2016 Phragmites Monitoring Results

for

Wazee Lake Recreation Area

Jackson County, Wisconsin

Phragmites australis subsp. australis from Wazee Lake Recreation Area

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ABSTRACT

Jackson County Parks and Recreation developed a management plan for non-native *Phragmites australis subsp. australis* (hereafter Phragmites) in Wazee Lake Recreation Area from 2015 through 2020. In 2015, the county was successful in securing a three-year grant from the Wisconsin Department of Natural Resources (WDNR) to control Phragmites. Efforts began before the grant with herbicide treatment of an 11-acre unit around the Tailings Pond in 2014 and prescribed burn of the entire Tailings Basin in spring 2015. Observations in 2016 suggest Phragmites in the 11-acre unit to be greatly reduced. However, new growth of Phragmites plants were observed within the 11-acre unit and were delineated for aerial herbicide treatment in 2017.

Fourteen treatment units were delineated by county staff in 2015 ranging in size from 0.1 to 10.37 acres and totaling 35 acres all together. These treatment units were located within and around the Tailings Basin. A total of 12 transects were established in 8 of the treatment units in 2015 for multi-year monitoring of Phragmites. Pre-treatment monitoring was done in August 2015 following modified methods from Moore (2015) with herbicide treatment of the 35 acres following one week later. In addition, 6 photo points were established where transects were problematic due to site access and/or high water levels. Transects and photo points were surveyed again in August 2016. Along 11 transects, there were a total of 180 quadrats where dominance class was recorded (transect #4 was not surveyed in 2016 due to high water). Sixty-seven percent (121) of the quadrats were dominated by previous years' growth of Phragmites. Only 8 quadrats were dominated by living Phragmites, 6 of which were in an area that has not yet been treated. In 2015 there were 150 quadrats dominated by Phragmites. The remaining 51 quadrats were dominated by water, other undesirable species, desirable species, bare ground, or mixed (no class dominated). These results suggest 90% reduction has been achieved in the areas where aerial spray was conducted. However, regrowth around the Tailings Pond demonstrates the need for continued monitoring and treatment.

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INTRODUCTION

Project Area

Wazee Lake Recreation Area is approximately 5 miles east of Black River Falls in Jackson County, Wisconsin. The property was the Jackson County Iron Mine from 1967 to 1983 owned by Inland Steel Mining Company. Before the mine closed, Inland Steel began reclamation of the site, which included planting vegetation to stabilize the soils. Due to the extremely poor nutrient content of the soils in the Tailings Basin area, less desirable plant species were selected for planting, one of which was the non-native and invasive *Phragmites australis subsp. australis,* hereafter Phragmites[1]

Project Background

Jackson County Forestry & Parks Department was awarded an Aquatic Invasive Species Control Grant in 2015 from the Wisconsin Department of Natural Resources. The grant funds are provided for three years for the control of Phragmites within the Wazee Lake Recreation Area. Control efforts are concentrated within and around the Tailings Basin with approximately 46 acres of Phragmites units delineated, many of which are small patches less than 3 acres in size. The areas delineated in Figure 1 illustrate control efforts in 2014-2016 and do not reveal all the locations of Phragmites in Wazee.

Control & Monitoring Efforts

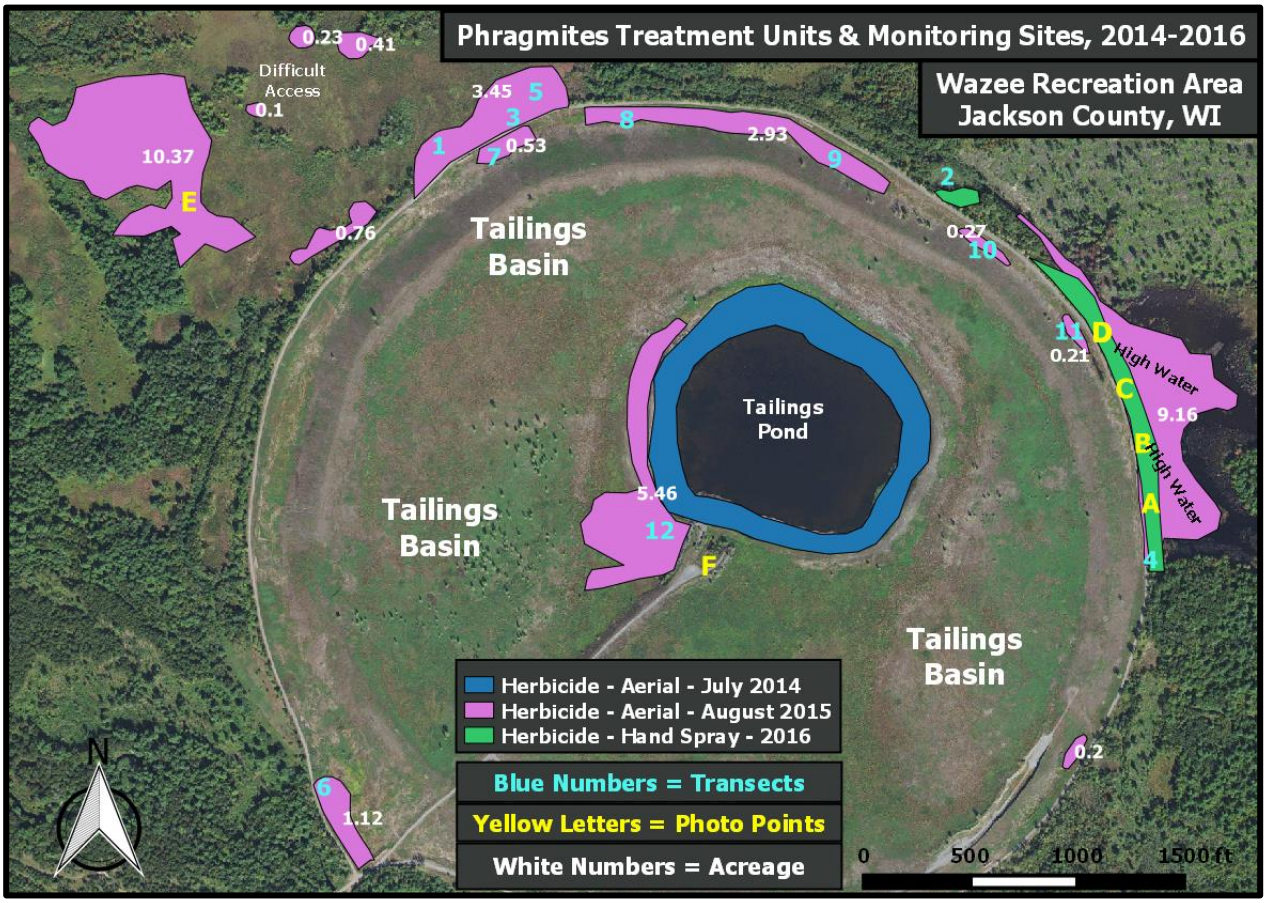
Control efforts began in July 2014 with aerial spray application of Imazapyr[2] on 11 acres immediately surrounding the Tailings Pond (blue polygon in Figure 1). Prescribed burning was attempted that winter but was unsuccessful because the fire would not carry. The following spring 2015, the entire tailings basin was burned, including the 11 acres that were treated with Imazapyr in 2014.

Jackson County partnered with Aquatic Plant and Habitat Services (APHS) in spring 2015 to assist with monitoring as outlined in the grant application. Monitoring efforts began with installation of 12 transects and another 6 photo points that were surveyed August 10-17, 2015 to collect pre-treatment data. Aerial spray of Imazapyr was completed on another 35 acres on August 24, 2015 (purple polygons in Figure 1).

The same 12 transects and 5 of the photos points were visited again August 12, 2016 to collect post-treatment data. The 11-acre unit that was treated in 2014 was also visited. Hand spraying with a solution of Imazapyr and glyphosate[3] was done in late September 2016 along the road near photos points A through D (green polygons in Figure 1) and at a small area along Lake Wazee at the Sherwood Forest Access (not illustrated on map).

[1] See Appendix A for further information on *Phragmites australis subsp. australis.*
[2] See Appendix B for further information on Imazapyr.
[3] See Appendix C for further information on glyphosate.

Figure 1 – Treatment and Monitoring Sites Map



Project Goals

Project goals listed below are an abbreviated version of those from the grant application submitted by Jackson County to the WDNR in early 2015. This report is intended to meet the requirements for Goal #3 in 2015 by establishing a monitoring strategy, defining monitoring locations, and providing pre- and post-treatment data for sites that were treated.

1. Reduce Phragmites by 90% in five years (2014-2019) using aerial and ground application of approved herbicides.
2. Remove biomass on treated sites through mechanical means and prescribed burning to aid in monitoring and increase effectiveness of re-treatment.
3. Conduct monitoring to determine effectiveness of treatment and the need for additional treatment.
4. Provide public education and outreach to prevent Phragmites control to new areas.

METHODS

Transects were installed at 12 locations in 2015 using 2 metal T-posts per transect to define each end with lengths ranging from 6 to 34 meters (Table 1). Transect length was largely dictated by site characteristics such as water depth and density of Phragmites and the mean length was 16 meters. Since the transects are to be visited over a number of years for monitoring purposes, T-posts were hammered using a post pounder to prevent ejection during freeze-thaw cycles. Latitude and longitude coordinates were captured using an iPhone 5c and Avenza Maps application. Transects were located within areas planned for 2015 herbicide treatment except for Transect 2 (Figure 1).

Table 1 – Transect & Photo Point Identifiers & Coordinates

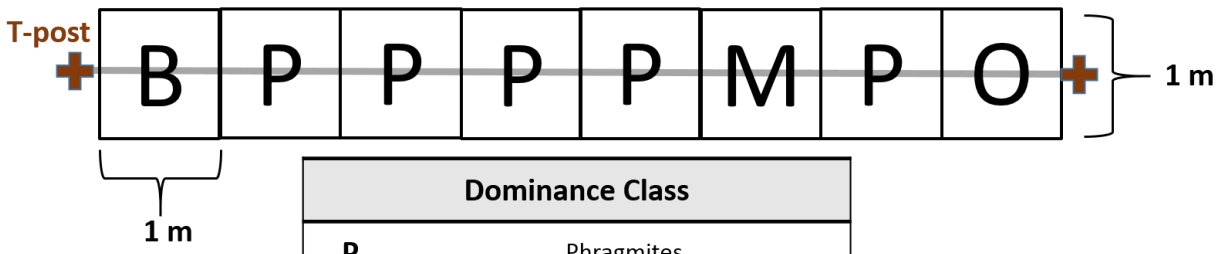
Transect Number	Transect Length (m)	Longitude	Latitude
1	15	*-90.720528*	*44.309271*
2	6	*-90.711455*	*44.308692*
3	18	*-90.719186*	*44.309609*
4	12	*-90.708002*	*44.303699*
5	34	*-90.718770*	*44.309929*
6	10	*-90.722902*	*44.301076*
7	16	*-90.719547*	*44.309107*
8	16	*-90.717151*	*44.309537*
9	15	*-90.713449*	*44.308957*
10	13	*-90.710856*	*44.307739*
11	14	*-90.709344*	*44.306663*
12	23	*-90.716775*	*44.304250*
Photo ID Letter		**Longitude**	**Latitude**
A		*-90.708204*	*44.304334*
B		*-90.708312*	*44.305107*
C		*-90.708612*	*44.305817*
D		*-90.709013*	*44.306553*
E		*-90.725241*	*44.308550*
F		*44.303689*	*44.303689*

Pre-treatment monitoring was completed between August 10 and 17, 2015 and post-treatment monitoring on August 12, 2016. A measuring tape was secured to each end of the transect and a one-square-meter quadrat frame was placed along the transect starting at the first meter. Dominance class was recorded as defined in Figure 2. “Water” and “Old Growth” were added to the dominance class list in 2016. Each meter along the transect was surveyed using this procedure. Photos were taken at each transect.

Photo points were established in 2015 at 6 locations as identified in Figure 1 and Table 1. Photos were taken at points A through D facing toward the 9.16-acre treatment unit. Point E photos were only taken in 2015 in various directions approximately 10 feet higher than ground level. Photos at point F were taken facing northeast. All photos were taken between August 10 and 17, 2015 and August 12, 2016.

Survey data were uploaded to an open source geographic information systems (GIS) program known as QGIS (QGIS, 2015). Maps were created to illustrate transect and photo point locations, treatment units, and dominance class.

Figure 2 - Transect Illustration & Dominance Class Description



Dominance Class	
P	Phragmites
D	Desirable Species
O	Other (non-Phragmites) undesirable species such as narrow-leaved cattail
B	Bare ground
M	Mixed; no single component dominating
W*	Water
OG*	Old growth of Phragmites

*Dominance determined by >50% of quadrat with majority cover by the component. *Dominance classes added in 2016*

RESULTS

Results of the 2015 Herbicide Treatment

The number of quadrats in a given transect was the same as its length. For example, transect 1 was 15 meters long (Table 2) so it had 15 quadrats. The total number of quadrats was 192 in 2015 and 180 in 2016 because transect 4 was not surveyed in 2016 due to high water conditions. All transects had a reduction in quadrats dominated by Phragmites except for transect 2, which wasn't treated in 2015 (Table 2 and Figure 4). Dominance classes were more variable in 2016 compared to the previous year. In 2015 there were only 2 dominance classes (Phragmites and Mixed) compared to 7 dominance classes this year. Transects 1, 3, 5, and 8-11 had quadrats that were dominated by old growth Phragmites. Old growth in transects 1, 3, and 5 was particularly thick with stems up to 8 feet tall making those transects difficult to tread through (Figure 3). Transect 6 had some quadrats dominated by desirable species, one dominated by other undesirable species (Canada thistle), and 5 dominated by bare ground. Most quadrats in transect 7 were dominated by water with sparse old growth Phragmites. Most quadrats along transect 12 were dominated by other undesirable species (birdsfoot trefoil). Photos of all transects in 2015 and 2016 are included for visual comparisons in Figure 7 through Figure 10. With the exception of transects 2 (not treated) and 4 (not surveyed due to high water), all photos a drastic decline in living Phragmites after herbicide treatment in 2015.

Photos of points A-D and F in 2015 and 2016 are in Figure 11 and Figure 12 for pre- and post-treatment comparison. Points A-D were dense Phragmites in 2015 with water levels too high for establishing transects. After herbicide treatment, much of the 9.16-acre treatment unit had lower Phragmites infestation but this was difficult to observe from the photo points because Phragmites had flourished along the perimeter and acted as a visual barrier for photo points A, B, and C. Consequently, that area was hand-sprayed with a solution of Imazapyr and glyphosate in late September, 2016. Point F was mixed-to-dense Phragmites to the north and east in 2015 and did not appear to have changed in 2016. Photo point E was not visited in 2016 due to limited accessibility.

Figure 3 – Photos of Thick Previous Years' Phragmites

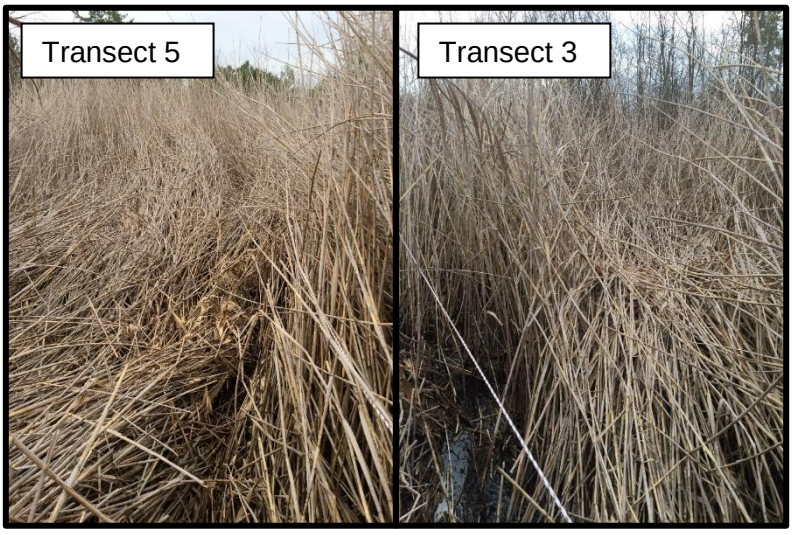
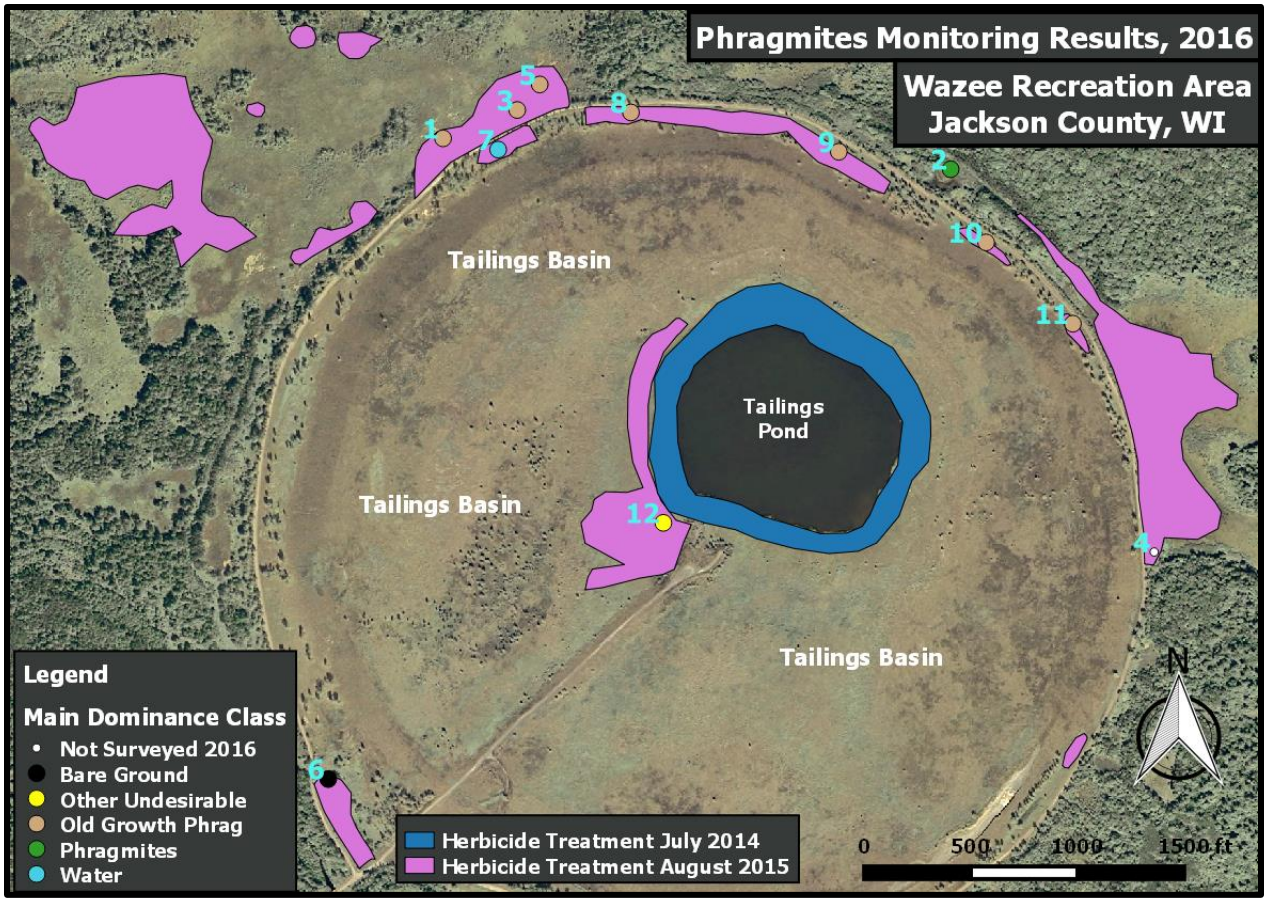


Table 2 - Dominance Class Quantified in Quadrats

Transect	Number of Quadrats in Dominance Class, 2015 vs 2016								
	2015		2016						
	Phragmites	Mixed	Phragmites	Mixed	Desirable	Other Undesirable	Bare Ground	Water	Old Growth
1	15	0	0	0	0	0	0	0	15
2	6	0	6	0	0	0	0	0	0
3	18	0	0	0	0	0	0	0	12
4	12	0	NS	NS	NS	NS	NS	NS	NS
5	34	0	0	0	0	0	0	0	34
6	0	10	0	0	4	1	5	0	0
7	16	0	2	1	0	0	0	12	0
8	13	3	0	0	3	0	0	1	12
9	15	0	0	0	0	0	0	0	21
10	7	6	0	0	0	0	0	0	13
11	14	0	0	0	0	0	0	0	14
12	0	23	0	4	1	15	4	0	0
TOTAL QUADRATS	**150**	**42**	**8**	**5**	**8**	**16**	**9**	**13**	**121**

Figure 4 – Main Dominance Classes in 2016



Results of the 2014 Herbicide Treatment

A walk around the tailings pond (11-acre treatment site) in June 2015 revealed very little Phragmites growing where herbicide was applied in 2014 (Figure 5). Although there are no pre-treatment data from this site, it is reasonable to estimate there was at least 90% reduction between 2014 and 2015. Jackson County staff visited the 2014 treatment area again in 2016 and delineated three areas where Phragmites is growing and planned for aerial spraying in 2017 (Figure 6).

Figure 5 – Tailings Pond Photo, 2014 Treatment Area

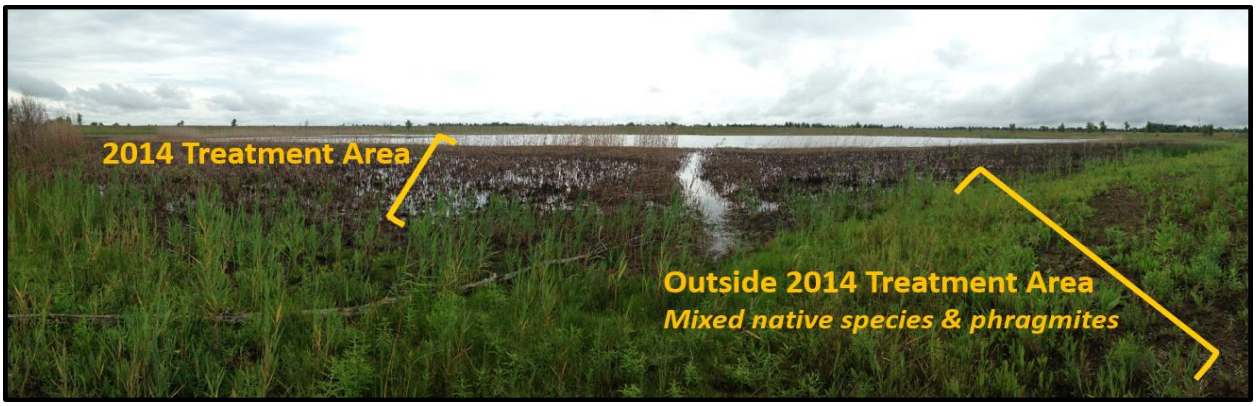


Figure 6 – Phragmites Regrowth Near Tailings Pond

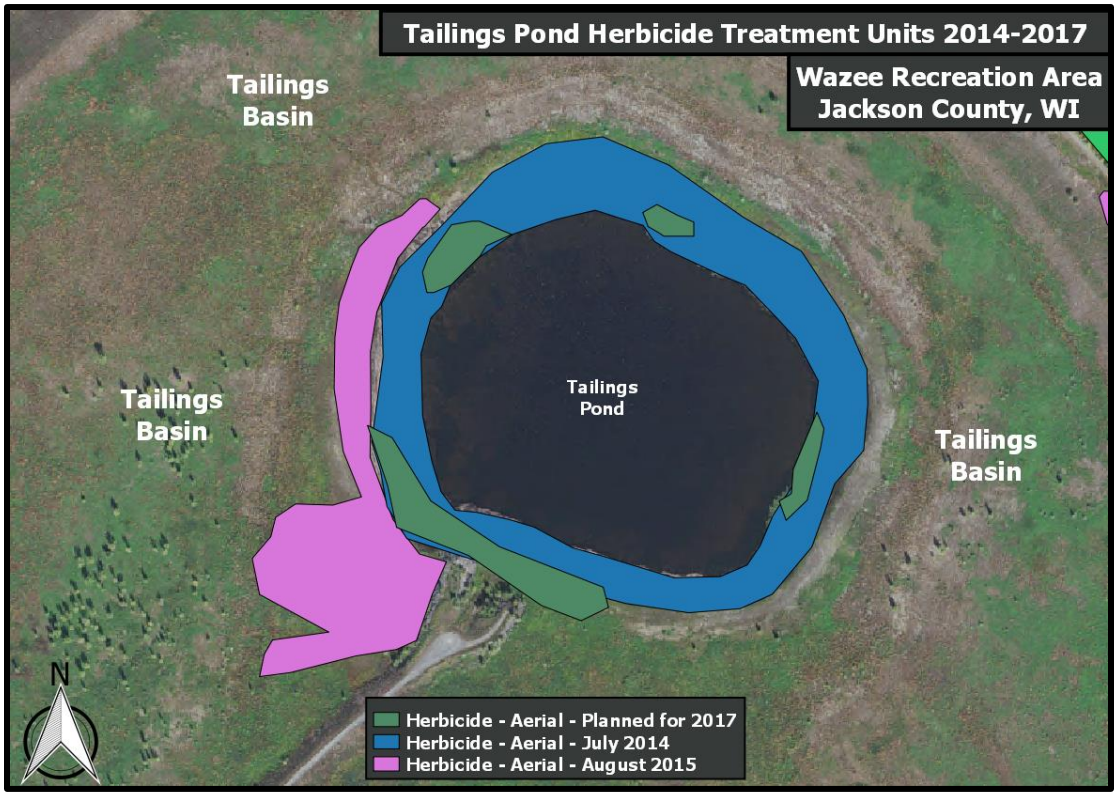


Figure 7 - Transect 1, 2, & 3 Photos 2015-2016

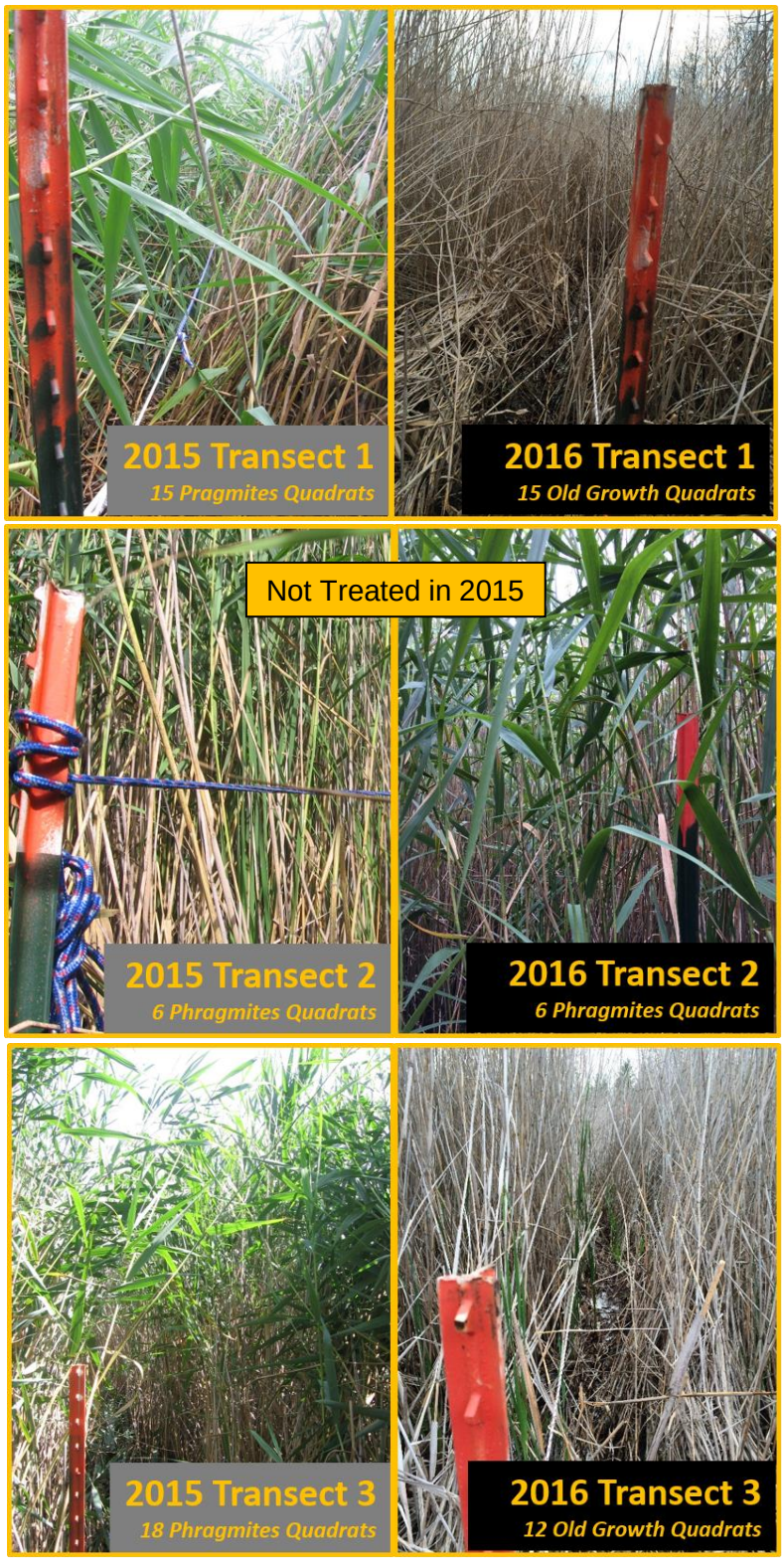


Figure 8 –Transect 4, 5, & 6 Photos 2015-2016

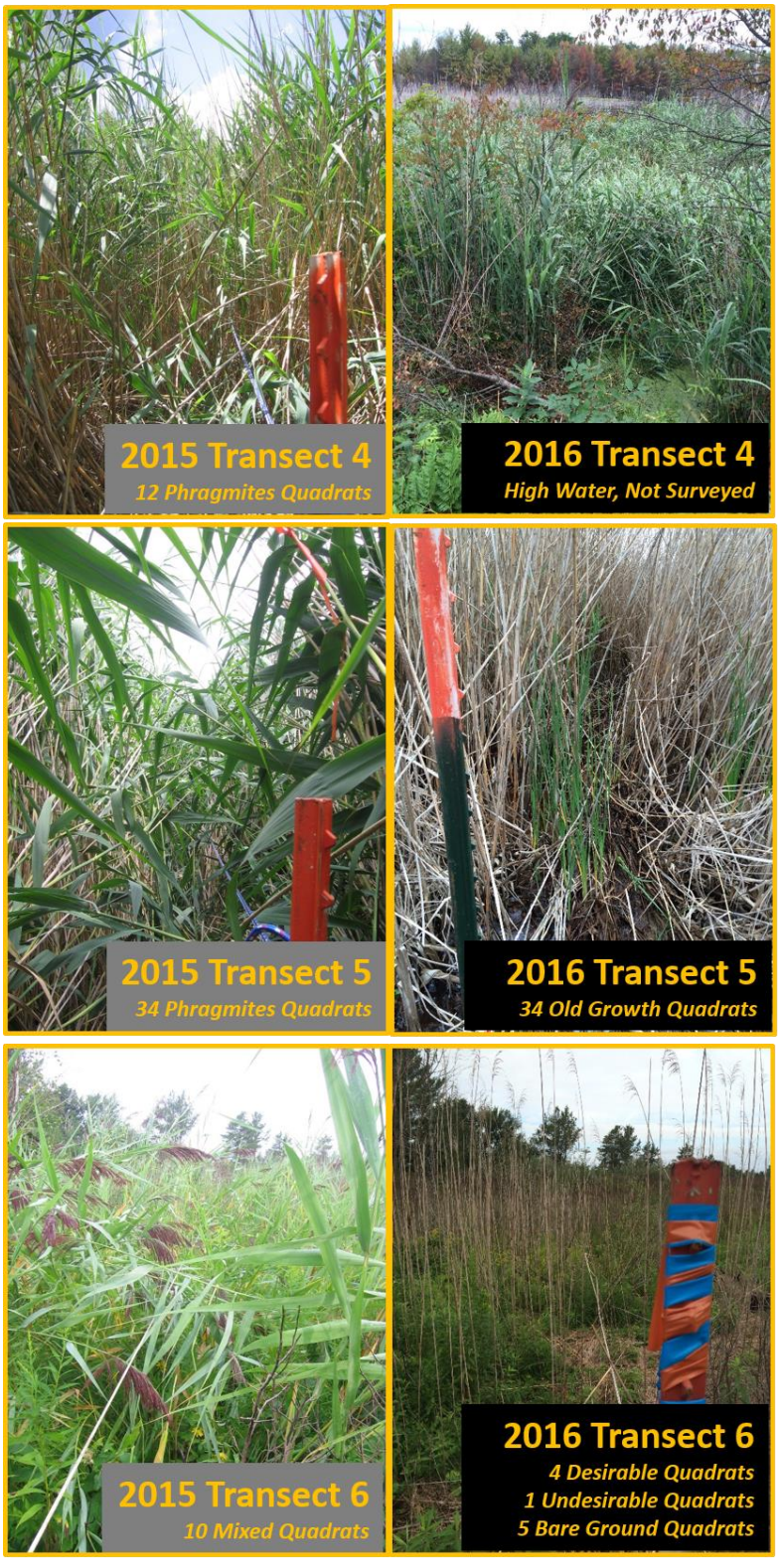


Figure 9 – Transect 7, 8, & 9 Photos 2015-2016

Figure 10 – Transect 10, 11, and 12 Photos 2015-2016

Figure 11 - Photo Points A, B, & C 2015-2016

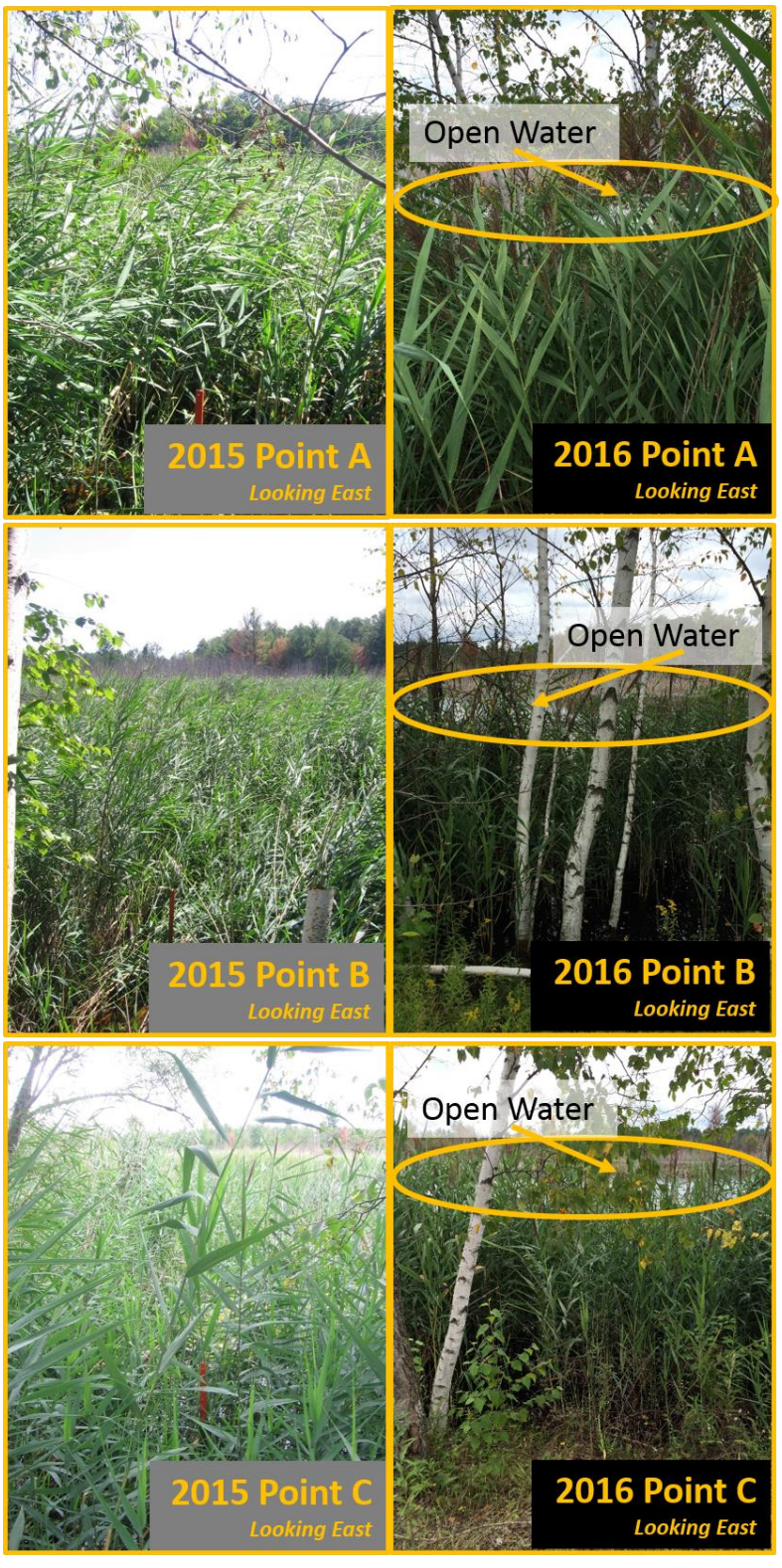


Figure 12 – Photos Points D & F 2015-2016

DISCUSSION

Survey results suggest a 90% reduction was achieved in the units that were treated with herbicide in 2015 (purple polygons in Figure 1). The methods used do not allow for statistically rigorous analysis, but conclusions can still be drawn from the data collected. If transect 2 (6 quadrats total) is removed from the data set, there were 174 quadrats total. Of those 174 quadrats only 2 were dominated by living Phragmites, which is only 1% of all quadrats and suggests 99% reduction was achieved. However, living Phragmites may still have been present in quadrats dominated by other classes as listed in Table 2 so 99% reduction is likely an over-estimate. The 121 quadrats dominated by old growth Phragmites were consistently dense and 100% cover. The remaining 51 quadrats were dominated by something else (174 quadrats less the 2 dominated by living Phragmites and 121 old growth = 51 quadrats). Theoretically, if 40% cover of living Phragmites was observed in all 51 quadrats, a reduction estimate of 85-90% could still be made. Field observations reveal those 51 quadrats were not covered with anywhere near 40% living Phragmites. Therefore, the estimated 90% reduction based on the data available is a reasonable conclusion.

Survey results suggested a 90% reduction in the 11-acre unit surrounding the Tailings Pond in 2015 after it had been treated in 2014. However, young Phragmites was found growing in enough areas to make plans for aerial herbicide spraying again in 2017. The areas highlighted in Figure 6 suggest 90% reduction did not last for more than one growing season.

REFERENCES

Moore, C. 2015. Learning-focused decision support for management of *Phragmites* in the U.S. Fish and Wildlife Service National Wildlife Refuge System. USGS Georgia Cooperative Fish and Wildlife Research Unit, University of Georgia. 7 May, 2015. http://greatlakesPhragmites.net/files/Moore-WebinarApril15.pdf.

QGIS Development Team, 2015. QGIS Geographic Information System. Open Source Geospatial Foundation Project. http://qgis.osgeo.org.

Swearingen, J. and K. Saltonstall. 2010. *Phragmites* Field Guide: Distinguishing Native and Exotic Forms of Common Reed (*Phragmites australis)* in the United States. Plant Conservation Alliance, Weeds Gone Wild. http://www.nps.gov/plants/alien/pubs/index.htm.

UWEX. 2016. University of Wisconsin-Extension. Wisconsin Horticulture, Bringing University Research to your Garden. https://hort.uwex.edu/articles/invhttp://dnr.wi.gov/topic/invasives/fact/Phragmites.htmlasive-Phragmites/. Accessed 11 January, 2016.

WDNR. 2016. Wisconsin Department of Natural Resources. Non-native Phragmites or Common reed (*Phragmites australis)*. http://dnr.wi.gov/topic/invasives/fact/Phragmites.html. Accessed 11 January, 2016.

APPENDIX A – INFORMATION ON *PHRAGMITES AUSTRALIS SUBSP. AUSTRALIS*

Phragmites australis is an erect perennial grass growing up to 15 feet tall. It remains standing through all seasons and the woody stems from previous years' growth make it challenging to navigate through. The plant is fairly easy to recognize based on its plume-like inflorescences (flowers). There is some difficulty, however, in identifying three subspecies because one is native and widespread in North America (*P. australis subsp. americanus*), one is non-native and from Europe *(P. australis*), and one whose origin is unclear but it occurs in the southern U.S. and into Central America (*P. australis subsp. berlandieri*) (Swearingen & Saltonstall, 2010).

Identification of *P. australis* (WDNR, 2016):

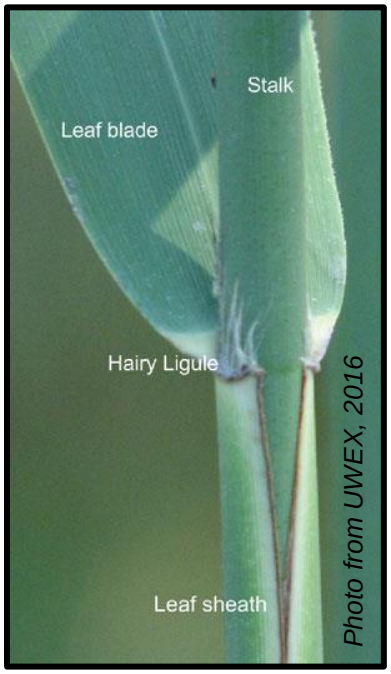
Leaves: Smooth, narrow leaves are 6- 24" long, 0.4-2.4" wide and blue-green in color. Leaf sheaths tightly clasp the stem, are difficult to remove, and stay on through winter. Long hairs are present at the junction of leaf and sheath.

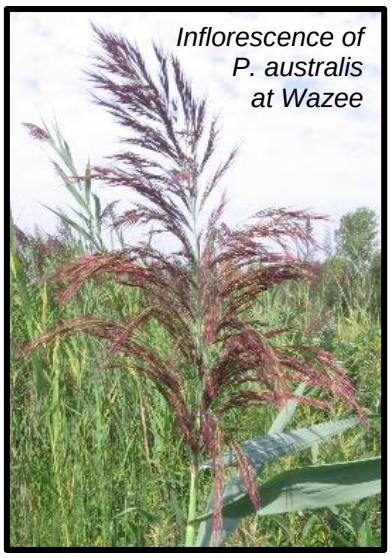
Flowers: Bushy, light brown to purple plumes are composed of spikelets that bloom July-September. Plumes are 7.5-15" long and often resemble feather dusters.

Fruits & seeds: Small and tan with many white hairs attached.

Roots: Stout oval rhizomes can reach to 6'deep and 10' horizontally.

Similar species: Native Phragmites (*Phragmites australis ssp. americanus*) has smooth, reddish-brown, flexible stems, often with shiny, round, black spots (a fungus). Its inflorescence is usually sparser than non-native Phragmites, as are most patches where it grows. Several species of Miscanthus grasses can be easily confused with Phragmites due to their showy, feathery plumes. However, they have smaller stems, a white mid-rib on the leaves, and white inflorescences.





Inflorescence of P. australis at Wazee

APPENDIX B – WDNR IMAZAPYR CHEMICAL FACT SHEET

Wisconsin Department of Natural Resources

January 2012

Imazapyr Chemical Fact Sheet

Formulations

Imazapyr was registered with the EPA for aquatic use in 2003. The active ingredient is isopropylamine salt of imazapyr, (2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-3-pyridinecarboxylic acid). Formulations that can be used on aquatic vegetation in Wisconsin include Habitat™, Ecomazapyr 2sl™, Imazapyr 2sl™, and Polaris AC. Imazapyr is used for control of emergent and floating-leaf vegetation. It is not recommended for control of submersed vegetation.

Aquatic Use and Considerations

Imazapyr is a systemic herbicide that moves throughout the plant tissue and prevents plants from producing a necessary enzyme, acetolactate synthase (ALS), which is not found in animals. Susceptible plants will stop growing soon after treatment and become reddish at the tips of the plant. Plant death and decomposition will occur gradually over several weeks to months. Imazapyr should be applied to plants that are actively growing. If applied to mature plants, a higher concentration of herbicide and a longer contact time will be required.

In Wisconsin, imazapyr is used to control the invasive plants common reed (*Phragmites australis*), purple loosestrife (*Lythrum salicaria*) and Japanese knotweed (*Polygonum cuspidatum*). Native species that are also controlled include cattails (*Typha* spp.), water lilies (*Nymphaea* sp.), pickerelweed (*Pontederia cordata*), duckweeds (*Lemna* spp.) and arrowhead (*Sagittaria* spp.).

It is important to note that repeated use of herbicides with the same mode of action can lead to herbicide-resistant plants, even in aquatic plants. More resistant weeds have developed to the ALS inhibitor herbicides than to other herbicide types, and so this mechanism of action may be more susceptible to developing resistance. In order to prevent herbicide resistance, avoid using the same type of herbicides year after year, and when possible, use non-herbicide methods of control instead.

Post-Treatment Water Use Restrictions

There are no restrictions on recreational use of treated water, including swimming and eating fish from treated water bodies. If application occurs within a ½ mile of a drinking water intake, then the intake must be shut off for 48 hours following treatment. There is a 120-day irrigation restriction for treated water, but irrigation can begin sooner if the concentration falls below one part per billion (ppb).

Herbicide Degradation, Persistence and Trace Contaminants

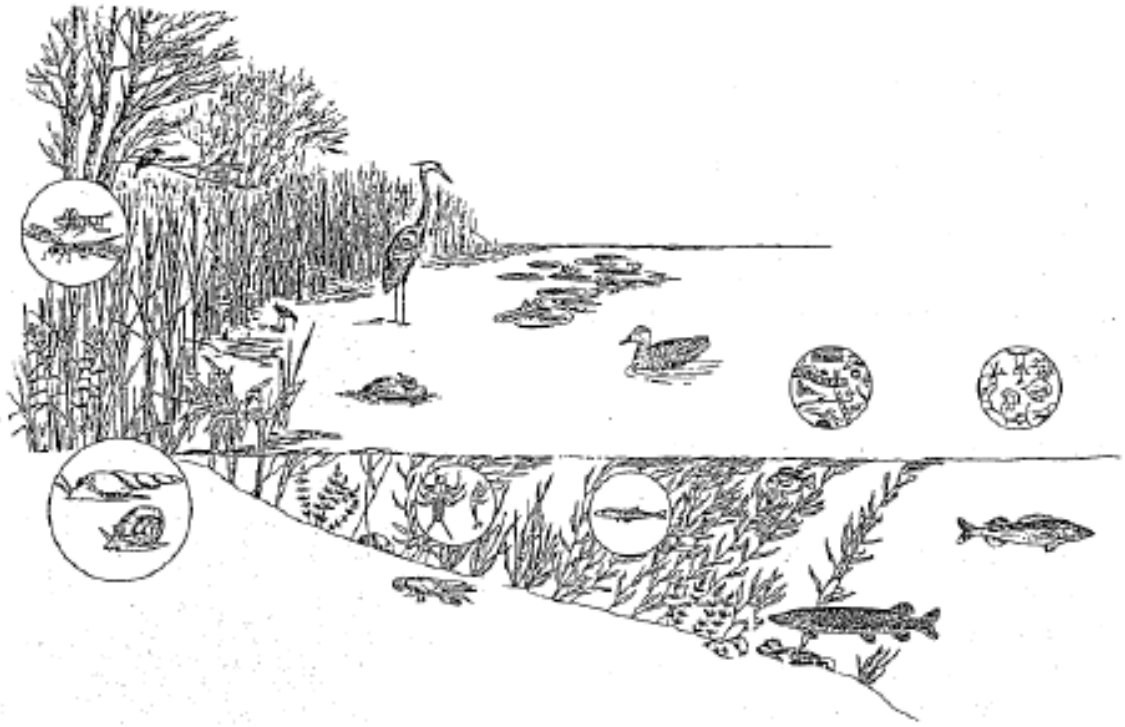
Imazapyr is broken down in the water by light and has a half-life (the time it takes for half of the active ingredient to degrade) ranging from three to five days.

Three degradation products are created as imazapyr breaks down. These are pyridine hydroxy-dicarboxylic acid, pyridine dicarboxylic acid (quinolinic acid), and nicotinic acid. These degradates persist in water for approximately the same amount of time as imazapyr (half-lives of three to eight days).

In soils imazapyr is broken down by microbes, and persists with a half-life of one to five months. It doesn't bind to sediments, so leaching through soil into groundwater is likely.

Impacts on Fish and Other Aquatic Organisms

Imazapyr is practically non-toxic (the EPA's lowest toxicity category) to fish, invertebrates, birds and mammals. Toxicity tests were not conducted on amphibians or reptiles. It does not bioaccumulate in animal tissues.



Human Health

Concentrated imazapyr has low acute toxicity on the skin or if ingested, but is harmful if inhaled and may cause irreversible damage if it gets in the eyes. Applicators should wear chemical-resistant gloves while handling, and persons not involved in application should avoid the treatment area during treatment.

Chronic toxicity tests for imazapyr indicate that it is not carcinogenic, mutagenic, or neurotoxic. It also does not cause reproductive or developmental toxicity, and is not a suspected endocrine disrupter.

Imazapyr degradates are no more toxic than imazapyr itself, and are excreted faster than imazapyr when ingested.

For Additional Information

Environmental Protection Agency
Office of Pesticide Programs
www.epa.gov/pesticides

Wisconsin Department of Agriculture, Trade, and Consumer Protection
http://datcp.wi.gov/Plants/Pesticides/

Wisconsin Department of Natural Resources
608-266-2621
http://dnr.wi.gov/lakes/plants/

Wisconsin Department of Health Services
http://www.dhs.wisconsin.gov/

National Pesticide Information Center
1-800-858-7378
http://npic.orst.edu/

Wisconsin Department of Natural Resources
Box 7921
Madison, WI 53707-7921

DNR PUB-WT-975 2012

APPENDIX C - WDNR GLYPHOSATE CHEMICAL FACT SHEET

Wisconsin Department of Natural Resources

January 2012

Glyphosate Chemical Fact Sheet

Formulations

Glyphosate is a commonly used herbicide that is used in both aquatic and terrestrial sites. The use of glyphosate-based herbicides that are not approved for aquatic use is very unsafe and is a violation of federal and state pesticide laws. Different formulations of glyphosate are available, including isopropylamine salt of glyphosate (Rodeo®, Shore-Klear®, Aquapro®) and potassium glyphosate (Refuge®).

Aquatic Use and Considerations

Glyphosate is a systemic herbicide that moves throughout the plant tissue and works by inhibiting an important enzyme needed for multiple plant processes, including growth.

Glyphosate is effective only on plants that grow above the water. It will not be effective on plants that are submerged or have most of their foliage under water, nor will it control regrowth from seed. Glyphosate can be used to control reed canarygrass (*Phalaris arundinacea*), cattails (*Typha* spp.), purple loosestrife (*Lythrum salicaria*), phragmites (*Phragmites australis*), water hyacinth (*Eichornia crassipes*) and water lettuce (*Pistia stratiotes*).

Glyphosate needs to be applied to plants that are actively growing. Effectiveness of glyphosate treatments may be reduced if applied when plants are growing poorly, such as due to drought stress, disease, or insect damage.

Experience with species such as purple loosestrife has shown that broadcast spray treatment can be ineffective if surrounding non-target plants are killed, since this clears an area for rapid regrowth from seeds. An alternative method of glyphosate application for small stands is effective but time-intensive: painting cut stems with glyphosate suing a wick type applicator. The herbicide will then travel from the cut stem down into the roots and kill the remaining portion of the plant. With some species, such as phragmites, it is important to remove the cut vegetation to avoid re-rooting from the cut material that is not treated with herbicide.

A surfactant approved for aquatic sites must be mixed with glyphosate before application. A surfactant helps the herbicide "stick" to the plant surfaces, and increases the rate of absorption. Not all surfactants are approved for use in aquatic environments and some may be toxic to aquatic organisms; the surfactant labels should be carefully read and followed.

Care must be used when applying glyphosate to prevent injury or death to desirable plants. To avoid drift, application is not recommended when winds exceed 5 mph. In addition, excessive speed or pressure during application may allow spray to drift and must be avoided.

Following treatment, plants will gradually wilt, appear yellow, and will die in approximately 2 to 7 days. It amy take up to 30 days for woody plants. Cooler or cloudy weather following treatment may delay the visible effects of treatment. Application should be avoided when heavy rain is predicted within 6 hours, because the herbicide may wash off the plants.

Post-Treatment Water Use Restrictions

Most aquatic forms of glyphosate have no restrictions on swimming or eating fish from treated water bodies. However, potable water intakes within ½ mile must be turned off for 48 hours after treatment. Due to different formulations and products containing glyphosate, every product label should be carefully reviewed by the user for varying post-treatment water use restrictions.

Herbicide Degradation, Persistence and Trace Contaminants

In water, the concentration of glyphosate is reduced through dispersal by water movement,

binding to the sediments, and break-down by microorganisms. Glyphosate's half-life (the time it takes for half of the active ingredient to degrade) is between 3 days and 19 weeks depending on water conditions. Glyphosate disperses rapidly in water so dilution occurs quickly, thus moving water will decrease concentration, but not half-life. The primary breakdown product of glyphosate is aminomethylphosphonic acid (AMPA), which is also degraded by microbes in water and soil. According to the EPA, available data do not suggest that this compound poses any hazard distinct from its parent compound, glyphosate.

Glyphosate contanes a nitrosamine (n-nitroso-glyphosate) as a contaminant at levels of 0.1 ppm or less. Tests to determine the potential health risks of nitrosamines are not required by the EPA unless the level exceeds 1.0 ppm.

Impacts on Fish and Other Aquatic Organisms

Laboratory testing by an herbicide manufacturer indicates that glyphosate is toxic to carp, bluegills, trout, and water fleas (*Daphnia* spp.) only at dosages well above the label application rates. Similarly, it is rated practically non-toxic to aquatic species tested. Studies by other researchers with glyphosate on important food chain organisms such as midge larvae, mayfly nymphs, and scuds have demonstrated a wide margin of safety between application rates and toxic dosages to rats and rabbits.

Human Health

Most concerns about glyphosate's adverse health effects revolve around applicator exposure or exposure via drift and the surfactant used in application. Some adverse effects from direct contact with the herbicide include temporary symptoms of dermatitis, eye ailments, headaches, dizziness, and nausea. Protective clothing (goggles, a face shield, chemical resistant gloves, aprons, and footwear) should be worn by applicators to reduce exposure to glyphosate. Confirmed and unconfirmed incidences involving the active ingredient glyphosate have been reported to the Health Effects Branch of the EPA. Recently it has been demonstrated that glysophate is toxic effect to human embryonic cells and linked to endocrine disruption.

For Additional Information

Environmental Protection Agency
Office of Pesticide Programs
www.epa.gov/pesticides

Wisconsin Department of Agriculture, Trade, and Consumer Protection
http://datcp.wi.gov/Plants/Pesticides/

Wisconsin Department of Natural Resources
608-266-2621
http://dnr.wi.gov/lakes/plants/

Wisconsin Department of Health Services
http://www.dhs.wisconsin.gov/

National Pesticide Information Center
1-800-858-7378
http://npic.orst.edu/

Wisconsin Department of Natural Resources
Box 7921
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