BUREAU OF WATER QUALITY

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GUIDANCE

Aquatic Invasive Species Team

Phragmites australis: A Statewide Management Strategy

21 April 2023

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APPROVED:

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5/10/2023

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Date

WISCONSIN
DEPT. OF NATURAL RESOURCES

PHRAGMITES AUSTRALIS

A STATEWIDE MANAGEMENT STRATEGY

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Wetland Invasive Plant Specialist
21 April 2023

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INTRODUCTION

The Wisconsin Department of Natural Resources has developed this document, *Phragmites australis*: A Statewide Management Strategy, to create a Wisconsin-wide approach to managing the non-native plant, *Phragmites australis* subsp. *australis*.

Non-native Phragmites is an aggressive wetland plant with a wide distribution across the continental United States. Because of its negative impacts on wetland function, as well as areas developed for human use, it has long been the focus of statewide management efforts in Wisconsin.

This document is not meant to be a definitive source of non-native Phragmites information. Instead, it is a summary of the Wisconsin Department of Natural Resources' collaborative long-term strategy for non-native Phragmites management. This document is expected to grow and adapt as statewide goals are achieved and priorities change.

This document consists of three parts:

Part I details the impacts, ecology, and biology of non-native Phragmites.

Part II builds off Part I, incorporating Phragmites information into management planning. It offers aspects to consider when developing a strategic and adaptive Phragmites management plan.

Part III describes the vision, goals, and objectives of the statewide Phragmites strategy. It outlines and elaborates on the actions integral to the success of a cooperative, landscape-scale, integrated pest management approach that empowers partners, land managers, and landowners.

Additionally, this document is meant to facilitate Phragmites-focused planning and control projects competing for Surface Water Grant Program funds. This guide defines the obstacles to successful Phragmites management and presents management alternatives. The aim is to align individual, site-specific goals with the large-scale, statewide goal of strategic, science-based management.

For the purposes of this document, any general mention of Phragmites or *Phragmites australis* refers to the non-native subspecies.

For more information regarding non-native *Phragmites australis*, visit www.greatlakesphragmites.net or dnr.wisconsin.gov/topic/Invasives/fact/Phragmites.html.

GENERAL DEFINITIONS

INVASIVE SPECIES

Section 23.22 (1) (c), Wis. Stats., defines "invasive species" as "nonindigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health." These species can be aquatic or terrestrial weeds, insect pests, nuisance animals, or disease-causing organisms.

NR 40

The Invasive Species Identification, Classification and Control Rule (Wis. Admin. Code NR 40) prohibits the possession, transport, transfer (including sale), or introduction of certain invasive species listed in the rule. The rule classifies invasive species into two categories: restricted and prohibited (see Appendix III). It also establishes "Preventative Measures" to slow the spread of invasives.

PART I
PHRAGMITES

IMPACTS and ECOLOGY

Since its likely introduction from Europe in the 1800s, non-native *Phragmites australis* subsp. *australis* has become a widespread species across the continental United States and Canada, establishing along highway corridors and coastal and inland wetlands within the Great Lakes region.

Phragmites (pronounced frag-MY-tees) thrives in disturbed, nutrient-rich, and saline areas. It can be found in roadside ditches where vehicular pollutants and road salts ward off less-tolerant species, bordering agricultural fields in swales with excess phosphorus and other nutrients, and along lakefronts, riparian corridors, and wetlands, blocking views, access, and replacing ecologically important or culturally significant habitat like wild rice marshes.

The negative ecological impacts of Phragmites are numerous, particularly in wetlands. Its rapid growth creates tall, dense stands known as monocultures, which shade out and displace native plants used as nesting and foraging habitat by a variety of wildlife including fish, birds, and amphibians. In addition to this loss of biodiversity, Phragmites can restructure a wetland's food webs, and alter its nutrient cycling and its hydrology, drying out wetlands by transpiring water at greater rates.

Figure 1. Non-native Phragmites growing over a stop sign. Photo: Amanda Smith, WDNR.

Phragmites also has many economic impacts. Dense stands can cause public safety concerns by blocking sightlines, damaging infrastructure like stormwater drainage or asphalt through root growth, and obstructing or delaying construction and maintenance. Phragmites can affect property values and recreational activities both aesthetically by impeding views and functionally by limiting access. Dead stands are highly combustible and, if left unmanaged, can increase the fire risk to surrounding properties. The management and control of Phragmites is generally a long-term commitment, requiring significant resources and efforts over several years to be effective.

BIOLOGY

Phragmites is a perennial, warm season wetland grass that can grow in dense stands up to 6 m (20 feet) tall. It is characterized by its long, blue-green leaves with sheaths that clasp tightly around the stiff, finely ridged, hollow stems. Seed heads, which resemble feathery plumes, bloom atop stalks between late July - September, ranging in color from silver to purple to brown. These plumes can be 19–38 cm (7.5-15″) tall, 20.3 cm (8″) wide, and carry hundreds to thousands of seeds per stalk. By winter, the stalks turn brown and lose their leaves, though the stalks and plumes remain throughout the season. While stands often consist of numerous imposing stalks, they are usually one plant, connected underground by an extensive, maze-like root network that makes up most of their biomass. This network is comprised of structures called rhizomes. Technically underground stems, these rhizomes act as transport systems, shuttling nutrients to portions of the plant that need them, allowing Phragmites to grow and expand rapidly across a wide range of habitats; it can be found in moist habitats including lakeshores, riverbanks, and disturbed areas such as roadways and constructed wetlands. Additionally, it can tolerate brackish waters, alkaline to acidic soils, and drought.

The biological aspects of non-native *Phragmites australis* that make it difficult to manage lie in its belowground rhizomes. Representing roughly 80% of the total plant biomass, the robust rhizomes store nutrients while the plant is dormant then use them for regrowth come spring. Because of this, management efforts that only target the aboveground stalks are ineffective. These efforts may alleviate the problem in the immediate short-term but could lead to perpetual management of a Phragmites patch as it continues to grow and spread. Therefore, effective management targets the rhizomes by taking advantage of Phragmites's phenology (Figure 2).

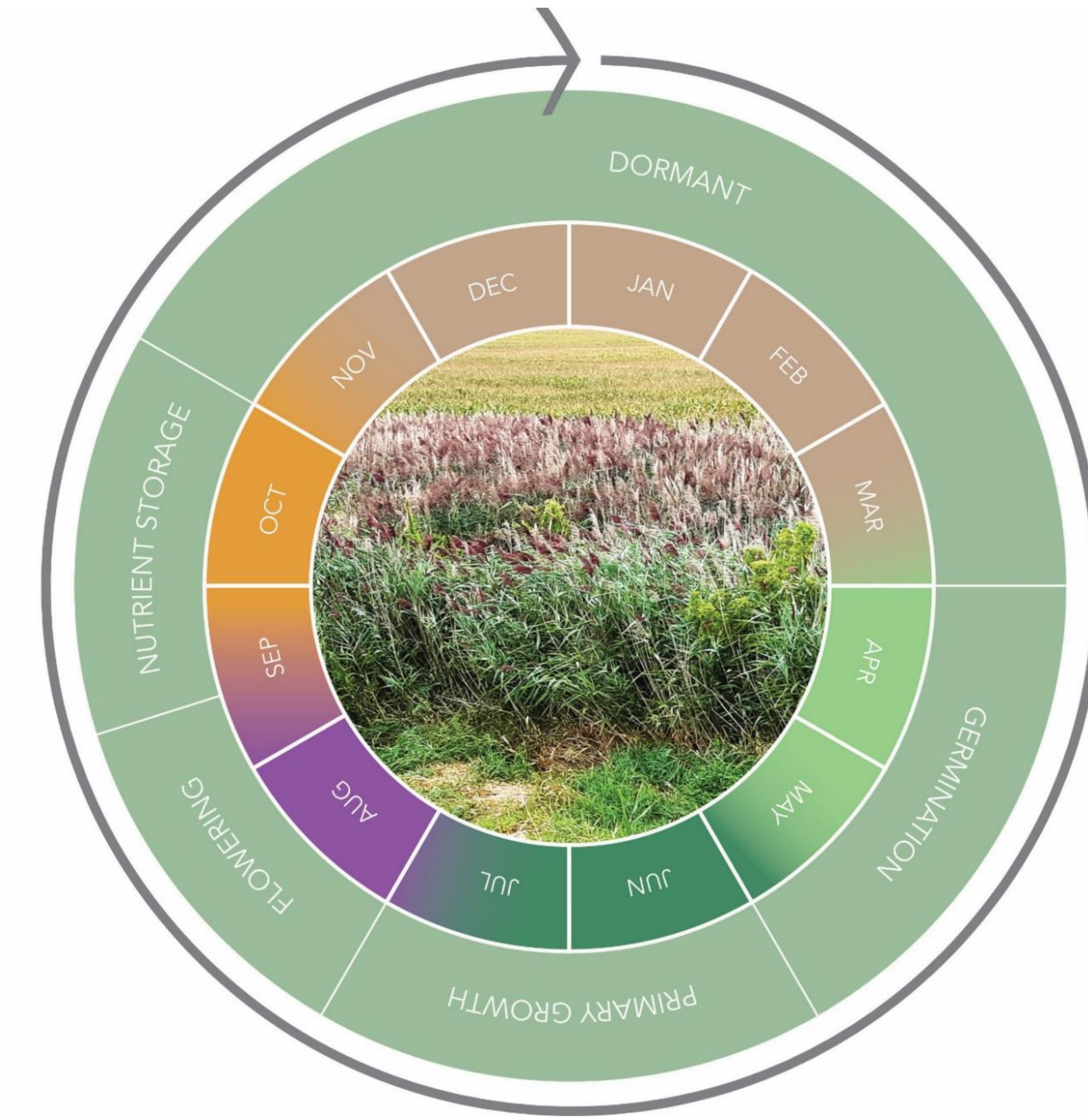


Figure 2. Non-native Phragmites annual phenology. Timing may vary depending on location throughout Wisconsin. Figure adapted from the Michigan Department of Environmental Quality's (MDEQ) document "A Guide to the Control and Management of Invasive Phragmites, Third Edition" and the Ontario Invasive Plant Council's (OIPC) document "Invasive Phragmites: Best Management Practices in Ontario."

TIMING

Phenology refers to the phases of Phragmites' annual lifecycle. These phases are influenced by its biology, habitat, season, and climate. Because these factors vary throughout the state, the timing of these phases can also vary. The Phragmites lifecycle can be broken down into three main phases: 1) the **growing phase**, which also includes germination and flowering, 2) the **translocating phase**, and 3) the **dormant phase**.

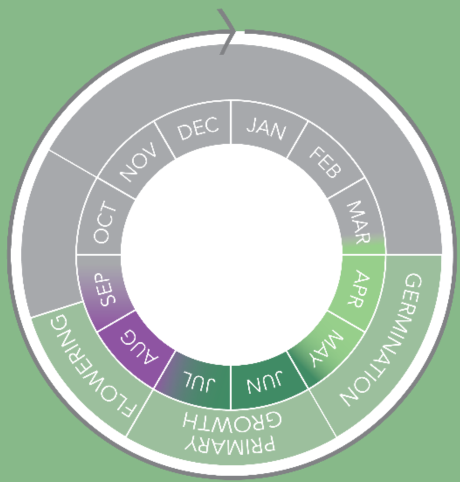


Figure 3. The Growing Phase

GROWING PHASE

The growing phase refers to the period when the aboveground stalks are growing, new shoots are emerging, and flower heads are developing. This phase is generally from mid- to late spring until late summer/early fall.

TRANSLOCATING PHASE

The translocating or nutrient storage phase refers to the period when Phragmites transports nutrients from its leaves and stalks to the belowground root biomass in preparation for the dormant phase. This phase generally extends from late summer/early fall until late fall, around the first killing frost.

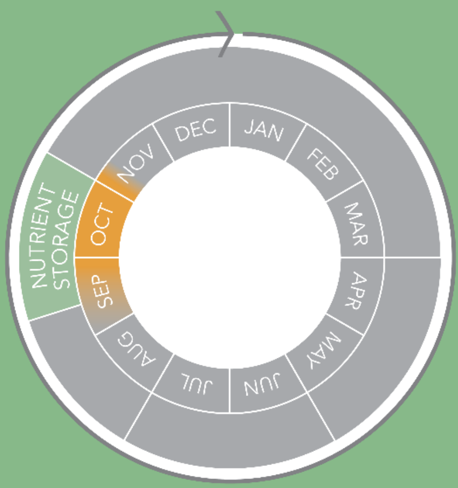


Figure 4. The Translocating Phase

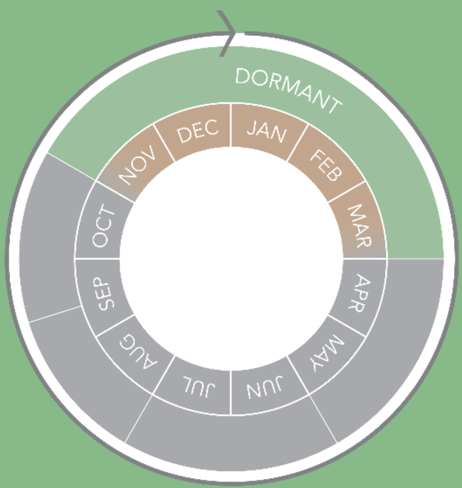


Figure 5. The Dormant Phase

DORMANT PHASE

The dormant phase refers to the period of inactivity in the belowground root system and the slow decomposition of the aboveground stalks. This phase generally extends from around the first killing frost until the following spring.

SPREAD

Phragmites spread is prolific and multifaceted. It is achieved through multiple mechanisms that can be broken down more broadly into three categories: seed dispersal, vegetative reproduction, and fragmentation. These mechanisms can be further exacerbated by human activity.

Figure 6. Distinct non-native Phragmites flower head. Photo: Matt Puz, WDNR.

Seed dispersal occurs when the hundreds to thousands of seeds produced by the feathery seed head are transported to new locations by wind or water, sometimes several miles from their source. Seeds can be further dispersed if soil containing seeds is moved by human activity e.g., transported in the tires of maintenance or recreation equipment. Seed viability is variable but is enhanced by genetic diversity and the presence of bare, non-inundated soils, typical of disturbed areas such as transportation corridors or exposed lakebeds. Seed dispersal is the primary mechanism for long-distance expansion but can also contribute to local expansion of existing populations.

Vegetative reproduction occurs primarily through the growth of rhizomes and stolons. Both structures are adapted stems connected to an existing plant that either run along the soil surface (stolons) or underground (rhizomes). Both can produce roots and shoots as they grow (see Figure 7). This is the primary mechanism for the growth of an already established Phragmites patch. This local expansion can be vigorous and aggressive. According to the Great Lakes Phragmites Collaborative website, studies have shown that the lateral spread of rhizomes averages approximately 40 cm (15.7") per year, while stolons can grow up to 14.5 cm (4.25") in a *day*.

Finally, fragmentation can occur when rhizomes are broken, which can lead to the growth of new roots and shoots. This may result from either natural causes or any number of management actions but is often true of roadside construction and maintenance crews or agricultural equipment that may be transporting soil containing viable rhizome fragments. Improperly disposing soil with these fragments may result in the unintended spread of Phragmites to new areas as well. Cut shoots can root and grow under favorable conditions. See Appendix I.

NATIVE and NON-NATIVE

Currently, there are three recognized subspecies, or lineages, of *Phragmites australis* in North America: non-native *Phragmites australis* subsp. *australis*, the introduced lineage on which this strategy is focused, and two native subspecies, *Phragmites australis* subsp. *americanus*, distributed across most of Canada and the contiguous United States, including Wisconsin, *and Phragmites australis* subsp. *berlandieri*, distributed throughout the extreme southern portions of the United States and Mexico.

Phragmites australis subsp. *americanus*, is a smaller, less aggressive subspecies than the non-native *Phragmites australis* subsp. *australis*. There are several characteristics that differentiate the native lineage from the non-native, including habitat, patch density, and several physical traits that aid in distinguishing between the two subspecies. For more information regarding these traits, refer to Appendix II.

HYBRIDIZATION

Mounting evidence through genetic testing implies that native and non-native Phragmites may hybridize in the wild, although this is thought to be rare. The existence of a hybrid Phragmites could complicate management at a statewide scale as the hybrid would provide greater genetic diversity – a major driver of Phragmites spread by seed.

Traits that facilitate dispersal, establishment, and aggressive growth in hybrids are collectively referred to as "hybrid vigor." While hybrid vigor in hybrid Phragmites has been detected in select cases, management of the hybrid does not differ from the non-native lineage. More research is needed to determine if, and to what extent, hybrid Phragmites would have to be managed differently than its non-native counterpart. As of this writing, no hybrid Phragmites has been observed in Wisconsin although preliminary reports in Minnesota allude to the presence of Phragmites hybridization. Further genetic analysis is needed to identify hybrids with reasonable certainty.

Figure 7. Non-native Phragmites shoots sprout from a stolon along the water surface. Existing patches line both banks of the channel. Photo: Matt Puz, WDNR.

PART II
MANAGEMENT

MANAGEMENT PLANNING

Developing an adaptive management plan is essential to achieving effective and successful Phragmites control. Adaptive management is a decision process in which a manager envisions desired project outcomes, plans management actions to achieve those outcomes, implements and assesses those actions to measure actual outcomes, uses that information to plan and adjust future actions, and, ultimately, shares what was learned throughout the process. It is meant to facilitate effective decisions and enhanced benefits. Suggested aspects of adaptive management planning include collecting baseline data through site assessments, defining management goals, analyzing management alternatives using Integrated Pest Management, and monitoring as well as identifying stakeholders, partners, funding sources, and educational or research opportunities that the project may support.

BASELINE DATA and SITE ASSESSMENTS

Site assessments should be conducted from an ecosystem perspective. They are used to evaluate both the target patch as well as its position within the surrounding landscape. Factors to consider when assessing the site include:

- Phragmites patch size, shape, density, age, and location
- Potential pathways of introduction and spread
    - Waterways, transportation corridors (roadways/railways), public access, recreational activities
- Level of adjacent development or human activity
    - Agricultural, impervious surfaces, wastewater treatment plants
- Surrounding habitat, soil characteristics, and other species present (both plant and animal)
- Adjacent properties and how this may affect management and/or permitting
- Other important or unique site features

Identifying this baseline data through site assessments will help in developing management goals and determining the appropriate management techniques to employ.

MANAGEMENT GOALS

Well-defined management goals are meant to establish reasonable targets for management outcomes, support long-term planning, and justify investments of time and costs. They can be ecologically, economically, and/or aesthetically focused and informed by an understanding of Phragmites ecology, the site assessment, and available resources. Plans should include overall project timelines as well as timing for specific management efforts. Well-established patches may require adapting efforts and resources as management timelines can reach many years. Goals for monitoring and restoration should be included at this stage of plan development as well.

INTEGRATED PEST MANAGEMENT

Integrated Pest Management (IPM) is a strategy that utilizes a combination of available management options in conjunction with current biological and ecological information to manage a target species effectively and economically. Timing multiple management alternatives to coincide with specific Phragmites life cycle events (Figure 2) can further deplete the resources it needs to grow. As previously mentioned, management should be site- and patch-specific. Combining IPM methods with native reseeding or planting has been shown to be the most effective approach to controlling Phragmites. It is worth restating: management of established Phragmites patches is generally a long-term commitment even when utilizing an IPM approach.

MANAGEMENT ALTERNATIVES

There are many alternatives for Phragmites management which differ by level of effort, efficacy, and cost. The success of any management technique will be dependent on site-specific characteristics such as environmental conditions, the size, age, and density of the Phragmites patch, and the resources available to managers. Many of these techniques are less effective, or even ineffective, (i.e., only providing seasonal, not long-term, control) when employed in isolation. Others, if employed at the wrong time, may promote plant growth. The most common IPM techniques and their efficacies are summarized below.

ALTERNATIVE	DESCRIPTION	COMBINE WITH
Manual*	Manual removal refers to plant removal using one's own muscle power, often using a spade or other cutting tool. When spading, the stem is severed at a 45-degree angle below the soil surface to deplete the rhizomes. Although effective, this must be done multiple times over the growing season, which generally limits this technique to small patches as it is labor intensive and time consuming. Small patches can also be covered with soil or plastic to further smother the plant after manual removal to increase treatment efficacy. Cutting plants above ground is ineffective unless combined with other techniques. At large scales, manual control before and/or after herbicide treatment or prior to flooding can increase treatment efficacy. Removing biomass with this technique allows more light and heat to reach the soil, aiding in the recovery of native plant communities from the seed bank.	Herbicide, hydrologic, tarping / smothering
Mechanical*	Mechanical control can be conducted using large or small mechanical equipment including weed whackers, mowers, Marsh Masters, or other large excavation equipment. Excavation, usually through dredging, can be an effective large scale control technique, but requires much higher costs and creates greater disturbance. Unintended consequences include the potential for Phragmites spread through fragmentation facilitated by dredging equipment. At large scales, mechanical control before and/or after herbicide treatment or prior to flooding can increase treatment efficacy. Removing biomass with this technique allows more light and heat to reach the soil, aiding in the recovery of native plant communities from the seed bank.	Herbicide, hydrologic, or both
Prescribed Burn*	Prescribed burning uses controlled fire to remove dead stalks. Like manual/mechanical control, removing biomass with fire allows more light and heat to reach the soil, aiding in the recovery of native plant communities from the seed bank. Proper permitting and safety measures should always be in place when utilizing this technique.	Herbicide, hydrologic, or both
Hydrologic	Hydrologic control is a management technique that utilizes water levels to flood Phragmites, reducing oxygen supply to the roots. This method can be very effective but is only appropriate when the necessary water control structures exist or where sufficient flooding occurs naturally. A minimum depth of 15 cm (6") below the water surface is recommended although efficacy can be affected by water clarity and quality. For natural systems, cutting the plant just above the soil surface prior to flooding (also known as the cut-to-drown technique) is best. This technique is most effective between mid-spring to mid-fall. In both instances, the previous year's dead biomass should be removed prior to flooding as it can supply new growth with oxygen. This is also true of stands that aren't completely submerged. Underwater portions can be drowned but the remaining above-water portions will need to be managed using a different technique. Research to determine an effective flood duration is ongoing.	All

*Removal of aquatic plants from navigable waters by manual or mechanical means, or through burning, may be subject to permitting under Wis. Adm. Code Ch. NR 109.

ALTERNATIVE	DESCRIPTION	COMBINE WITH
Chemical	Herbicide treatment is the most common technique for Phragmites control. Treatments during the "translocating phase" impact the underground biomass after the herbicide is absorbed by the leaves. The most common active ingredients are glyphosate and imazapyr, which are broad-spectrum herbicides (only certain formulations of these herbicides are legally approved for wetland use). Timing of treatment is essential, especially in wetland habitats, to avoid adverse effects to other wildlife. Studies have found imazapyr to be more effective than glyphosate, although imazapyr persists in the soil longer and has more negative non-target effects on native plants. Research detailing the long-term effects on non-target native plants is lacking, which makes it difficult to understand the exact effects of herbicide use. Label instructions should always be followed, and herbicide should only be applied by licensed herbicide applicators. Herbicide applications to waters of the state are subject to permitting pursuant to Wis. Adm. Code Ch. NR 107, Aquatic Plant Management (APM).	All
Grazing	Rotational grazing involves the use of animals such as cattle, goats, horses, and buffalo to reduce Phragmites growth. Feeding during the growing season is most effective, but negative, animal-related side effects like excess nutrients, soil compaction, and impacts to native plants should be considered before implementing this management technique. There is little support for this method throughout the United States, although it is under active research.	Herbicide
Restoration	Restoration is a management technique used to help tip the scales in favor of a desired plant community that occurs following Phragmites control. Restoration through native seed sowing or planting can help suppress Phragmites regrowth or introduction of new invasive species. Understanding how the site may have been altered as well as its historic plant community composition can give insight into potential restoration goals. Incorporating restoration at an ecosystem level through water quality improvements, nutrient input reductions, and wetland restoration within the surrounding landscape can help alleviate stressors promoting Phragmites dominance. While approaches of this magnitude can be logistically and economically challenging, this ecosystem perspective can be essential to management success and to preventing the further spread and reestablishment of Phragmites.	All

EXAMPLE IPM APPROACHES

Below are examples of IPM approaches and their management timings. Examples 1 and 2 illustrate potential options for differing site conditions and manager capacities within a given year that could also be implemented in subsequent years. Example 3 is a more detailed example that utilizes an array of alternatives which change over a 2-year period. Note: This is not an exhaustive list. Other combinations for a given year or combinations of yearly IPM approaches can be used as appropriate over the lifespan of management. The calendars begin just prior to the start of the growing phase (March) and span 12-months. The first killing frost is shown in mid-October but this will vary based on location within the state. "Treat" herbicide treatments are not differentiated by application type or between glyphosate- or imazapyr-based products. Cutting refers to any manual or mechanical removal (e.g., spading, mowing, etc.). Blocks represent periods in which treatment can occur e.g., herbicide treatment can occur anywhere between the late summer through early to mid-fall, but the timing can shift based on location throughout the state and whether management occurred prior to treatment (such as a pre-treatment cutting).

CUT / BURN + TREAT+ CUT / BURN

The first approach combines herbicide treatment with pre- and post-treatment cutting or burning. Burning can be used as an alternative to cutting, especially if dead stalks and litter cover a substantial area and are unrealistic to remove manually or mechanically. In summer, stalks can be cut anywhere from 4 to 12 inches above ground or burned prior to herbicide treatment. This shifts the plant's priorities from growing seed heads to regrowing leaves and stalks. Cutting/burning should be done at least four weeks before herbicide treatment to allow for enough regrowth. Treating should be done in late summer/fall as it begins to transfer nutrients to its rhizomes and before the first killing frost. Post-herbicide cutting/burning to remove dead stalks should be done no less than two weeks after treatment to allow the plant to absorb the herbicide. This is best done in winter during the plant's dormant phase. Note: This approach can still be effective without a pre-treatment cut or burn.

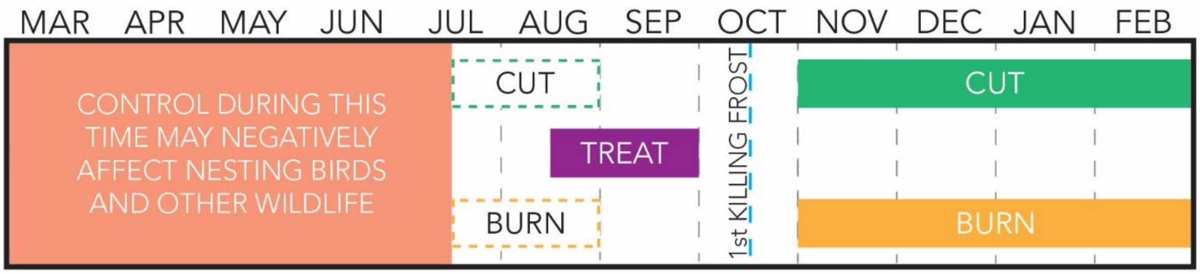


Figure 8. Non-native Phragmites IPM Example 1.

CUT UNDERWATER OR CUT + FLOOD

The second approach applies to sites that can take advantage of high water levels or where water levels can be altered using water control structures. For sites with high water, cutting the stalks underwater is best done during either the growing season or in late summer/fall when the plants begin transporting nutrients to their roots. For sites that have the capacity to manipulate water levels, cutting may be unnecessary if the appropriate depth is achievable. Otherwise, stalks can be cut prior to flooding. Drawing down the water levels later in the season is generally seen as a technique to encourage native plant growth. In both instances, the length of time the plant should be submerged varies based on water depth and clarity, although cut plants should remain submerged for at least a month.

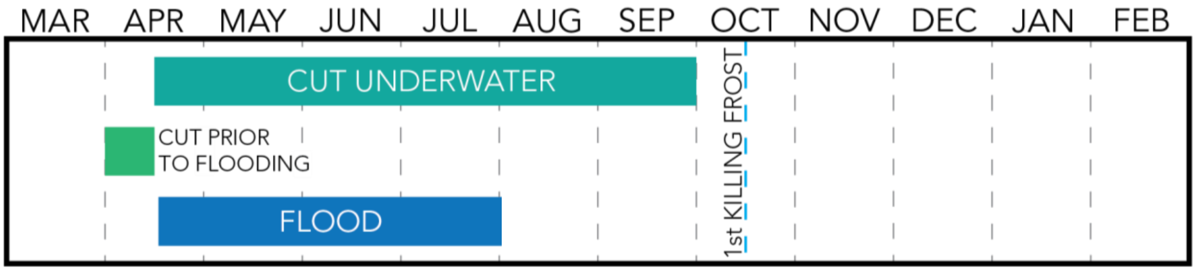


Figure 9. Non-native Phragmites IPM Example 2.

MULTI-YEAR IPM MANAGEMENT

The multi-year IPM approach outlined below is based on this example management scenario: A large, dense Phragmites patch in a historically high-quality wetland habitat, home to a diverse community of plant and bird species, has been prioritized for control by land managers. The site's water level can be manipulated through a water control structure. Their goal is to control 75% of the patch in the first year while also promoting the restoration of plants native to this wetland. The land managers will use a detailed IPM approach to achieve the intended results. In the first year, the large patch is burned just before the beginning of the growing phase. With the aboveground biomass burned away, the site is then flooded in mid-March using the water control structure. In July, the water is drawn down to promote native plant growth. In late fall after a hard frost, native seeds are sown to promote soil contact before the first snowfall. The following year, no management is done between March and July to avoid impacting nesting bird populations. During pre-treatment monitoring in mid-July, the managers find that a large portion of the patch has been controlled, but there are small patches of regrowth. They also find that many natives have regrown in place of Phragmites. To avoid impacts to the native plants, the small patches are chemically treated by hand in early fall. Dead stalks are then cut in the winter, removed from the site, and properly landfilled. Monitoring occurs again in mid-July the following year and the 'Year 2' IPM approach is continued in subsequent years.

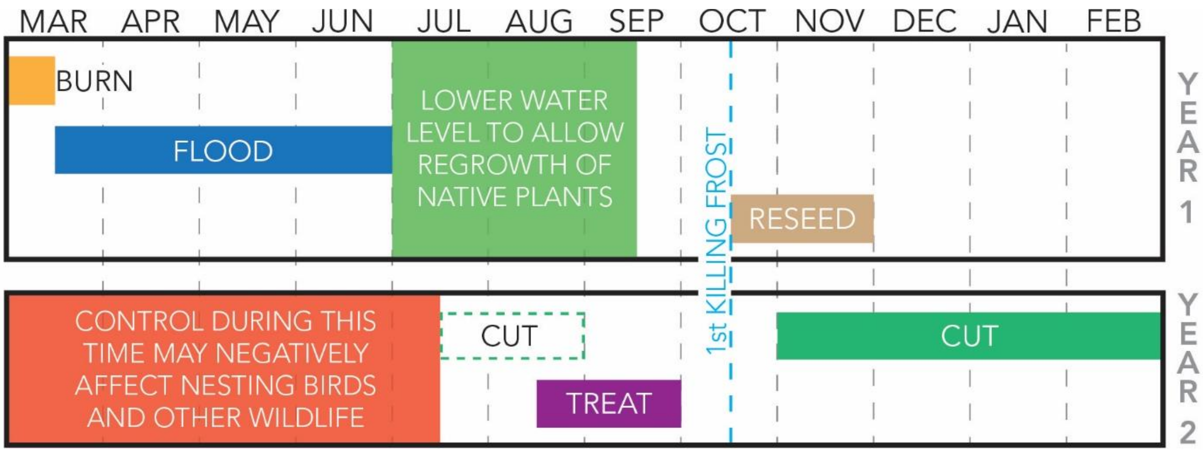


Figure 10. Non-native Phragmites IPM Example 3 utilizes many techniques over a 2-year period to meet site goals.

Additional information regarding control combinations and timing can be found through the Great Lakes Phragmites Collaborative, the Michigan Department of Environmental Quality, and the Ontario Invasive Plant Council.

MONITORING

Monitoring is used to evaluate management actions, progress towards management goals, and to determine if management needs to be adapted. Budgeting time and resources into both pre- and post-treatment monitoring can give a clearer picture of the effects of management actions. Aligning monitoring efforts with management goals is essential. For example, if goals focus on the reduction of Phragmites and restoration of important species (e.g., Manoomin - wild rice), both species should be included in the monitoring efforts. Finally, monitoring can show whether the expected outcomes are being reached and, if not, can inform adjustments to the management plan.

INNOVATIVE METHODS

Researchers continue to explore and develop new control techniques and strategies. For over a decade researchers from Cornell University have been working to identify a biological control agent for Phragmites. A pilot study of a stem-boring moth was recently conducted in Ontario. Biological control represents a low-cost management alternative but carries with it the potential for unseen consequences of new species introduction. Additionally, research at the United States Geological Survey Great Lakes Science Center has focused on limiting the effects of beneficial microbes on Phragmites and on gene silencing technology which can target potential genes that promote spread and essentially 'switch them off.' Though likely several years away from field implementation, this research represents a prospective shift in future Phragmites management.

PART III
STATE STRATEGY

Wisconsin's *Phragmites australis* Statewide Management Strategy is a culmination of decades of research and lessons learned from past management throughout the state and within the Great Lakes region. It refines an early strategy conceptualized in the Strategic Analysis of Aquatic Plant Management in Wisconsin. Phragmites control is often most successful when the site(s) is linked to its broader landscape context, prioritized based on location, size, and age, and adaptively managed using a suite of techniques as part of an IPM approach. The following is a statewide vision for controlling Phragmites with goals and objectives developed to measure progress towards achieving this vision, while enhancing the goals of the Great Lakes Phragmites Collaborative and other regional organizations.

VISION, GOALS, and OBJECTIVES

"We aim to reduce the overall impact of non-native *Phragmites australis* in Wisconsin by prioritizing pioneering patches within the prohibited counties, especially near or within high-quality or sensitive areas, through a long-term, coordinated, collaborative, landscape-scale, IPM approach."

This vision is threefold:

1. Given the distribution of Phragmites across Wisconsin's landscape, and with the current capacity, funding, and present technology, eradication is unrealistic. However, reducing the impacts of Phragmites on a statewide scale is possible.
2. Site prioritization is key to an efficient Phragmites management strategy. Prioritizing sites based on the impact to high-quality or sensitive areas, patch age and size, and location within the landscape and state can make control more cost effective and increase the likelihood of success.
3. Finally, because this is a statewide approach, it will be a statewide effort. This involves a coordinated and collaborative network that manages Phragmites at a state, county, and local level through partnerships with government agencies and non-governmental entities like CISMAs and universities. Robust communication within these partnerships can ensure site-specific, IPM strategies are employed to control Phragmites, monitoring is conducted to evaluate site goals, and successes are shared with a broader audience.

GOAL - PRIORITIZE SITES

Factors to consider when prioritizing sites include the species' NR 40 designation, the size, age, and density of the patch, the surrounding habitat quality, the broader landscape/watershed context, and other factors. These factors can apply to many sites across the landscape or to many patches within one site.

Because Phragmites is listed as prohibited and is less established within the western portion of the state, pioneering patches in these areas should be prioritized over established patches in the restricted, eastern portion of the state. The prohibited status in the western portion of the state also affords additional opportunities for grant funding (Appendix III).

Both stand age and stand size influence control success. All else being equal, small or newly established populations should be controlled first. Young, small patches can spread rapidly both through seed dispersal and vegetative growth. However, these patches are typically easier and less costly to manage because they have yet to produce substantive underground biomass. This also lowers the chance that these patches will reemerge after initial control. As patches become larger and well-established, control becomes less effective.

Similarly, established populations within natural wetlands often have more detrimental impacts, both ecologically and through physical disturbances caused by management actions. Prioritizing these areas for control early may reduce not only the long-term negative ecological impacts and limit the scale and magnitude of disturbances related to management, but also prevent further spread to sensitive areas.

Sites can also be prioritized across the landscape based on built environment impacts and potential safety hazards. Large, dead stands could be fire hazards, especially when they occur within industrial areas. Patches may also affect drainage patterns, especially along roadsides and in agricultural areas. Alternatively, sites that receive additional inputs like nutrients and salinity may be lower priority.

OBJECTIVES

- Develop a site prioritization scheme and apply it to project selection efforts, such as state or federal grant applications, in coordination with DNR land managers
- Ensure control efforts are guided by a planning effort that includes site- or patch-level prioritization.
- Require state-funded grant projects to implement the prioritization strategy outlined in this section
- Implement outreach, monitoring, and control through EDR grants within prohibited counties
- For high density areas within the restricted counties, limit management to small, localized areas with an emphasis on high-quality, unique and/or sensitive lake or wetland habitat

GOAL - INCORPORATE IPM MANAGEMENT PRACTICES

Once priority sites and/or populations have been identified, site-specific management goals should be well defined. Combining these goals with the site characteristics should be the basis for selecting appropriate management techniques to best achieve control results.

Focused integrated management plans can help direct control activities and provide the basis for science-based management decisions. A detailed management timeline that describes what management actions will occur, and when, based on site conditions is indicative of a thoughtful project. This can include how secondary techniques complement other techniques (e.g., pre-treatment cutting paired with herbicide or removal of dead stands paired with flooding), how treatment will vary across multiple sites or multiple patches within one site, and if restoration efforts may be employed.

OBJECTIVES

- Identify control techniques that match site's characteristics
- Work with the aquatic plant management (APM) program to ensure following the strategy constitutes a management plan for permitting
- Train partners on how to apply for APM permits

GOAL - INCORPORATE PRE- and POST-TREATMENT MONITORING

As described in Part II, monitoring is a critical aspect for evaluating management techniques and goals and is paramount to a long-term management strategy for Phragmites. Data collection through monitoring offers invaluable insights into the efficacy of management and can direct adaptive strategies should outcomes differ from the defined management goals.

Monitoring can be split into two general categories: pre- and post-treatment monitoring. Pre-treatment monitoring allows for the current site conditions to be recorded. Pre-treatment monitoring data can then be compared to post-treatment monitoring data to measure the outcomes of specific management practices. Even if Phragmites is controlled at a particular site, monitoring should be conducted for several years following treatment to capture the long-term effects of management and to stay vigilant should Phragmites reemerge.

OBJECTIVES

- Craft a standardized and repeatable pre- and post-treatment monitoring strategy to assess control efficacy and non-target impacts
- Employ pre- and post-treatment evaluation methods for all Phragmites control projects
- Utilize Rapid Floristic Quality Assessments (FQA) to assess plant community response to treatment

GOAL - PREVENT THE SPREAD

According to the USDA's National Invasive Species Information Center, "the most economical and safest way to manage invasive species is by prevention." In Phragmites's case, vigilance through early detection monitoring, especially in prohibited counties, can ease the already strained resources required for management. This includes awareness of nutrient-rich or disturbed areas such as recently restored wetlands and sensitive areas near existing Phragmites patches. Including prevention efforts as part of invasive species control could substantially reduce long-term control commitments and costs.

Changes in climate may lead to new patterns of spread. For example, Phragmites spread may be further facilitated by the unpredictability of future Great Lakes and inland water levels. Studies have shown that bare, sandy soils are favored conditions for Phragmites expansion. If water levels were to drop, exposing bare lake bottom, the potential for Phragmites to expand into these areas is high.

Transportation corridors and other disturbed areas are major pathway for Phragmites spread. Dispersal by airborne seeds ignores site, county, watershed, and state boundaries. Therefore, it is important to map potential pathways that may contribute to airborne seed dispersal and manage these areas accordingly to prevent further Phragmites spread. Funding from the recently passed Bipartisan Infrastructure Law may provide greater opportunities for prevention along roadsides.

Always follow the proper disinfection and disposal guidance and be aware that management alternatives that remove biomass (like spading or cut-to-drown) can potentially result in seed spread, if not cautious. Recognizing these potential expansion pathways and having a management response in place is crucial to this strategic approach.

OBJECTIVES

- Develop strategy to determine distribution in prohibited region
- Define strategy/objectives that utilize the pathway approach to prevention via road networks with Wisconsin Department of Transportation (WisDOT), county, and town road crews including communication and decontamination steps following maintenance/construction along roadsides or soil and fill transport, and continuing agreements to treat Phragmites within prohibited counties.
- Develop and communicate key prevention steps for waterfowl hunters

GOAL – FUND THROUGH SURFACE WATER GRANTS PROGRAM

The Surface Water Grant Program (SWGP) supports assessment and planning for aquatic invasive species (AIS) control projects. This strategic plan is meant to specifically facilitate Phragmites-specific control projects competing for SWGP funding. To align individual goals with statewide goals, it is expected that the strongest control projects will detail assessment, planning, and management by following the rationale described in this strategy while incorporating the minimum criteria for a site-specific management plan funded under the Surface Water Grant Program. These criteria can be found in the Management Planning appendix of the program's applicant guide, available on the grant program website. Plans funded through the Surface Water Grant Program will present and evaluate information in five modules: 1) Baseline data and assessment, 2) Management goals, 3) Management alternatives, 4) Broader impacts, and 5) Implementation. High-priority sites or vulnerable areas will benefit from a site-specific plan that takes a directed and thoughtful approach to planning for control and evaluation. Larger-scale plans that identify regional priorities may vary somewhat from this formula, though they, too, should contain information pertaining to each of the five basic planning modules. Note that some type of site-specific plan is a pre-requisite for control projects seeking the support of an AIS Population Management grant under the Surface Water Grant Program.

OBJECTIVES

- Encourage the drafting of regional strategic Phragmites control plans consistent with this strategy by providing funding priority under the Surface Water Grant Program
- Prioritize Phragmites control projects directed by such a plan, or which propose work consistent with the planning and best management practices outlined in this strategic plan

GOAL - ENCOURAGE ENROLLMENT IN REGIONAL EFFORTS

A primary initiative of the Great Lakes Phragmites Collaborative (GLPC), is the Phragmites Adaptive Management Framework (PAMF). PAMF is a tool for enhancing management strategies throughout the Great Lakes region. PAMF incorporates specific management combinations into a model which provides site-specific control guidance. This guidance is refined based on data collected during post-management monitoring. As enrollment grows and the amount and type of data increases, the PAMF model is further refined, producing better guidance for individual sites, which contributes to a better understanding of the implementation and effectiveness of Phragmites management strategies and methods within the Great Lakes region.

While Phragmites control is largely context dependent, greater involvement in regional efforts of this type is essential to creating a broader landscape-scale approach focused on reducing the impacts of Phragmites. GLPC and PAMF are excellent resources for obtaining and distributing knowledge, updates, challenges, and success stories.

OBJECTIVES

- Require PAMF enrollment on state-funded projects
- Include partners in PAMF trainings / monitoring efforts. Pass PAMF information along to partners
- Share state successes / challenges with a broader regional audience

GOAL - ADVANCE RESEARCH and TECHNOLOGY

As more is learned about Phragmites, management techniques are refined, and new techniques are invented. Emerging technologies have the potential to revolutionize Phragmites management, but their success relies on sound research. Current underdeveloped but promising approaches include the use of drones, utilizing Great Lakes water level fluctuations, and emphasizing restoration practices.

Drones are great resources for mapping and controlling hard-to-reach sites and use herbicide more efficiently by minimizing wind-caused drift to non-target areas. While there are instances of drone use throughout the state, more research is needed to determine the efficacy of drone use for mapping, controlling, and monitoring Phragmites.

Strategically utilizing the natural fluctuations of Great Lakes water levels presents an opportunity to employ the "cut-to-drown" technique at a large scale. Involvement in this research would contribute to an existing USGS project exploring the effectiveness of this technique.

Finally, research for restoration techniques, especially in heavily degraded sites like roadsides, is lacking. Managing Phragmites and encouraging native communities to return following control can help reduce time and resources that might otherwise be spent controlling reintroduction of Phragmites or controlling secondary invasions by other invasive species following control.

OBJECTIVES

- Support Phragmites projects using emerging technologies (e.g., drones)
- Solicit proposals for state or regional priority Phragmites research through the AIS Research Grants
- Identify opportunities for additional research and new technology
- Stay up to date on current research underway within Wisconsin and/or the Great Lakes region

GOAL - COMMUNICATE and COLLABORATE WITH PARTNERS

Because of the long-term and widespread nature of Phragmites management, coordination at a statewide level is imperative. Communication across Wisconsin can leverage a range of resources like funding, capacity, abilities, expertise, and time to better prioritize control efforts and to meet regional, county, or local government Phragmites goals more efficiently.

Partner-piloted programs, through the efforts of Cooperative Invasive Species Management Areas (CISMAs) and consultants, have been integral in expanding knowledge and outreach to private landowners regarding Phragmites management. Additional efforts through educational institutions, like the University of Wisconsin Green-Bay or Wisconsin Sea Grant, further elucidate management strategies by conducting and sharing research.

While the Wisconsin DNR coordinates most of the state's Phragmites management, broad scale, effective collaboration with other agencies, groups, and individuals can contribute greatly towards the goal of effectively managing non-native Phragmites in the state. The Wisconsin DOT, local and municipal governments, Great Lakes Indian Fish and Wildlife Commission, regional CISMAs, research universities, and private landowners are all critical partners in this effort. Collaboration may also include sharing successes with and from regional entities like GLPC and continued financial support from the Great Lakes Restoration Initiative (GLRI) and other federal initiatives. Finally, the importance of volunteer-led endeavors should not be understated, as many successes throughout the US and Canada have followed this model.

OBJECTIVES

- Identify all partners
- Meet with partners, roll out strategy, establish key regional contacts, create a distribution list, and establish a working group that meets and reports consistently throughout the year
- Develop a Phragmites-specific webpage or clearinghouse

REFERENCES

Boos, T., K. Kearns, C. LeClair, B. Panke, B. Scriver, and B. Williams (Eds). 2009. A Field Guide to Terrestrial Invasive Plants in Wisconsin. Wisconsin Department of Natural Resources. Madison, WI.

Carlson, M.L., K.P. Kowalski, and D.A. Wilcox. 2009. Promoting species establishment in a *Phragmites*-dominated Great Lakes coastal wetland. *Natural Areas Journal, 29,* 263-280.

Cleland, E., M. McFarlane, J. Gilbert, and F. Chua. 2021. Invasive *Phragmites* – A Strategic Framework for Coordinated Management in Ontario. Green Shovels Collaborative. Ontario, CA.

[CMP] Conservation Measures Partnership. 2020. Open Standards for the Practice of Conservation. Version 4.0. CMP, Washington, D.C.

Elsey-Quirk, T., and M.A. Leck. 2021. High Reinvasion Potential of Phragmites australis in a Delaware River (USA) Tidal Freshwater Marsh Following Chemical Treatment: the Role of the Seedbank. *Wetlands*, *41*(1), 1-12.

Farnsworth, E.J., and L.A. Meyerson. 2003. Comparative ecophysiology of four wetland plant species along a continuum of invasiveness. *Wetlands 23*:750-762.

Fer, T. and Z. Hroudova. 2009. Genetic diversity and dispersal of *Phragmites australis* in a small river system. *Aquatic Botany, 90*, 165-171.

Gary A. Fewless Herbarium, Cofrin Center for Biodiversity, University of Wisconsin-Green Bay. "*Phragmites australis*." Retrieved 4 February 2022. https://www.uwgb.edu/biodiversity-old/herbarium/wetland_plants/phraus01.htm

Gettys, L.A., T.H. Haller, D.G. Petty (eds). 2014. Biology and control of aquatic plants: a best management practices handbook. 3rd edition. Aquatic Ecosystem Restoration Foundation. http://aquatics.org/bmp%203rd%20edition.pdf

[GLPC] Great Lakes Phragmites Collaborative, Great Lakes Commission. n.d.a. "How Does it Spread?" Retrieved 8 February 2022. https://www.greatlakesphragmites.net/phragbasics/spread/

[GLPC] Great Lakes Phragmites Collaborative, Great Lakes Commission. n.d.b. "PAMF Strategic Plan." Retrieved 25 February 2022. https://www.greatlakesphragmites.net/wp-content/uploads/2020/11/PAMF-StrategicPlan-20201105.pdf

[GLPC] Great Lakes Phragmites Collaborative, Great Lakes Commission. n.d.c. "Management Techniques" Retrieved 15 March 2022. https://www.greatlakesphragmites.net/management/techniques/

[GLPC] Great Lakes Phragmites Collaborative, Great Lakes Commission. 2019. "*Phragmites* Adaptive Management Framework Participant Guide, Version 4. Great Lakes Commission, Ann Arbor, MI.

[GLRI] Great Lakes Restoration Initiative, United States Environmental Protection Agency. n.d. "About." Retrieved 21 February 2022. https://www.glri.us/about

[GLRI] Great Lakes Restoration Initiative, United States Environmental Protection Agency. 2019. Great Lakes Restoration Initiative Action Plan III. United States Environmental Protection Agency, Washington, D.C.

[GLRI] Great Lakes Restoration Initiative, United States Geological Survey. 2020. "Invasive *Phragmites* Science: Management Tools for the Control of Invasive *Phragmites* to Foster the Restoration of the Great Lakes." Retrieved 22 February 2022. https://www.usgs.gov/special-topics/great-lakes-restoration-initiative/science/invasive-phragmites-science-management

Hazelton, E.L.G., T.J. Mozdzer, D.M. Burdick, K.M. Kettenring, and D.F. Whigham. 2014. *Phragmites australis* management in the United States: 40 years of methods and outcomes. *AoB plants 6*: plu001; doi:10.1093/aobpla/plu001

Juneau, K.J. and C.S. Tarasoff. 2013. The seasonality of survival and subsequent growth of common reed (*Phragmites australis*) rhizome fragments. *Invasive Plant Science and Management, 6*(1), 79-86.

[MDEQ] Michigan Department of Environmental Quality. 2014. A Guide to the Control and Management of Invasive *Phragmites*, Third Edition. Michigan Department of Environmental Quality, Lansing, MI.

[MSUE] Michigan State University Extension. n.d. "Phragmites – Native or Not?" Retrieved 20 March 2022. https://mnfi.anr.msu.edu/pdfs/phragmites-native-non-native.pdf

[MTRI] Michigan Tech Research Institute. 2018. Comprehensive *Phragmites* Management Strategy. Michigan Technological University, Houghton, MI.

Moore, V. 2021. Invasive Species Impacts on Transportation Infrastructure. Federal Highway Administration, U.S. Department of Transportation. Washington, DC

[NISIC] National Invasive Species Information Center, United States Department of Agriculture. n.d. "Common Reed." Accessed 4 February 2022. https://www.invasivespeciesinfo.gov/aquatic/plants/common-reed

[NISIC] National Invasive Species Information Center, United States Department of Agriculture. n.d. "Control Mechanisms." Accessed 2 March 2022. https://www.invasivespeciesinfo.gov/subject/control-mechanisms

Nichols, G. 2020. Invasive *Phragmites* (*Phragmites australis*) Best Management Practices in Ontario: Improving species at risk habitat through the management of Invasive *Phragmites*. Ontario Invasive Plant Council. Peterborough, ON.

Quirion, B., Z. Simek, A. Dávalos, and B. Blossey. 2018. Management of invasive *Phragmites* australis in the Adirondacks: a cautionary tale about prospects of eradication. *Biological Invasions, 20*(1), 59-73.

Robichaud, C.D. and R.C. Rooney. 2021. Effective suppression of established invasive Phragmites australis leads to secondary invasion in a coastal marsh. *Invasive Plant Science and Management*, *14*(1), 9-19.

Rohal, C.B., C. Cranney, E.L.G. Hazelton, and K.M.Kettenring. 2019. Invasive *Phragmites australis* management outcomes and native plant recovery are context dependent. *Ecology and evolution*, *9*(24), 13835-13849. https://doi.org/10.1002/ece3.5820

Saltonstall, K., Lambert, A.M., and Rice, N. What happens in Vegas, better stay in Vegas: *Phragmites australis* hybrids in the Las Vegas Wash. *Biol Invasions 18*, 2463-2474 (2016). https://doi.org/10.1007/s10530-016-1167-5

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. https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/idpmctn11494.pdf

Tulbure, M.G. and C.A. Johnston. 2010. Environmental conditions promoting non-native Phragmites australis expansion in Great Lakes coastal wetlands. *Wetlands*, *30*(3), 577-587.

[USEPA] United States Environmental Protection Agency. n.d. "Integrated Pest Management (IPM) Principles." Retrieved 22 February 2022. https://www.epa.gov/safepestcontrol/integrated-pest-management-ipm-principles

[USGS] United States Geological Survey. n.d. "Phragmites Management and Variable Great Lakes Water Levels. Retrieved 10 June 2022. https://geonarrative.usgs.gov/phragmiteswaterlevels/

Willcox, J.D. 2013. Response of *Phragmites australis* to Black Plastic Treatment. Master's theses. 444. University of Connecticut. Storrs, CT. https://opencommons.uconn.edu/gs_theses/444

[WDNR] Wisconsin Department of Natural Resources. n.d. "Non-native *Phragmites* or Common Reed." Retrieved 7 February 2022. https://dnr.wisconsin.gov/topic/Invasives/fact/Phragmites.html

[WDNR] Wisconsin Department of Natural Resources. 2016. Saving Our Waters: Protect Your Wetlands From Invasive Phragmites. Wisconsin Department of Natural Resources. Madison, WI. https://dnr.wi.gov/topic/invasives/documents/ProtectWetlandsPhragmitesBookletWeb.pdf

[WDNR] Wisconsin Department of Natural Resources. 2018. Wisconsin Aquatic Invasive Species Management Plan. Wisconsin Department of Natural Resources. Madison, WI.

[WDNR] Wisconsin Department of Natural Resources. 2019. Strategic Analysis of Aquatic Plant Management in Wisconsin. Wisconsin Department of Natural Resources. Madison, WI

[WDNR] Wisconsin Department of Natural Resources. 2020. 2018 – 2020 Invasive Species Report. Wisconsin Department of Natural Resources. Madison, WI.

Wisconsin Wetland Team. 2008. Reversing the Loss: A Strategy to Protect, Restore and Explore Wisconsin Wetlands. Wisconsin Department of Natural Resources. Madison, WI. https://dnr.wi.gov/topic/wetlands/documents/reversingloss08_final.pdf

Zedler, J.B. and S. Kercher. 2004. Causes and Consequences of Invasive Plants in Wetlands: Opportunities, Opportunists, and Outcomes. Critical Reviews in *Plant Sciences, 23*:5, 431-452, DOI: 10.1080/07352680490514673

APPENDIX I: Spread

When viewed in order from Figure 11 – Figure 15, the right side of these figures represents the effects of newly established non-native Phragmites and its subsequent spread in a native wetland community. Alternatively, viewing the right side of the figures in reverse order, from Figure 15 – Figure 11, represents successful restoration, although it should be noted that research on post-restoration plant community composition has found restored plant communities generally differ from the reference conditions which the right side of Figure 11 may better represent. Though restoration efforts may help control the target invasive species, the native community that returns may not be the same community that existed prior to Phragmites establishment. Additional management may be needed to restore the historic hydrology, which may in turn affect the native plant community composition. This can be described as the difference between restoring a wetland's former plant community and restoring its function.

Figures adapted and with permission from the Great Lakes Phragmites Collaborative "How Does It Spread?" webpage and Able et al. (2003) as found in Zedler and Kercher (2004).

Figure 11. An established nonnative Phragmites patch (left) disperses seeds into a diverse, native wetland habitat (right). Depending on the system, this dispersal may occur over several miles by either wind or water. Simultaneously, the established Phragmites spread by rhizomes, increasing the size of the established patch.

Figure 12. Phragmites seeds establish, producing rhizomes and new stalks which quickly shade out native species (right). Simultaneously, the established Phragmites patch produces vegetative litter which facilitates spread by rhizomes into the wetter portions of the site (left).

Figure 13. The newly established Phragmites patch produces new shoots, further shading out native species, degrading the formerly diverse, native wetland habitat (right). Both patches produce vegetative litter which further facilitates spread by rhizomes and alters site hydrology.

Figure 14. A new Phragmites monoculture forms. Both patches produce vegetative litter which further facilitates spread by rhizomes and alters site hydrology.

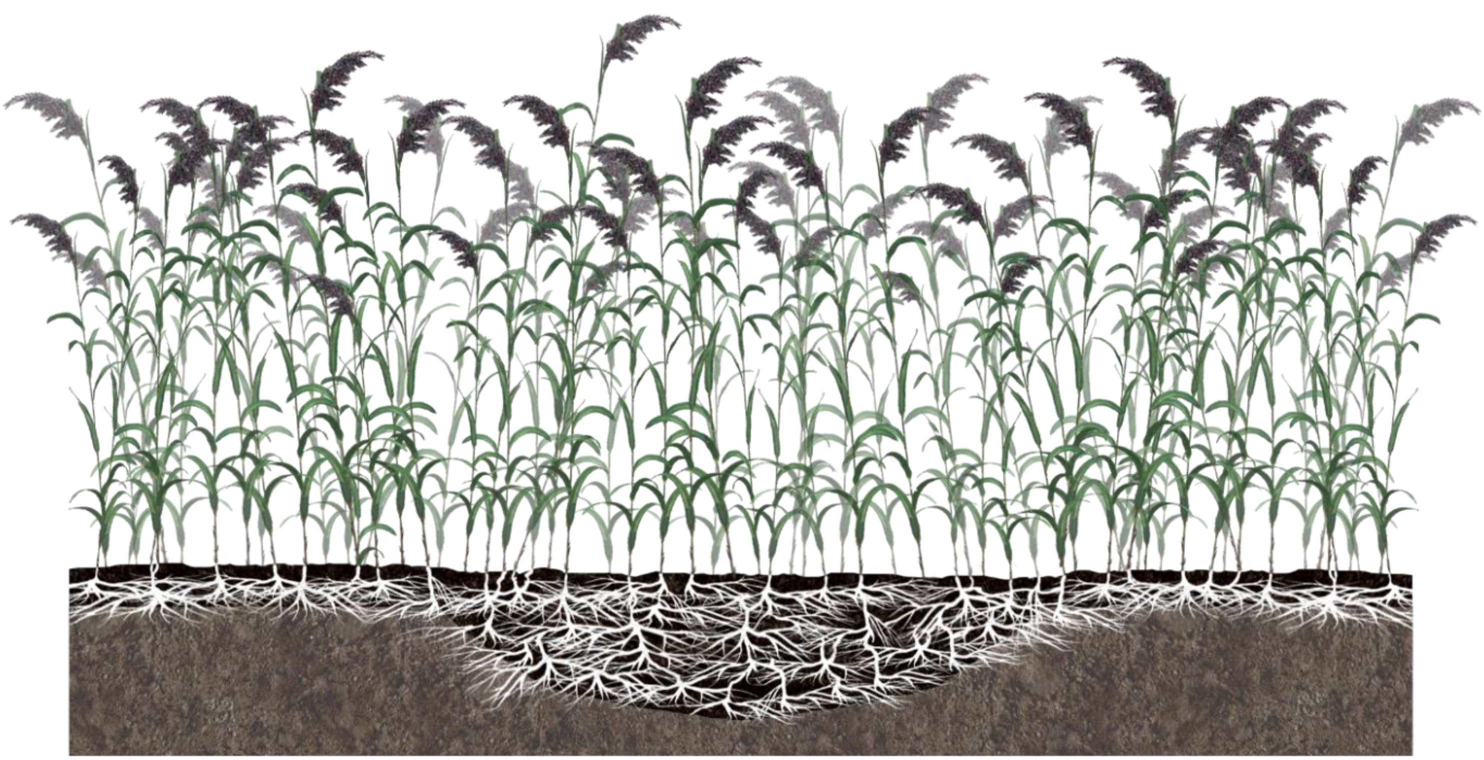
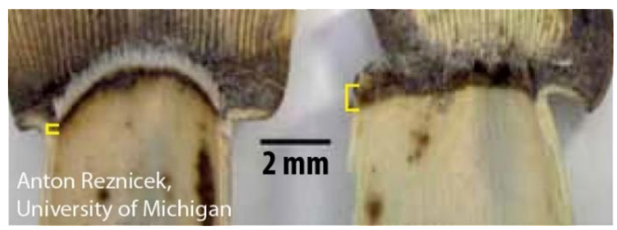


Figure 15. The Phragmites monoculture alters the native community and historical hydrology beyond recognition.

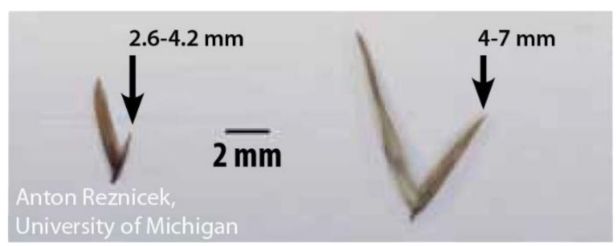
APPENDIX II: Native & Non-native ID

There are several morphological characteristics that help differentiate the non-native subspecies, *Phragmites australis* subsp. *australis,* from the native subspecies, *Phragmites australis* subsp. *americanus.* Below are several images and descriptions from the Michigan State University Extension document "Phragmites – Native or Not?" and the Wisconsin DNR document "Saving Our Waters: Protect Your Wetlands From Invasive Phragmites," which compare these characteristics. While most of these differences seem obvious when compared side-by-side, this same opportunity rarely occurs in the field, and these characteristics may also be less distinct than the examples below. Always get confirmation from experts and report all suspected non-native stands to the Wisconsin DNR.

NON-NATIVE NATIVE



LIGULES
Where the leaf blade meets the sheath is a membranous extension known as the ligule. The non-native Phragmites ligule ranges from 0.1 – 0.4 mm, while the wider, native ligule ranges from 0.4 – 1 mm. The native ligule is also less sturdy and more likely to shred or fray.



GLUMES
Phragmites seed heads are comprised of many branches supporting numerous spikelets. At the base of each spikelet are two bracts called glumes. The lowest (and shortest) glume of a non-native *Phragmites* spikelet ranges from 2.6 – 4.2 mm long, while the glume of the native subspecies ranges from 4 – 7 mm.

DENSITY and SIZE
Non-native Phragmites usually grows in thick, dense monocultures. Individual stalks can grow up to 6m (20 feet) tall. As a result of their height and density, these monocultures shade out other species, often detrimentally impacting the native plant community.

Native Phragmites, on the other hand, typically grows as scattered stems, better fitting into the native community, rather than forming dense monocultures. Individual stalks typically grow to 2 m (6.5 feet) in height.

COLOR

There are several color differences between the two subspecies. Non-native Phragmites stems and leaves are generally a bluish or grayish-green color. The seed heads range from purple to silver to brown. The leaf sheath is held tight to the stem, causing the plant to retain its green color throughout the season. The exposed lower stems between the leaves (the internodes) are usually tannish-green, though they may have a hint of pink. The stems are "corrugated," with tiny vertical ridges, easily detected by running your thumbnail around the stem.

Native Phragmites stems and leaves are generally a yellowish-green color. The seed heads are purple tinged when immature before browning. They are usually smaller and less robust with fewer seeds than the non-native subspecies. The leaf sheaths fall off easily, turning the stems a reddish-maroon color when exposed to sunlight. The leaves are smooth and somewhat shiny.

FUNGUS

A typical characteristic of native Phragmites is the presence of black dots – resembling marks from a permanent marker – found underneath the leaf sheath on the smooth, shiny stem. These black dots result from a fungus that grows exclusively on the native species. Indistinct molds may appear on the rigid dull stem of non-native Phragmites, but they are usually easily discernible from the black fungus found on the native subspecies.

NON-NATIVE

NON-NATIVE | NATIVE





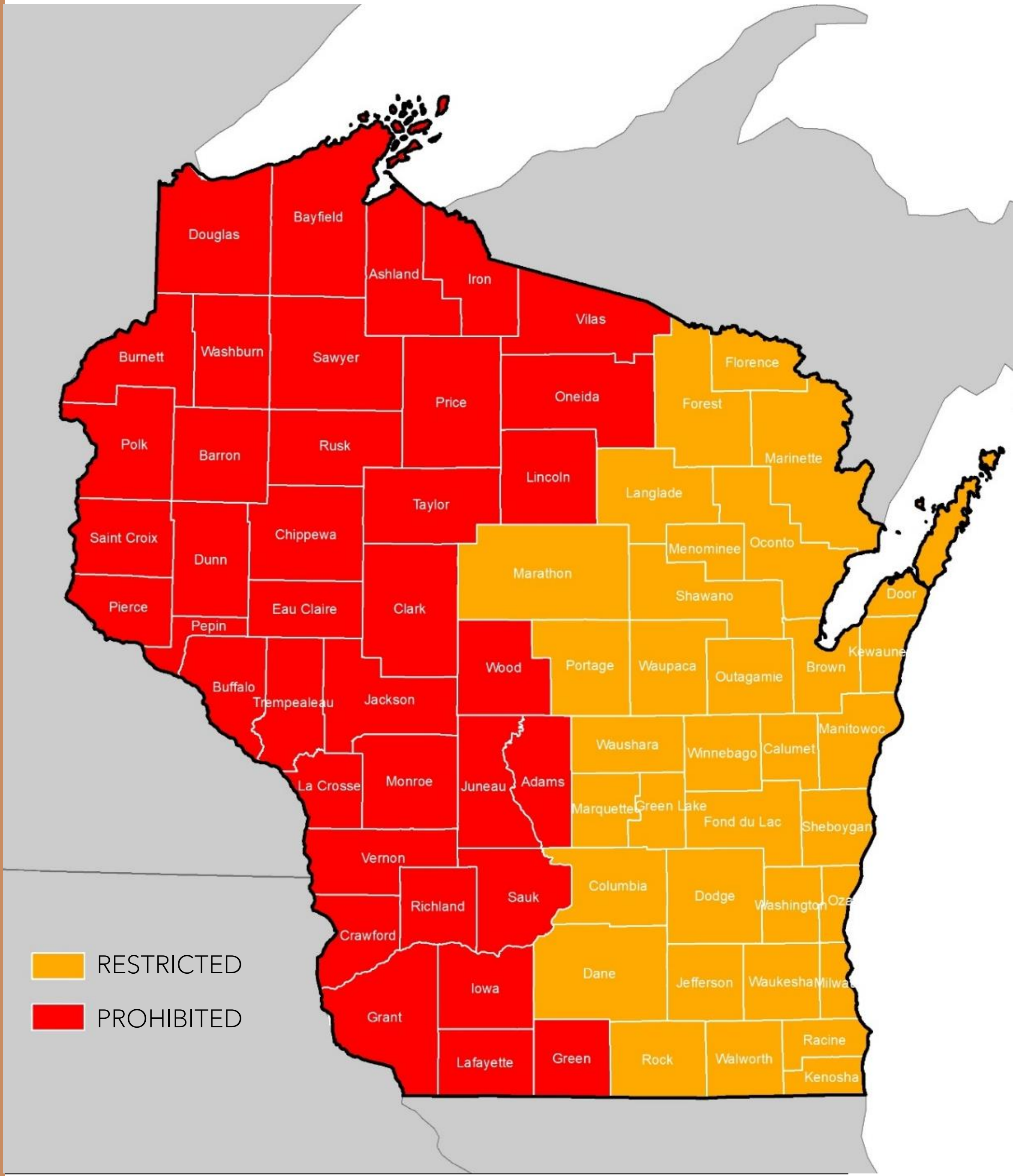

APPENDIX III: NR 40

Non-native Phragmites has a split NR 40 classification in Wisconsin. The western portion of the state is listed as prohibited and the eastern portion is listed as restricted. The plant is found most frequently in the eastern restricted portion of the state, where many of the patches occur. In the prohibited counties, it is most abundant along the shoreline of the St. Louis River Estuary between Superior, Wisconsin and Duluth, Minnesota.

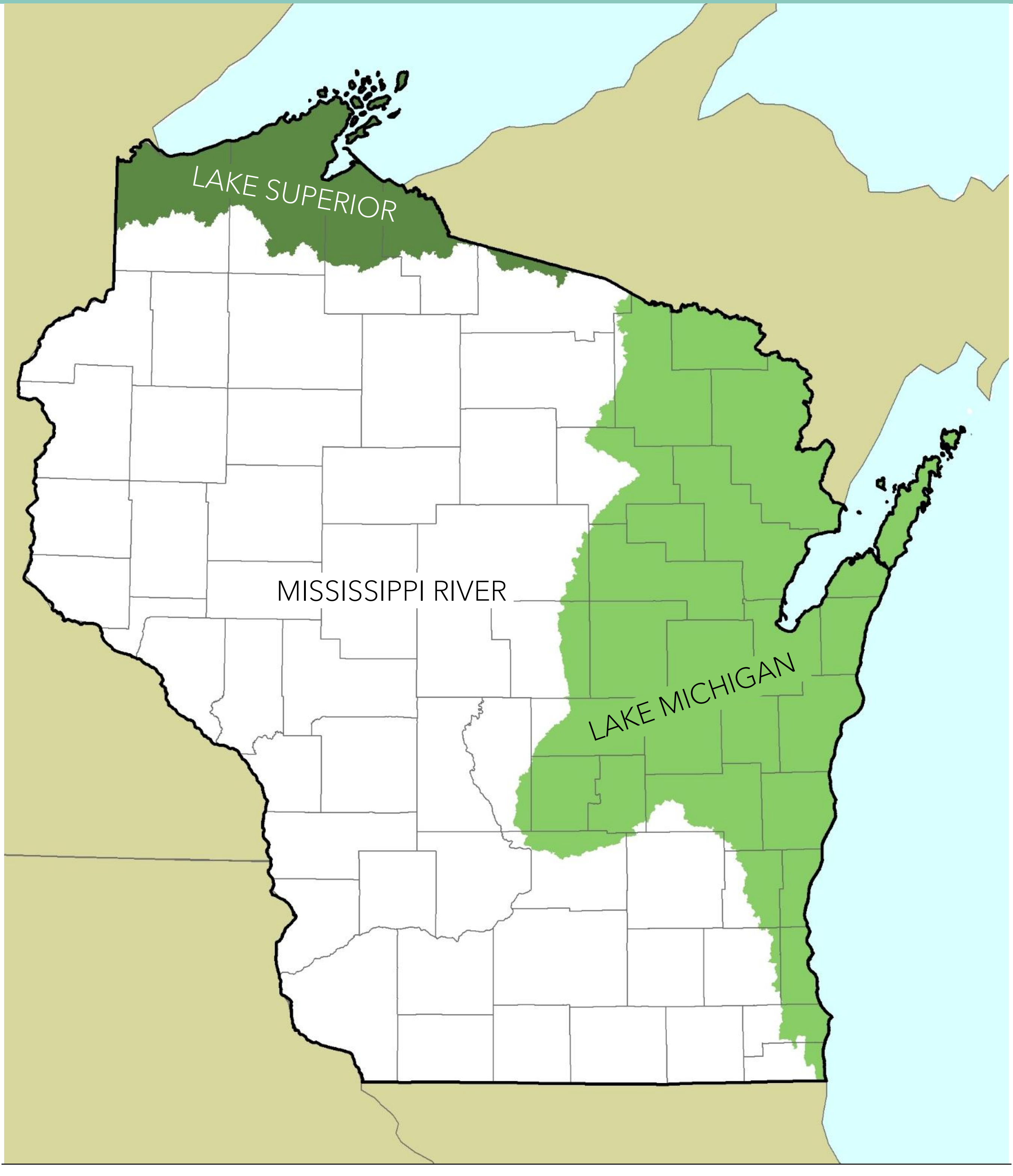
Whether a Phragmites site occurs in a prohibited or restricted county will subject the site to different legal and management scenarios. In prohibited counties, possession of Phragmites is illegal and WDNR can conduct control activities, if warranted. Additionally, the number of EDR grants per site is not limited as the purpose of the prohibited classification is either to contain or eradicate Phragmites. In restricted counties, possession of Phragmites is legal and EDR grants are limited to one per verified population, which must also be determined to be a pioneering population. Control is encouraged but not required in restricted counties. This distinction is also a method WDNR employs to strategically fund Phragmites control across Wisconsin.

NR 40 classifications are subject to change per the reoccurring NR 40 revision process.

See the Surface Water Grant Program guidance and DNR webpage for more details.



APPENDIX IV: Great Waters Watersheds



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