

# **APPENDIX G**

## **Methods to Manage Aquatic Plants - University of Wisconsin Extension**

Note: This is to present various options for managing aquatic plants. Because this was written for Wisconsin lake managers, permitting information is specific to Wisconsin. Those interested in using these methods should verify permitting requirements for Ohio.

# Management Options for Aquatic Plants



Updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
<b>No management</b>	N	Do not actively manage plants	<p>Minimizing disturbance can protect native species that provide habitat for aquatic fauna, reduce shoreline erosion, may improve water clarity, and may limit spread of invasive species</p> <p>No financial cost</p> <p>No system disturbance</p> <p>No unintended effects of chemicals</p> <p>Permit not required</p>	<p>May allow small population of invasive plants to become larger, more difficult to control later</p> <p>Excessive plant growth can hamper navigation and recreational lake use</p> <p>May require modification of lake users' behavior and perception</p>
<b>Mechanical Control</b>	May be required under NR 109	<p>Plants reduced by mechanical means</p> <p>Wide range of techniques, from manual to highly mechanized</p>	<p>Flexible control</p> <p>Can balance habitat and recreational needs</p>	<p>Must be repeated, often more than once per season</p> <p>Can suspend sediments and increase turbidity and nutrient release</p>
a. Handpulling/Manual raking	Y/N	<p>SCUBA divers or snorkelers remove plants by hand or plants are removed with a rake</p> <p>Works best in soft sediments</p>	<p>Little to no damage done to lake or to native plant species</p> <p>Can be highly selective</p> <p>Can be done by shoreline property owners without permits within an area &lt;30 ft wide OR where selectively removing exotics</p> <p>Can be very effective at removing problem plants, particularly following early detection of an invasive exotic species</p>	<p>Very labor intensive</p> <p>Needs to be carefully monitored</p> <p>Roots, runners, and even fragments of some species, particularly Eurasian watermilfoil (EWM) will start new plants, so all of plant must be removed</p> <p>Small-scale control only</p>

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b. Harvesting	Y	Plants are "mowed" at depths of 2-5 ft, collected with a conveyor and off-loaded onto shore  Harvest invasives only if invasive is already present throughout the lake	Immediate results  EWM removed before it has the opportunity to autofragment, which may create more fragments than created by harvesting  Usually minimal impact to lake ecology  Harvested lanes through dense weed beds can increase growth and survival of some fish  Can remove some nutrients from lake	Not selective in species removed  Fragments of vegetation can re-root  Can remove some small fish and reptiles from lake  Initial cost of harvester expensive
<b>Biological Control</b>	Y	Living organisms (e.g. insects or fungi) eat or infect plants	Self-sustaining; organism will over-winter, resume eating its host the next year  Lowers density of problem plant to allow growth of natives	Effectiveness will vary as control agent's population fluctuates  Provides moderate control - complete control unlikely  Control response may be slow  Must have enough control agent to be effective
a. Weevils on EWM	Y	Native weevil prefers EWM to other native water-milfoil	Native to Wisconsin: weevil cannot "escape" and become a problem  Selective control of target species  Longer-term control with limited management	Need to stock large numbers, even if some already present  Need good habitat for overwintering on shore (leaf litter) associated with undeveloped shorelines  Bluegill populations decrease densities through predation

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b. Pathogens	Y	Fungal, bacterial, or viral pathogen introduced to target species to induce mortality	<p>May be species specific</p> <p>May provide long-term control</p> <p>Few dangers to humans or animals</p>	<p>Largely experimental; effectiveness and longevity unknown</p> <p>Possible side effects not understood</p>
c. Allelopathy	Y	Aquatic plants release chemical compounds that inhibit other plants from growing	<p>May provide long-term, maintenance-free control</p> <p>Spikerushes (<i>Eleocharis</i> spp.) appear to inhibit Eurasian watermilfoil growth</p>	<p>Initial transplanting slow and labor-intensive</p> <p>Spikerushes native to WI, and have not effectively limited EWM growth</p> <p>Wave action along shore makes it difficult to establish plants; plants will not grow in deep or turbid water</p>
d. Native plantings	Y	Diverse native plant community established to compete with invasive species	<p>Native plants provide food and habitat for aquatic fauna</p> <p>Diverse native community more repellant to invasive species</p>	<p>Initial transplanting slow and labor-intensive</p> <p>Nuisance invasive plants may outcompete plantings</p> <p>Transplants from another lake or nursery may unintentionally introduce invasive species</p> <p>Largely experimental; few well-documented cases</p>

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<b>Physical Control</b>	Required under Ch. 30 / NR 107	Plants are reduced by altering variables that affect growth, such as water depth or light levels		
a. Fabrics/ Bottom Barriers	Y	Prevents light from getting to lake bottom	Reduces turbidity in soft-substrate areas  Useful for small areas	Eliminates all plants, including native plants important for a healthy lake ecosystem  May inhibit spawning by some fish  Need maintenance or will become covered in sediment and ineffective  Gas accumulation under blankets can cause them to dislodge from the bottom  Affects benthic invertebrates  Anaerobic environment forms that can release excessive nutrients from sediment
b. Drawdown	Y, May require Environmental Assessment	Lake water lowered with siphon or water level control device; plants killed when sediment dries, compacts or freezes  Season or duration of drawdown can change effects	Winter drawdown can be effective at restoration, provided drying and freezing occur. Sediment compaction is possible over winter  Summer drawdown can restore large portions of shoreline and shallow areas as well as provide sediment compaction  Emergent plant species often rebound near shore providing fish and wildlife habitat, sediment stabilization, and increased water quality  Success demonstrated for reducing EWM, variable success for curly-leaf pondweed (CLP)  Restores natural water fluctuation important for all aquatic ecosystems	Plants with large seed bank or propagules that survive drawdown may become more abundant upon refilling  May impact attached wetlands and shallow wells near shore  Species growing in deep water (e.g. EWM) that survive may increase, particularly if desirable native species are reduced  Can affect fish, particularly in shallow lakes if oxygen levels drop or if water levels are not restored before spring spawning  Winter drawdown must start in early fall or will kill hibernating reptiles and amphibians  Navigation and use of lake is limited during drawdown

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c. Dredging	Y	<p>Plants are removed along with sediment</p> <p>Most effective when soft sediments overlay harder substrate</p> <p>For extremely impacted systems</p> <p>Extensive planning required</p>	<p>Increases water depth</p> <p>Removes nutrient rich sediments</p> <p>Removes soft bottom sediments that may have high oxygen demand</p>	<p>Severe impact on lake ecosystem</p> <p>Increases turbidity and releases nutrients</p> <p>Exposed sediments may be recolonized by invasive species</p> <p>Sediment testing may be necessary</p> <p>Removes benthic organisms</p> <p>Dredged materials must be disposed of</p>
d. Dyes	Y	<p>Colors water, reducing light and reducing plant and algal growth</p>	<p>Impairs plant growth without increasing turbidity</p> <p>Usually non-toxic, degrades naturally over a few weeks.</p>	<p>Appropriate for very small water bodies</p> <p>Should not be used in pond or lake with outflow</p> <p>Impairs aesthetics</p> <p>Effects to microscopic organisms unknown</p>
e. Non-point source nutrient control	N	<p>Runoff of nutrients from the watershed are reduced (e.g. by controlling construction erosion or reducing fertilizer use) thereby providing fewer nutrients available for plant growth</p>	<p>Attempts to correct source of problem, not treat symptoms</p> <p>Could improve water clarity and reduce occurrences of algal blooms</p> <p>Native plants may be able to better compete with invasive species in low-nutrient conditions</p>	<p>Results can take years to be evident due to internal recycling of already-present lake nutrients</p> <p>Requires landowner cooperation and regulation</p> <p>Improved water clarity may increase plant growth</p>

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<b>Chemical Control</b>	Required under NR 107	<p>Granules or liquid chemicals kill plants or cease plant growth; some chemicals used primarily for algae</p> <p>Results usually within 10 days of treatment, but repeat treatments usually needed</p> <p>Chemicals must be used in accordance with label guidelines and restrictions</p>	<p>Some flexibility for different situations</p> <p>Some can be selective if applied correctly</p> <p>Can be used for restoration activities</p>	<p>Possible toxicity to aquatic animals or humans, especially applicators</p> <p>Often affect desirable plant species that are important to lake ecology and compete with invasive species</p> <p>Treatment set-back requirements from potable water sources and/or drinking water use restrictions after application, usually based on concentration</p> <p>May cause severe drop in dissolved oxygen causing fish kill, depends on plant biomass killed, temperatures and lake size and shape</p> <p>Often controversial</p>
a. 2,4-D (e.g. Weedar, Navigate)	Y	<p>Systemic<sup>1</sup> herbicide selective to broadleaf<sup>2</sup> plants that inhibits cell division in new tissue</p> <p>Applied as liquid or granules during early growth phase</p>	<p>Moderately to highly effective, especially on EWM</p> <p>Monocots, such as pondweeds (e.g. CLP) and many other native species not affected.</p> <p>Can be used in synergy with endothall for early season CLP and EWM treatments</p> <p>Can be selective depending on concentration and seasonal timing</p> <p>Widely used aquatic herbicide</p>	<p>May cause oxygen depletion after plants die and decompose</p> <p>May affect native dicots such as water lilies and coontail</p> <p>Cannot be used in combination with copper herbicides (used for algae)</p> <p>Toxic to fish</p>

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b. Endothall (e.g. Aquathol)	Y	<p>Broad-spectrum<sup>3</sup>, contact<sup>4</sup> herbicide that inhibits protein synthesis</p> <p>Applied as liquid or granules</p>	<p>Especially effective on CLP and also effective on EWM</p> <p>May be effective in reducing reestablishment of CLP if reapplied several years in a row in early spring</p> <p>Can be selective depending on concentration and seasonal timing</p> <p>Can be combined with 2,4-D for early season CLP and EWM treatments, or with copper compounds</p> <p>Limited off-site drift</p>	<p>Affects many native pondweeds</p> <p>Not as effective in dense plant beds; heavy vegetation requires multiple treatments</p> <p>Not to be used in water supplies; post-treatment restriction on irrigation</p> <p>Toxic to aquatic fauna (to varying degrees)</p>
c. Diquat (e.g. Reward)	Y	<p>Broad-spectrum, contact herbicide that disrupts cellular functioning</p> <p>Applied as liquid, can be combined with copper treatment</p>	<p>Mostly used for water-milfoil and duckweed</p> <p>Rapid action</p> <p>Limited direct toxicity on fish and other animals</p>	<p>May affect non-target plants, especially native pondweeds, coontail, elodea, naiads</p> <p>Toxic to aquatic invertebrates</p> <p>Must be reapplied several years in a row</p> <p>Ineffective in muddy or cold water (&lt;50°F)</p>



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d. Fluridone (e.g. Sonar or Avast)	Y; special permit and Environmental Assessment may be required	<p>Broad-spectrum, systemic herbicide that inhibits photosynthesis</p> <p>Must be applied during early growth stage</p> <p>Available with a special permit only; chemical applications beyond 150 ft from shore not allowed under NR 107</p> <p>Applied at very low concentration at whole lake scale</p>	<p>Effective on EWM for 1 to 4 years with aggressive follow-up treatments</p> <p>Some reduction in non-target effects can be achieved by lowering dosage</p> <p>Slow decomposition of plants may limit decreases in dissolved oxygen</p> <p>Low toxicity to aquatic animals</p>	<p>Affects native milfoils, coontails, elodea, and naiads, even at low concentrations</p> <p>Requires long contact time: 60-90 days</p> <p>Often decreases water clarity, particularly in shallow eutrophic systems</p> <p>Demonstrated herbicide resistance in hydrilla subjected to repeat treatments</p> <p>Unknown effect of repeat whole-lake treatments on lake ecology</p>
e. Glyphosate (e.g. Rodeo)	Y	<p>Broad-spectrum, systemic herbicide that disrupts enzyme formation and function</p> <p>Usually used for purple loosestrife stems or cattails</p> <p>Applied as liquid spray or painted on loosestrife stems</p>	<p>Effective on floating and emergent plants</p> <p>Selective if carefully applied to individual plants</p> <p>Non-toxic to most aquatic animals at recommended dosages</p> <p>Effective control for 1-5 years</p>	<p>RoundUp is often illegally substituted for Rodeo; surfactants in RoundUp believed to be toxic to reptiles and amphibians</p> <p>Cannot be used near potable water intakes</p> <p>Ineffective in muddy water</p> <p>No control of submerged plants</p>

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Option	Permit Needed?	How it Works	PROS	CONS
f. Triclopyr (e.g. Renovate)	Y	Systemic herbicide selective to broadleaf plants that disrupts enzyme function  Applied as liquid spray or liquid	Effective on many emergent and floating plants  Most effective on dicots, such as purple loosestrife; may be more effective than glyphosate  Control of target plants occurs in 3-5 weeks  Low toxicity to aquatic animals  No recreational use restrictions following treatment	Impacts may occur to some native plants at higher doses (e.g. coontail)  May be toxic to sensitive invertebrates at higher concentrations  Retreatment opportunities may be limited due to maximum seasonal rate (2.5 ppm)  Sensitive to UV light; sunlight can break herbicide down prematurely  Relatively new management option for aquatic plants (since 2003)
g. Copper compounds (e.g. Cutrine Plus)	Y	Broad-spectrum, systemic herbicide that prevents photosynthesis  Used to control planktonic and filamentous algae  Wisconsin allows small-scale control only	Reduces algal growth and increases water clarity  No recreational or agricultural restrictions on water use following treatment  Herbicidal action on hydrilla, an invasive plant not yet present in Wisconsin	Elemental copper accumulates and persists in sediments  Short-term results  Long-term effects of repeat treatments to benthic organisms unknown  Toxic to invertebrates, trout and other fish, depending on the hardness of the water  Clear water may increase plant growth

<sup>1</sup>Systemic herbicide - Must be absorbed by the plant and moved to the site of action. Often slower-acting than contact herbicides.  
<sup>2</sup>Broadleaf herbicide - Affects only dicots, one of two groups of plants. Aquatic dicots include waterlilies, bladderworts, watermilfoils, and coontails.  
<sup>3</sup>Broad-spectrum herbicide - Affects both monocots and dicots.  
<sup>4</sup>Contact herbicide - Unable to move within the plant; kills only plant tissue it contacts directly.  
**This document is intended to be a guide to available aquatic plant control techniques, and is not necessarily an exhaustive list.**  
**References to registered products are for your convenience and not intended as an endorsement or criticism of that product versus other similar products.**  
**Specific effects of herbicide treatment contingent on usage within label guidelines and in accordance with all applicable laws.**  
**Please contact your local Aquatic Plant Management Specialist when considering a permit.**

# Aquatic Plant Control Techniques Not Allowed in Wisconsin



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Option	How it Works	PROS	CONS
<b>Biological Control</b>			
a. Carp	Plants eaten by stocked carp	<p>Effective at removing aquatic plants</p> <p>Involves species already present in Madison lakes</p>	<p>Illegal to transport or stock carp in Wisconsin</p> <p>Carp cause resuspension of sediments, increased water temperature, lower dissolved oxygen levels, and reduction of light penetration</p> <p>Widespread plant removal deteriorates habitat for other fish and aquatic organisms</p> <p>Complete alteration of fish assemblage possible</p> <p>Dislodging of plants such as EWM or CLP turions can lead to accelerated spreading of plants</p>
b. Crayfish	Plants eaten by stocked crayfish	Reduces macrophyte biomass	<p>Illegal to transport or stock crayfish in Wisconsin</p> <p>Control not selective and may decimate plant community</p> <p>Not successful in productive, soft-bottom lakes with many fish predators</p> <p>Complete alteration of fish assemblage possible</p>
<b>Mechanical Control</b>			
a. Cutting (no removal)	Plants are "mowed" with underwater cutter	<p>Creates open water areas rapidly</p> <p>Works in water up to 25 ft</p>	<p>Root system remains for regrowth</p> <p>Fragments of vegetation can re-root and spread infestation throughout the lake</p> <p>Nutrient release can cause increased algae and bacteria and be a nuisance to riparian property owners</p> <p>Not selective in species removed</p> <p>Small-scale control only</p>
b. Rototilling	<p>Sediment is tilled to uproot plant roots and stems</p> <p>Works in deep water (17 ft)</p>	<p>Decreases stem density, can affect entire plant</p> <p>Small-scale control</p> <p>May provide long-term control</p>	<p>Creates turbidity</p> <p>Not selective in species removed</p> <p>Fragments of vegetation can re-root</p> <p>Complete elimination of fish habitat</p> <p>Releases nutrients</p> <p>Increased likelihood of invasive species recolonization</p>
c. Hydroraking	<p>Mechanical rake removes plants from lake</p> <p>Works in deep water (14 ft)</p>	Creates open water areas rapidly	<p>Fragments of vegetation can re-root</p> <p>May impact lake fauna</p> <p>Creates turbidity</p> <p>Plants regrow quickly</p> <p>Requires plant disposal</p>