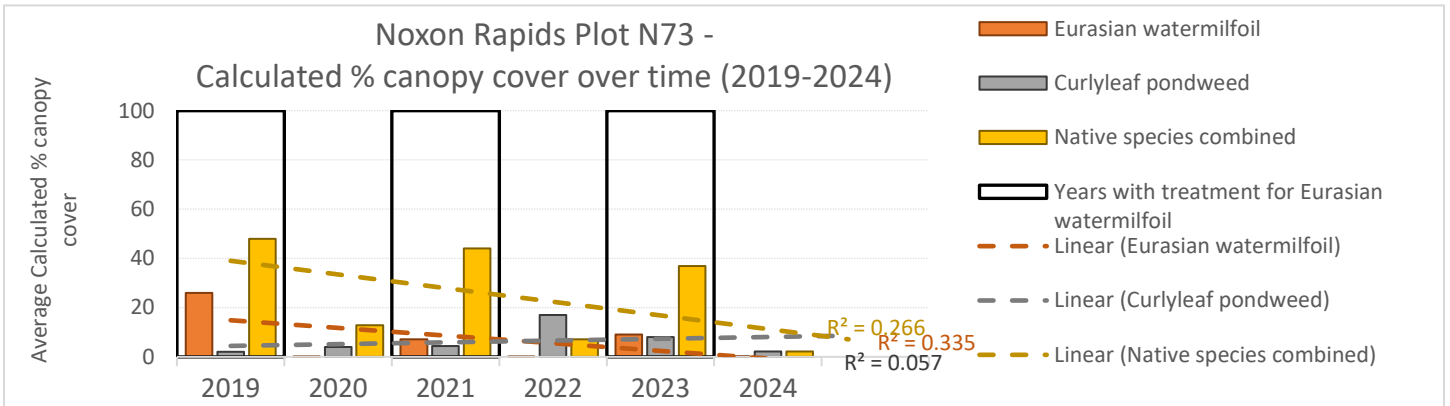
Nox-31 – Potential Treatment Plot



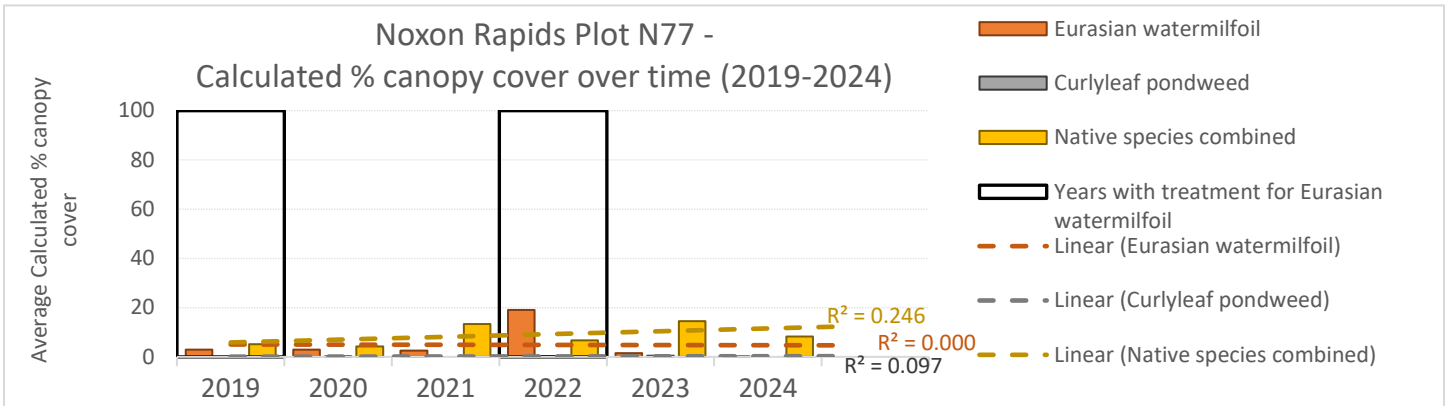
Nox-52 – Potential Treatment Plot



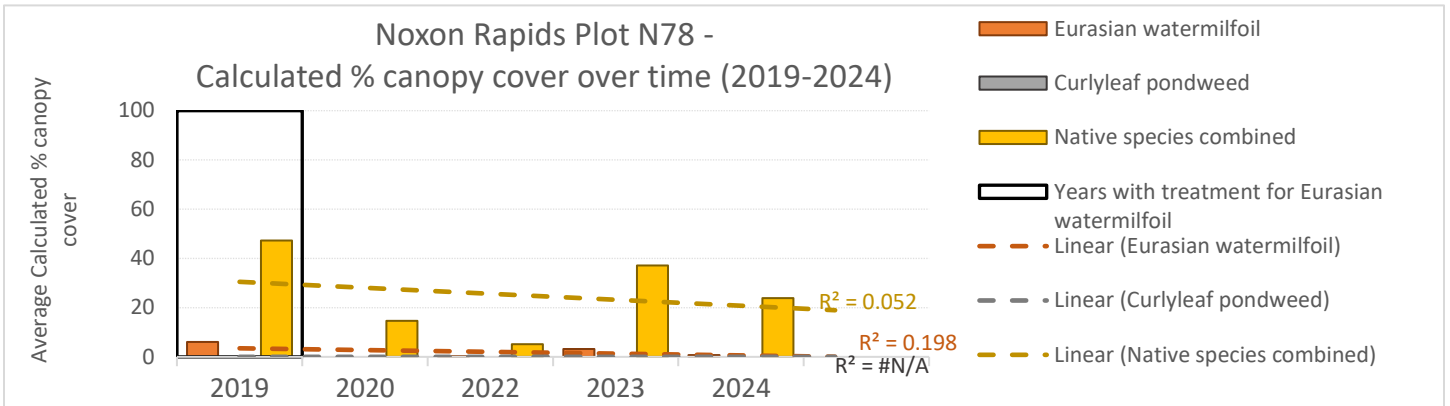
Nox-73 – Potential Treatment Plot



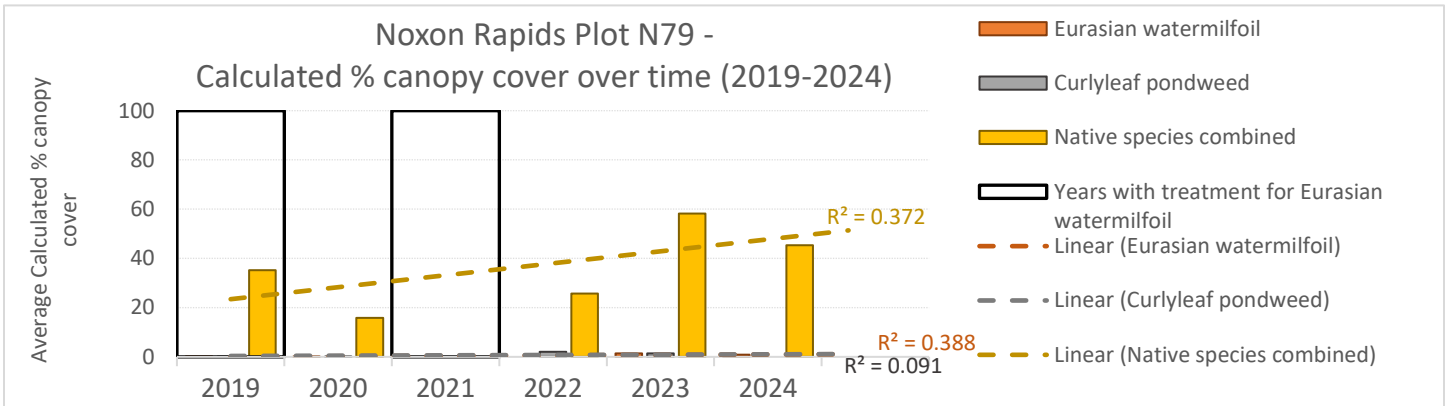
Nox-77 – Potential Treatment Plot



Nox-78 – Potential Treatment Plot



Nox-79 – Potential Treatment Plot



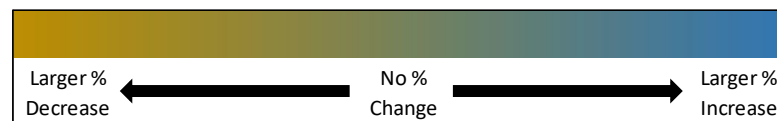
Appendix 2 – Canopy cover abundances among years for each plot for different species. Percent changes represent those differences between 2023 and 2024 as well as between 2019 and 2024.

Eurasian watermilfoil (<i>Myriophyllum spicatum</i>)																									
	C05	C06	C12	C20	C29	C30	C31 ^c	C32 ^c	C33 ^c	N01	N02	N03	N04	N05 ^c	N06 ^c	N08	N09 ^c	N11	N2301	N31	N52	N73	N77	N78	N79
2019	7.4	3.4	5.2	0.0	0.9	1.9	N/A	N/A	N/A	33.1	26.0	0.5	4.7	N/A	N/A	1.9	N/A	26.0	N/A	4.2	0.8	25.9	3.4	5.6	0.3
2020	0.1	0.6	1.2	0.0	0.7	1.1	4.1	19.1	0.0	0.0	0.8	2.8	4.9	4.5	26.7	0.1	0.0	0.0	N/A	1.5	0.0	0.1	3.0	0.0	0.1
2021	11.0	2.5	1.3	2.0	0.2	0.1	10.3	5.6	0.0	10.3	19.8	14.9	3.2	14.5	25.2	22.4	-	19.0	N/A	1.8	2.4	7.1	2.6	N/A	N/A
2022	2.0	2.2	2.0	0.3	1.5	1.9	1.1	0.0	0.0	9.0	0.0	2.5	17.7	36.9	41.7	2.7	0.0	43.8	N/A	10.1	9.6	0.0	19.2	0.0	0.0
2023	7.0	11.7	1.4	2.4	11.5	7.4	9.8	7.2	0.2	13.7	7.4	7.3	7.3	41.5	27.4	24.2	0.0	2.9	0.9	8.1	0.6	9.0	1.6	3.2	1.4
2024	0.0	0.5	3.5	0.1	2.2	0.6	5.1	3.5	0.1	0.2	0.0	0.1	9.6	21.6	37.4	0.0	2.8	34.0	6.0	2.3	2.3	0.2	0.2	0.8	0.8
2023-2024 % Change	-100	-96	153	-96	-81	-91	-48	-51	-58	-98	-100	-98	32	-48	37	-100	Up 2.8	1087	536	-72	310	-97	-90	-76	-41
2019-2024 % Change	-100	-87	-33	Up 0.1	156	-65	26	-82	Up 0.1	-99	-100	-74	104	378	40	-100	Up 2.8	31	N/A	-46	185	-99	-95	-86	183

Curlyleaf pondweed (<i>Potamogeton crispus</i>)																									
	C05	C06	C12	C20	C29	C30	C31 ^c	C32 ^c	C33 ^c	N01	N02	N03	N04	N05 ^c	N06 ^c	N08	N09 ^c	N11	N2301	N31	N52	N73	N77	N78	N79
2019	10.1	0.1	4.3	9.7	0.0	0.0	N/A	N/A	N/A	0.0	0.1	1.5	4.8	N/A	N/A	6.5	N/A	0.8	N/A	28.2	1.0	2.0	0.0	0.0	0.1
2020	15.2	1.0	1.2	11.2	0.0	0.0	0.7	0.0	0.0	0.6	1.5	3.8	5.5	0.0	0.9	10.6	0.0	8.7	N/A	20.9	0.6	4.0	0.2	0.0	0.1
2021	12.2	0.0	2.5	0.0	0.0	0.1	0.0	0.0		1.3	0.4	2.6	5.7	1.0	10.1	16.6	N/A	18.7	N/A	27.3	0.7	4.4	0.0	N/A	N/A
2022	11.8	0.0	0.5	0.0	0.0	0.0	4.4	20.1	1.0	0.7	0.7	3.5	3.0	4.3	17.6	15.6	2.7	2.8	N/A	13.4	0.3	16.8	0.3	0.0	2.1
2023	15.7	0.2	0.0	3.8	0.0	0.3	0.2	8.3	0.4	0.8	0.1	3.4	10.2	5.6	9.0	6.6	0.0	4.1	1.1	6.3	0.7	8.0	0.5	0.0	1.4
2024	6.8	0.5	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.1	0.0	0.0	3.2	0.0	0.0	9.6	0.0	0.1	0.0	6.5	0.0	2.2	0.0	0.0	0.0
2023-2024 % Change	-57	211	0	-100	0	-26	-100	-100	-100	-87	-100	-100	-69	-100	-100	44	0	-97	-100	4	-100	-73	-100	0	-100
2019-2024 % Change	-32	425	-100	-100	0	Up 0.2	-100	0	0	237	-100	-100	-33	0	-100	46	0	-86	N/A	-77	-100	8	0	0	-100

Flowering rush (<i>Butomus umbellatus</i>)																									
	C05	C06	C12	C20	C29	C30	C31 ^c	C32 ^c	C33 ^c	N01	N02	N03	N04	N05 ^c	N06 ^c	N08	N09 ^c	N11	N2301	N31	N52	N73	N77	N78	N79
2019	0.0	0.0	0.0	0.0	0.0	0.08	N/A	N/A	N/A	0.0	0.0	0.0	0.0	N/A	N/A	0.0	N/A	0.05	N/A	0.0	1.0	0.0	0.0	0.0	0.0
2020	0.0	0.0	0.0	0.0	0.0	0.06	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	0.0	0.2	0.0	0.0	0.0	0.0
2021	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.4	0.0	N/A	0.0	N/A	0.0	2.3	0.0	0.0	N/A	N/A
2022	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0	0.0	0.8	0.0	0.2	0.0	0.3	0.0	0.0	0.0	N/A	0.0	0.7	0.0	0.1	0.0	0.0
2023	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.2	1.3	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0	0.0
2024	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2023-2024 % Change	0	0	0	0	0	-14	0	0	0	-66	-67	0	0	0	-100	0	0	0	0	0	-100	0	0	0	0
2019-2024 % Change	0	0	0	0	0	1881	0	0	0	Up 0.1	Up 0.4	0	0	0	0	0	0	-100	N/A	0	-100	0	0	0	0

c = Control Plots (First surveyed in 2020)



Coontail (*Ceratophyllum demersum*)

	C05	C06	C12	C20	C29	C30	C31 ^c	C32 ^c	C33 ^c	N01	N02	N03	N04	N05 ^c	N06 ^c	N08	N09 ^c	N11	N2301	N31	N52	N73	N77	N78	N79
2019	18.2	14.5	17.3	0.2	0.0	1.6	N/A	N/A	N/A	17.4	27.0	10.2	22.7	N/A	N/A	18.3	N/A	53.1	N/A	12.4	12.2	26.7	1.5	0.3	20.9
2020	12.9	13.8	11.8	0.0	0.0	2.3	27.4	9.1	71.8	6.2	13.3	6.5	7.7	14.5	28.4	9.5	11.3	4.1	N/A	12.4	11.3	11.6	3.3	0.0	12.1
2021	33.0	19.2	28.9	0.0	0.0	3.3	46.6	43.6	62.1	5.6	24.5	29.8	9.7	26.3	44.6	14.9	-	9.7	N/A	4.4	18.8	25.3	0.0	N/A	N/A
2022	17.0	9.9	21.6	0.3	0.0	3.4	3.6	32.8	18.0	17.9	4.8	9.8	4.4	22.3	21.3	2.0	4.2	14.2	N/A	37.0	13.9	6.0	1.9	0.1	16.8
2023	34.2	30.6	37.4	0.7	0.0	18.1	26.7	53.7	67.9	13.8	16.4	42.1	16.4	27.1	45.3	27.9	6.7	21.0	9.3	65.7	2.0	24.5	5.1	1.1	36.1
2024	16.3	1.4	21.5	0.3	0.0	1.6	19.3	33.4	50.6	6.2	1.2	3.1	14.6	36.7	28.6	1.0	7.5	34.5	1.7	32.0	2.2	0.2	4.0	0.5	35.7
2023-2024 % Change	-52	-96	-42	-53	0	-91	-27	-38	-25	-55	-93	-93	-11	36	-37	-96	12	65	-82	-51	15	-99	-22	-50	-1
2019-2024 % Change	-11	-91	24	124	0	-2	-29	268	-30	-64	-96	-69	-36	153	1	-95	-33	-35	N/A	158	-82	-99	164	118	71

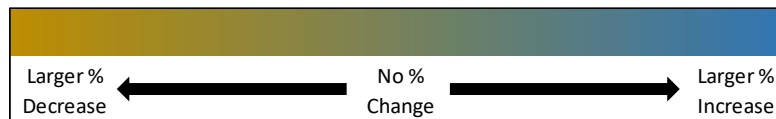
Muskgrass species (*Chara* species)

	C05	C06	C12	C20	C29	C30	C31 ^c	C32 ^c	C33 ^c	N01	N02	N03	N04	N05 ^c	N06 ^c	N08	N09 ^c	N11	N2301	N31	N52	N73	N77	N78	N79
2019	0.9	0.0	0.1	0.0	0.0	0.2	N/A	N/A	N/A	0.1	0.1	0.0	0.1	N/A	N/A	0.2	N/A	0.3	N/A	0.0	1.5	0.0	0.0	0.0	0.5
2020	0.2	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.2	0.3	0.0	0.2	0.0	0.0	0.1	0.0	0.0	N/A	0.1	2.7	0.0	0.1	0.0	0.6
2021	1.6	0.0	0.1	0.0	0.2	0.8	0.0	0.0	0.0	18.9	2.4	5.1	6.1	10.6	0.0	6.6	-	18.3	N/A	1.3	11.9	0.1	5.3	N/A	N/A
2022	0.3	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	5.5	0.2	0.3	0.2	0.0	0.0	1.0	0.4	0.8	N/A	0.0	3.8	0.1	0.4	0.1	0.2
2023	0.3	0.0	0.0	0.3	0.0	0.6	0.0	0.0	0.0	9.8	3.4	1.3	1.0	9.6	0.0	9.1	13.1	3.1	0.0	0.0	0.7	0.1	1.5	0.0	8.7
2024	0.0	0.0	0.0	2.6	0.0	0.1	0.0	0.0	0.0	0.6	0.6	0.1	1.7	0.0	0.0	0.2	0.0	1.2	0.0	1.0	4.8	0.0	0.2	0.0	0.9
2023-2024 % Change	-100	0	0	928	0	-77	0	0	0	-94	-83	-95	69	-100	0	-98	-100	-63	0	Up 1.0	571	-100	-89	0	-90
2019-2024 % Change	-100	0	-100	0	0	-39	0	0	0	681	368	Up 0.1	1325	0	0	9	0	256	N/A	Up 1.0	230	0	Up 0.2	0	66

Waterweed species (*Elodea* species)

	C05	C06	C12	C20	C29	C30	C31 ^c	C32 ^c	C33 ^c	N01	N02	N03	N04	N05 ^c	N06 ^c	N08	N09 ^c	N11	N2301	N31	N52	N73	N77	N78	N79
2019	6.6	18.7	24.3	30.0	30.6	5.3	N/A	N/A	N/A	5.8	39.6	0.2	18.5	N/A	N/A	3.0	N/A	9.4	N/A	11.6	0.5	20.0	1.7	43.6	5.9
2020	3.6	7.8	18.1	11.9	9.4	23.8	4.7	11.0	7.6	1.1	3.6	12.4	5.8	1.6	12.5	13.2	0.5	0.5	N/A	13.3	0.0	0.1	0.6	5.3	1.8
2021	12.3	31.9	19.9	12.9	21.0	13.0	26.4	18.6	12.9	4.5	41.9	18.1	23.0	28.3	8.2	14.2	-	19.3	N/A	30.4	4.3	8.9	2.8	N/A	N/A
2022	0.8	13.7	43.2	10.2	0.5	3.4	2.6	2.3	9.0	2.1	0.5	2.5	8.5	21.6	7.1	1.7	20.3	4.1	N/A	43.0	1.9	0.9	2.7	4.5	0.6
2023	14.4	40.6	5.3	47.9	35.0	28.6	53.5	9.3	37.9	5.8	35.1	16.2	5.7	4.5	7.7	14.5	2.4	2.7	18.3	27.6	0.0	5.0	1.8	27.3	8.0
2024	1.2	6.1	18.1	1.4	3.8	6.1	19.8	2.3	22.8	1.3	0.7	0.7	16.6	13.7	4.6	0.3	8.9	14.3	27.0	5.8	3.5	0.7	0.3	23.4	8.1
2023-2024 % Change	-92	-85	242	-97	-89	-79	-63	-76	-40	-79	-98	-96	191	205	-41	-98	272	433	47	-79	Up 3.5	-86	-82	-15	1
2019-2024 % Change	-83	-68	-26	-95	-88	16	325	-79	199	-78	-98	296	-11	737	-63	-90	40	51	N/A	-50	595	-96	-81	-46	36

c = Control Plots (First surveyed in 2020)

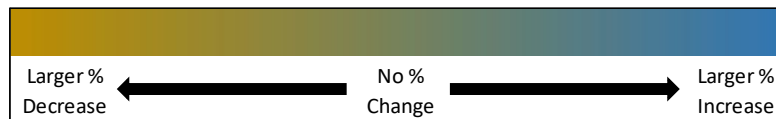


Northern watermilfoil (<i>Myriophyllum sibiricum</i>)																									
	C05	C06	C12	C20	C29	C30	C31 ^c	C32 ^c	C33 ^c	N01	N02	N03	N04	N05 ^c	N06 ^c	N08	N09 ^c	N11	N2301	N31	N52	N73	N77	N78	N79
2019	0.0	0.0	0.0	0.0	0.0	0.0	N/A	N/A	N/A	0.0	0.0	0.0	0.0	N/A	N/A	0.0	N/A	0.2	N/A	0.0	0.0	0.0	0.0	0.0	0.0
2020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.6	0.0	0.0	0.0	0.0	N/A	0.0	0.0	0.1	0.0	0.0	0.0
2021	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	-	0.0	N/A	0.0	0.0	0.0	0.0	N/A	N/A
2022	0.0	0.0	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.7	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.2	N/A	0.2	0.8	0.0	0.0	0.0	0.2
2023	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.03	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.4	3.1
2024	0.0	0.2	0.9	1.7	0.2	0.0	0.0	6.0	0.2	10.4	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.0	0.0	1.0	4.2	0.1	0.0	0.0	0.0
2023-2024 % Change	0	Up 0.2	Up 0.9	Up 1.7	Up 0.2	0	0	Up 6.0	Up 0.2	30255	-55	0	Up 0.2	0	0	0	Up 0.2	0	0	Up 1.0	Up 4.2	-79	0	-100	-99
2019-2024 % Change	0	Up 0.2	Up 0.9	Up 1.7	Up 0.2	0	0	Up 6.0	Up 0.2	0	0	0	Up 0.2	-100	0	0	Up 0.2	-100	N/A	Up 1.0	Up 4.2	Up 0.1	0	0	0

Water nymph species (<i>Najas</i> species)																									
	C05	C06	C12	C20	C29	C30	C31 ^c	C32 ^c	C33 ^c	N01	N02	N03	N04	N05 ^c	N06 ^c	N08	N09 ^c	N11	N2301	N31	N52	N73	N77	N78	N79
2019	0.0	0.0	0.0	0.0	0.0	0.1	N/A	N/A	N/A	0.0	0.0	0.0	0.0	N/A	N/A	0.0	N/A	0.0	N/A	0.0	0.0	0.0	0.0	0.0	0.0
2020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	0.0	0.0	0.0	0.0	0.0	0.0
2021	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	0.0	0.0	0.0	0.0	N/A	N/A
2022	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	0.0	0.0	0.0	0.0	0.0	0.0
2023	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.01	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2024	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2023-2024 % Change	0	0	0	0	0	0	0	0	0	-100	0	0	-100	0	0	0	0	0	0	0	0	0	0	0	0
2019-2024 % Change	0	0	0	0	0	-100	0	0	0	0	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0

Narrow leaved Potamogeton species (<i>Potamogeton/Stuckenia</i> species)																									
	C05	C06	C12	C20	C29	C30	C31 ^c	C32 ^c	C33 ^c	N01	N02	N03	N04	N05 ^c	N06 ^c	N08	N09 ^c	N11	N2301	N31	N52	N73	N77	N78	N79
2019	0.1	0.2	0.0	0.0	0.0	2.7	N/A	N/A	N/A	1.0	1.4	0.3	0.1	N/A	N/A	0.8	N/A	1.8	N/A	0.4	0.5	0.0	0.0	0.8	6.8
2020	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.9	1.4	0.1	0.0	1.7	1.2	4.6	1.6	2.8	N/A	0.3	0.5	0.0	0.2	9.4	1.2
2021	0.0	0.0	0.0	0.0	0.0	4.4	0.0	0.0	0.0	2.1	1.8	2.2	4.3	0.4	3.4	19.3	-	4.4	N/A	1.9	0.2	1.4	2.7	N/A	N/A
2022	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	1.3	4.5	0.4	1.4	0.3	1.7	2.0	5.8	1.4	N/A	0.0	0.4	0.0	0.3	0.9	6.6
2023	0.0	0.0	0.0	1.2	0.0	15.4	0.0	0.0	0.0	1.7	12.7	2.2	4.9	2.8	0.2	9.9	8.3	3.4	0.7	1.5	0.5	0.1	1.1	8.1	1.7
2024	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0	0.0	0.8	3.4	1.9	0.7	0.3	0.0	8.4	9.3	1.8	0.3	0.0	1.6	0.3	0.9	0.0	0.1
2023-2024 % Change	0	0	0	-100	0	-48	0	0	0	-53	-73	-11	-86	-89	-100	-15	11	-47	-62	-100	250	237	-19	-100	-94
2019-2024 % Change	-100	-100	0	0	0	198	0	0	0	-22	141	665	1255	-83	-100	938	463	-3	N/A	-100	214	Up 0.3	Up 0.9	-100	-99

c = Control Plots (First surveyed in 2020)

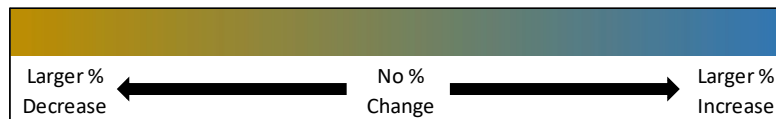


White-stemmed pondweed (<i>Potamogeton praelongus</i>)																									
	C05	C06	C12	C20	C29	C30	C31 ^c	C32 ^c	C33 ^c	N01	N02	N03	N04	N05 ^c	N06 ^c	N08	N09 ^c	N11	N2301	N31	N52	N73	N77	N78	N79
2019	0.0	0.0	0.0	0.0	0.0	0.0	N/A	N/A	N/A	0.0	0.1	0.0	0.0	N/A	N/A	0.2	N/A	0.0	N/A	0.0	0.0	0.0	0.0	0.0	0.0
2020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.2	1.0	0.8	0.0	0.0	N/A	1.5	0.2	0.0	0.0	0.0	0.0
2021	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	1.0	0.6	-	0.0	N/A	0.0	8.0	0.0	0.0	N/A	N/A
2022	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	2.5	0.0	0.0	N/A	0.0	0.0	0.0	0.0	0.0	0.0
2023	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2024	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.1	1.7	0.0	1.1	3.4	0.0	0.1	0.0	1.0	1.1	0.0	0.0	0.0	0.0
2023-2024 % Change	0	0	0	0	0	0	0	0	0	-100	Up 3.0	Up 0.1	Up 1.7	0	Up 1.1	Up 3.4	0	Up 0.1	0	Up 1.0	Up 1.1	0	0	0	0
2019-2024 % Change	0	0	0	0	0	0	0	0	0	0	1897	Up 0.1	Up 1.7	-100	12	1436	0	Up 0.1	N/A	Up 1.0	Up 1.1	0	0	0	0

Richardson's pondweed (<i>Potamogeton richardsonii</i>)																									
	C05	C06	C12	C20	C29	C30	C31 ^c	C32 ^c	C33 ^c	N01	N02	N03	N04	N05 ^c	N06 ^c	N08	N09 ^c	N11	N2301	N31	N52	N73	N77	N78	N79
2019	0.0	0.0	0.0	0.2	0.0	1.2	N/A	N/A	N/A	0.0	0.0	0.0	0.0	N/A	N/A	0.1	N/A	0.1	N/A	0.0	1.0	0.0	0.2	0.0	0.1
2020	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	N/A	0.0	0.0	0.0	0.0	0.0	0.1
2021	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	1.3	0.0	0.0	0.0	N/A	0.0	N/A	0.3	0.0	2.2	2.5	N/A	N/A
2022	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.3	0.0	0.0	0.1	0.2	0.7	0.0	0.0	0.0	0.0	0.0	N/A	0.0	0.1	0.0	0.0	0.0	0.0
2023	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.3	0.7	1.5	0.4	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	5.0	4.8	0.0	0.0
2024	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.1	1.9	0.9	0.1	0.3	0.1	0.0	0.0	0.1	0.1	2.0	0.0	0.7	2.7	0.0	0.0
2023-2024 % Change	0	0	0	0	0	-60	0	0	0	-63	172	-38	-69	Up 0.3	Up 0.1	0	0	-44	Up 0.1	Up 2.0	0	-87	-43	0	0
2019-2024 % Change	0	0	0	-100	0	-52	0	0	0	285	Up 1.9	Up 0.9	Up 0.1	Up 0.3	Up 0.1	-70	0	-2	N/A	Up 2.0	-100	Up 0.7	1721	0	-100

White water buttercup (<i>Ranunculus aquatilis</i>)																									
	C05	C06	C12	C20	C29	C30	C31 ^c	C32 ^c	C33 ^c	N01	N02	N03	N04	N05 ^c	N06 ^c	N08	N09 ^c	N11	N2301	N31	N52	N73	N77	N78	N79
2019	5.9	4.7	0.1	0.0	0.0	0.0	N/A	N/A	N/A	0.9	0.1	0.0	0.4	N/A	N/A	0.5	N/A	0.6	N/A	0.0	0.0	0.5	1.2	1.9	0.1
2020	10.1	15.3	0.7	0.0	0.0	0.3	0.0	9.9	0.0	4.3	0.0	2.0	1.8	0.0	0.0	4.0	0.0	0.1	N/A	0.8	0.0	1.0	0.0	0.0	0.1
2021	20.8	23.4	0.4	0.4	0.0	0.4	0.0	25.5	0.0	11.6	0.1	0.5	16.1	0.4	0.2	13.7	N/A	2.6	N/A	0.0	0.2	6.2	0.0	N/A	N/A
2022	14.9	16.4	0.0	3.0	0.0	0.0	0.0	20.4	0.0	0.2	0.0	0.2	8.7	0.0	0.3	0.3	0.8	0.7	N/A	1.4	0.3	0.5	0.9	0.0	0.3
2023	30.0	26.0	0.6	7.4	0.0	0.0	0.0	20.8	0.0	0.1	0.1	1.7	8.6	0.3	0.6	1.4	0.6	0.4	0.3	0.0	0.0	0.9	0.2	0.1	0.6
2024	9.9	8.2	0.0	3.3	0.0	0.8	0.0	18.3	0.0	0.0	0.0	0.4	7.5	0.7	1.4	0.0	0.1	0.1	0.8	0.2	0.0	0.1	0.2	0.0	0.5
2023-2024 % Change	-67	-68	-100	-55	0	Up 0.8	0	-12	0	-59	-100	-76	-13	142	137	-100	-87	-68	145	Up 0.2	0	-89	-27	-100	-27
2019-2024 % Change	69	73	-100	Up 3.3	0	Up 0.8	0	84	0	-95	-100	Up 0.4	1931	Up 0.7	Up 1.4	-100	Up 0.1	-80	N/A	Up 0.2	0	-80	-86	-100	281

c = Control Plots (First surveyed in 2020)



Appendix 3 – Canopy cover abundances (%) for each year (2019-2024)

2024 Potential Treatment Plots	C05	C06	C12 ^x	C20	C29 ^x	C30	N01	N02	N03	N04 ^x	N08	N11	N31 ^x	N52 ^x	N73	N77	N78	N79
Elodea spp.	1	6	18	1	4	6	1	1	1	17	0	14	6	4	1	0	23	8
Coontail	16	1	22	0	0	2	6	1	3	15	1	35	32	2	0	4	1	36
Eurasian watermilfoil	0.0	0.5	3.5	0.1	2.2	0.6	0.2	0.0	0.1	9.6	0.0	34.0	2.3	2.3	0.2	0.2	0.8	0.8
Curlyleaf pondweed	7	1	0.0	0.0	0.0	0.2	0.1	0.0	0.0	3.2	9.6	0.1	6.5	0.0	2.2	0.0	0.0	0.0
Native narrow-leaved pondweed spp.	0	0	0	0	0	8	1	3	2	1	8	2	0	2	0	1	0	0
White water buttercup	10	8	0	3	0	1	0	0	0	7	0	0	0	0	0	0	0	0
Chara/Nitella spp.	0	0	0	3	0	0	1	1	0	2	0	1	1	5	0	0	0	1
Richardson's pondweed	0	0	0	0	0	1	0	2	1	0	0	0	2	0	1	3	0	0
Flowering rush	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
White-stemmed pondweed	0	0	0	0	0	0	0	3	0	2	3	0	1	1	0	0	0	0
Northern watermilfoil	0	0	1	2	0	0	10	0	0	0	0	0	1	4	0	0	0	0
Water stargrass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Slender Naiad	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Illinois pondweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

X = Treated in 2024

2024 Untreated Control Plots	C31	C32	C33	N05	N06	N09	N2301
Elodea spp.	20	2	23	14	5	9	27
Coontail	19	33	51	37	29	8	2
Eurasian watermilfoil	5	3	0.1	22	37	3	6
Curlyleaf pondweed	0	0.0	0.0	0.0	0.0	0.0	0.0
Native narrow-leaved pondweed spp.	0	0	0	0	0	9	0
White water buttercup	0	18	0	1	1	0	1
Chara/Nitella spp.	0	0	0	0	0	0	0
Richardson's pondweed	0	0	0	0	0	0	0
Flowering rush	0	0	0	0	0	0	0
White-stemmed pondweed	0	0	0	0	1	0	0
Northern watermilfoil	0	6	0	0	0	0	0
Water stargrass	0	0	0	0	0	0	0
Slender Naiad	0	0	0	0	0	0	0
Illinois pondweed	0	0	0	0	0	0	0

2023 Potential Treatment Plots	C05‡	C06‡	C12	C20	C29	C30‡	N01‡	N02‡	N03‡	N04‡	N08‡	N11	N31‡	N52	N73‡	N77	N78	N79
Elodea spp.	14	41	5	48	35	29	6	35	16	6	15	3	28	0	5	2	27	8
Coontail	34	31	37	1	0	18	14	16	42	16	28	21	66	2	25	5	1	36
Eurasian watermilfoil	7	12	1	2	12	7	14	7	7	7	24	3	8	1	9	2	3	1
Curlyleaf pondweed	16	0	0	4	0	0	1	0	3	10	7	4	6	1	8	1	0	1
Native narrow-leaved pondweed spp.	0	0	0	1	0	15	2	13	2	5	10	3	1	0	0	1	8	2
White water buttercup	30	26	1	7	0	0	0	0	2	9	1	0	0	0	1	0	0	1
Chara/Nitella spp.	0	0	0	0	0	1	10	3	1	1	9	3	0	1	0	1	0	9
Richardson's pondweed	0	0	0	0	0	1	0	1	1	0	0	0	0	0	5	5	0	0
Flowering rush	0	0	0	0	0	2	0	1	0	0	0	0	0	2	0	0	0	0
White-stemmed pondweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern watermilfoil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Water stargrass	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
Slender Naiad	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Illinois pondweed	0	0	0	0	0	0	0	5	0	2	6	0	0	1	0	0	0	0

‡ = Treated in 2023

2023 Untreated Control Plots	C31	C32	C33	N05	N06	N09	N2301
Elodea spp.	54	9	38	4	8	2	18
Coontail	27	54	68	27	45	7	9
Eurasian watermilfoil	10	7	0	41	27	0	1
Curlyleaf pondweed	0	8	0	6	9	0	1
Native narrow-leaved pondweed spp.	0	0	0	3	0	8	1
White water buttercup	0	21	0	0	1	1	0
Chara/Nitella spp.	0	0	0	10	0	13	0
Richardson's pondweed	0	0	0	0	0	0	0
Flowering rush	0	0	0	0	1	0	0
White-stemmed pondweed	0	0	0	0	0	0	0
Northern watermilfoil	0	0	0	0	0	0	0
Water stargrass	0	0	0	0	0	0	0
Slender Naiad	0	0	0	0	0	0	0
Illinois pondweed	0	0	0	0	0	0	0

2022 Potential Treatment Plots	C05	C06	C12	C20	C29	C30	N01 [#]	N02	N03 [#]	N04 [#]	N08 [#]	N11 [#]	N31 [#]	N52 [#]	N73	N77 [#]	N78	N79
Elodea spp.	1	14	43	10	0	3	2	1	2	8	2	4	43	2	1	3	4	1
Coontail	17	10	22	0.3	0	3	18	5	10	4	2	14	37	14	6	2	0.1	17
Eurasian watermilfoil	2	2	2	0.3	2	2	9	0	2	18	3	44	10	10	0.1	19	0.2	0.0
Curlyleaf pondweed	12	0	0.5	0	0	0	1	1	4	3	16	3	13	0.3	17	0.3	0	2
Native narrow-leaved pondweed spp.	0	0	0	0	0	2	1	5	0.4	1	2	1	0	0.4	0	0.3	1	7
White water buttercup	15	16	0	3	0	0	0.2	0	0.2	9	0.3	1	1	0.3	0	1	0	0.3
Chara/Nitella spp.	0.3	0	0	0	0	0.2	6	0.2	0.3	0.2	1	1	0	4	0.1	0.4	0.1	0.2
Richardson's pondweed	0	0	0	0	0	0.4	0	0.1	0.2	1	0	0	0	0.1	0	0	0	0
Flowering rush	0	0	0	0	0	2	0	1	0	0.2	0	0	0	1	0	0.1	0	0
White-stemmed pondweed	0	0	0	0	0	0	0	1	0	0	3	0	0	0	0	0	0	0
Northern watermilfoil	0	0	0.3	0	0	0.1	1	0	0	0.2	0	0.2	0.2	1	0	0	0	0.2

#=Plots treated in 2022

2022 Control Plots	Untreated Control Plots						Potential Harvester Plots				
	C32	C31	C33	N05	N06	N09	N07	N10	N30	N37	N88
Elodea spp.	2	3	9	22	7	20	-	15	8	3	10
Coontail	33	4	18	22	21	4	-	16	12	5	20
Eurasian watermilfoil	0	1	0	37	42	0.1	-	30	20	5	10
Curlyleaf pondweed	20	4	1	4	18	3	-	26	30	9	41
Native narrow-leaved pondweed spp.	0	0	0	0.3	2	6	-	10	1	1	0.4
White water buttercup	20	0	0	0	0.3	1	-	1	7	6	2
Chara/Nitella spp.	0	0	0	0	0	0.4	-	0	0	1	0
Richardson's pondweed	0.3	0	0	0	0	0	-	0	0	0	0
Flowering rush	0	0	0	0	0.3	0	-	0	0.2	0	0
White-stemmed pondweed	0	0	0	0	0	0	-	0	0	0	4
Northern watermilfoil	0	0	0	0	0	0	-	0.1	1	0.1	1

2021 Potential Treatment Plots	C05	C06	C12	C20	C29	C30	N01^	N02^	N03^	N04^	N08^	N11	N31	N52	N73^	N77	N78	N79^
Elodea spp.	12.3	31.9	19.9	12.9	21.0	13.0	4.5	41.9	18.1	23.0	14.2	19.3	30.4	4.3	8.9	2.8	-	-
Coontail	33.0	19.2	28.9	0	0	3.3	5.6	24.5	29.8	9.7	14.9	9.7	4.4	18.8	25.3	0	-	-
Eurasian watermilfoil	11.0	2.5	1.3	2.0	0.2	0.1	10.3	19.8	14.9	3.2	22.4	19.0	1.8	2.4	7.1	2.6	-	-
Curlyleaf pondweed	12.2	0	2.5	0	0	0.1	1.3	0.4	2.6	5.7	16.6	18.7	27.3	0.7	4.4	0	-	-
Native narrow-leaved pondweed spp.	0	0	0	0	0	4.4	2.1	1.8	2.2	4.3	19.3	4.4	1.9	0.2	1.4	2.7	-	-
White water buttercup	20.8	23.4	0.4	0.4	0	0.4	11.6	0.1	0.5	16.1	13.7	2.6	0	0.2	6.2	0	-	-
Chara spp.	1.6	0	0.1	0	0.2	0.8	18.9	2.4	5.1	6.1	6.6	18.3	1.3	11.9	0.1	5.3	-	-
Richardson's pondweed	0	0	0	3.3	0	0	0	0	1.7	1.3	0	0	0.3	0.0	2.2	2.5	-	-
Flowering rush	0	0	0	0	0	0.1	0	0.6	0	0	0	0	0	2.3	0	0	-	-
White-stemmed pondweed	0	0	0	0	0	0	0	0.8	0	0	0.6	0	0	8.0	0	0	-	-
Northern watermilfoil	0	0	0	0	0	0	0.1	0.3	0	0	0	0	0	0	0	0	-	-

^=Plots treated in 2021; Unable to sample N78 and N79 due to boat troubles

2021 Untreated Control Plots	C31	C32	C33	N05	N06	N09
Elodea spp.	26.4	18.6	12.9	28.3	8.2	-
Coontail	46.6	43.6	62.1	26.3	44.6	-
Eurasian watermilfoil	10.3	5.6	0	14.5	25.2	-
Curlyleaf pondweed	0	0	0	1.0	10.1	-
Native narrow-leaved pondweed spp.	0	0	0	0.4	3.4	-
White water buttercup	0	25.5	0	0.4	0.2	-
Chara spp.	0	0	0.0	10.6	0	-
Richardson's pondweed	0	0	0	0	0	-
Flowering rush	0	0	0	0	0.4	-
White-stemmed pondweed	0	0	0	0	1.0	-
Northern watermilfoil	0	0	0	0	0	-

Unable to sample N09 due to boat troubles

Potential Treatment Plots 2020	C05	C06*	C12*	C20	C29	C30*	N01	N02	N03*	N04*	N08	N11	N31*	N52	N61	N73	N77	N78	N79
Elodea spp.	3.6	7.8	18.1	11.9	9.4	23.8	1.1	3.6	12.4	5.8	13.2	0.5	13.3	0	NA	0.1	0.6	5.3	1.8
Coontail	12.9	13.8	11.8	0	0	2.3	6.2	13.3	6.5	7.7	9.5	4.1	12.4	11.3	NA	11.6	3.3	0	12.1
Eurasian watermilfoil	0.1	0.6	1.2	0	0.7	1.1	0	0.8	2.8	4.9	0.1	0	1.5	0	NA	0.1	3.0	0	0.1
Curlyleaf pondweed	15.2	1.0	1.2	11.2	0	0	0.6	1.5	3.8	5.5	10.6	8.7	20.9	0.6	NA	4.0	0.2	0	0.1
Native narrow-leaved pondweed spp.	0	0	0	0	0	1.7	0.9	1.4	0.1	0	4.6	2.8	0.3	0.5	NA	0	0.2	9.4	1.2
White water buttercup	10.1	15.3	0.7	0	0	0.3	4.3	0	2.0	1.8	4.0	0.1	0.8	0	NA	1.0	0.0	0	0.1
Chara spp.	0.2	0	0	0	0	0.4	0.2	0.3	0	0.2	0.1	0	0.1	2.7	NA	0	0.1	0	0.6
Richardson's pondweed	0	0	0	0	0	0.1	0.1	0	0	0	0.1	0	0	0	NA	0	0.0	0	0.1
Flowering rush	0	0	0	0	0	0.1	0.1	0	0	0	0	0	0	0.2	NA	0	0.0	0	0
White-stemmed pondweed	0	0	0	0	0	0	0	0	0	0.6	0.8	0	1.5	0.2	NA	0	0.0	0	0
Northern watermilfoil	0	0	0	0	0	0	0.1	0	0.1	0	0	0	0	0	NA	0.1	0.0	0	0

* = plots treated in 2020

Untreated Control Plots 2020	C31	C32	C33	N05	N06	N09
Elodea spp.	4.7	11.0	7.6	1.6	12.5	0.5
Coontail	27.4	9.1	71.8	14.5	28.4	11.3
Eurasian watermilfoil	4.1	19.1	0	4.5	26.7	0
Curlyleaf pondweed	0.7	0	0	0	0.9	0
Native narrow-leaved pondweed spp.	0	0	0	1.7	1.2	1.6
White water buttercup	0	9.9	0	0	0	0
Chara spp.	0	0	0	0	0	0
Richardson's pondweed	0	0	0	0	0	0
Flowering rush	0	0	0	0	0	0
White-stemmed pondweed	0	0	0	0.2	1.0	0
Northern watermilfoil	0	0	0	0.6	0	0

Untreated Controls - First Surveyed in 2020

Potential Treatment Plots 2019	C05 [†]	C06 [†]	C12 [†]	C20	C29 [†]	C30 [†]	N01	N02 [†]	N03 [†]	N04 [†]	N08 [†]	N11 [†]	N31 [†]	N52 [†]	N61	N73 [†]	N77 [†]	N78 [†]	N79 [†]
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Elodea spp.	7	19	24	30	31	5	6	40	0.2	19	3	9	12	1	NA	20	2	44	6
Coontail	18	14	17	0.2	0	2	17	27	10	23	18	53	12	12	NA	27	2	0.25	21
Eurasian watermilfoil	7	3	5	0	1	2	33	26	1	5	2	26	4	1	NA	26	3	6	0.3
Curlyleaf pondweed	10	0.1	4	10	0	0	0.03	0.1	2	5	7	1	28	1	NA	2	0	0	0.1
Native narrow-leaved pondweed spp.	0.1	0.2	0	0	0	3	1	1	0.3	0.1	1	2	0.4	1	NA	0	0	1	7
White water buttercup	6	5	0.1	0	0	0	1	0.1	0	0.4	0.5	0.6	0	0	NA	1	1	2	0.1
Chara spp.	1	0	0.1	0	0	0.2	0.1	0.1	0	0.1	0.2	0.3	0	1	NA	0	0	0	1
Richardson's pondweed	0	0	0	0.2	0	1	0.03	0	0	0	0.1	0.1	0	1	NA	0	0.2	0	0.1
Flowering rush	0	0	0	0	0	0.1	0	0	0	0	0	0.05	0	1	NA	0	0	0	0
White-stemmed pondweed	0	0	0	0	0	0	0	0.1	0	0	0.2	0	0	0	NA	0	0	0	0
Northern watermilfoil	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	NA	0	0	0	0
Grass leaved pondweed	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	NA	0	0	0	0
Waternymph spp.	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	NA	0	0	0	0

† = plots treated in 2019