# Aquatic Weed Control

*Adapted from North Central Regional Extension Publication No. 241, Carole A. Lembi, Aquatic Weed Specialist, Purdue University and Aquatic Pest Control, University of California Leaflet 2961 and Aquatic Weed Management (SRAC Pub No 361 – 2013)*

Specific requirements for commercial applicators in the Aquatic Pest Control category relate to a **practical knowledge in four major areas**:

- ☑ Water use situations
- ☑ Weed management alternatives
- ☑ Weed identification
- ☑ Principles of limited area application.

**Effective management of aquatic pests requires an integrated approach that incorporates cultural, mechanical, biological, and chemical methods as appropriate**.

## Why is Aquatic Weed Control Necessary?

Aquatic plants are those that grow partly or wholly in water; they may be rooted in the mud or floating freely. Plants are natural and important components of the aquatic environment. Microscopic plants (algae) form the base of the aquatic food chain. Larger algae and plants provide habitat for fish and food organisms, and all plants produce oxygen as they photosynthesize during the daylight hours. However, excessive growths of these plants can have a detrimental effect on a body of water and its inhabitants. Many shallow, nutrient-rich ponds, lakes, and drainage ditches provide ideal conditions for abundant aquatic plant growth. Effective management of aquatic plants requires an integrated approach that incorporates cultural, mechanical, biological, and chemical methods as appropriate.

**Aquatic weeds:**

- **Interfere with or prohibit recreational activities such as swimming, fishing, and boating.**
- **Detract from the aesthetic appeal of a body of water.**
- **Stunt or interfere with a balanced fish population.**
- **Fish kills due to oxygen depletion from the water occur when plants die and decompose.**
- **Produce quiet water areas that are ideal for mosquito breeding.**
- **Certain algae can give water bad tastes and odors.**
- **Impede water flow in drainage ditches, irrigation canals, and culverts, causing water to back up.**
- **Deposition of weeds, sediment, and debris can cause bodies of water to fill in.**

# Water Use Situations

The demand for water resources for recreation, agriculture, and industry is increasing. Several species of aquatic plants are pests because they can interfere with water uses. When control is necessary, it must not harm people or the environment.

Habitats for aquatic weeds involve various proportions of water and soil, including intermittently wet ditches, ditches that always hold standing water, streams, stock ponds, farm ponds, lakes, ornamental ponds, and intermediate habitats. We will consider three types of water situations - static, limited flow impoundments, and moving water.

**Static Water** is totally confined or confined for much of the year within a known area. There is no downstream movement. However, even totally enclosed bodies of water often have appreciable water movement because of wind and changes in water temperature. Plants commonly grow in static water up to 12 feet deep and may grow in very clear water that is more than 20 feet deep. If a herbicide is applied, there is no reason to expect any appreciable downstream movement unless there is overflow from unusual conditions.

*John C. French Sr., Retired, Universities:Auburn, GA, Clemson and U of MO, Bugwood.org*

**Limited-flow Water Impoundments** Ditches may be intermittently wet or dry, depending upon climatic conditions. Their purpose is to drain the surrounding land area so considerable amounts of water must pass through. Herbicides applied to these habitats may move downstream following an influx of water from surrounding areas.

Many farm ponds may have limited flow because there nearly always is an overflow pipe and an emergency overflow channel (spillway). An overflow pipe permits passage of a continuous and relatively well-defined amount of water at all times. An emergency spillway provides a release when storms dump excess amounts of water into a pond in a short time. Overflow or release water can carry small amounts of aquatic herbicides downstream from the application site. Sudden rainstorms that interrupt or come immediately after a pesticide application can move larger amounts downstream.

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*Gerald Holmes, California Polytechnic State University at San Luis Obispo, Bugwood.org*

**Moving Water** occurs in streams, creeks, streams, and rivers where there is always some detectable downstream current. Varying amounts of pesticides may move downstream from application sites. These situations **present the greatest potential as environmental hazards.**

# Aquatic Weed Control - Identification

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## Aquatic Weed Identification

Identification is the first and most important step in managing aquatic weeds. Most control methods target specific weeds or groups of weeds with similar growth habits. **Aquatic weeds are divided into two botanical groups; algae and flowering plants.** Algae are usually structurally very simple with no apparent roots, leaves, or stems. However, some (for example, *Chara*) can resemble flowering plants. Flowering plants have roots, shoots, shoots, and stems. **You must be able to distinguish between algae and flowering plants to make effective chemical control decisions.**

## Algae

Most species of algae live in the water, where they form the base of the aquatic food chain. They shade the bottom of the pond and limit the depth at which other aquatic plants can grow. **"Blooms" occur when there is a rapid increase in algae.** This usually results from a combination of factors including excess available nutrients, warm temperatures, sunlight, and limited water flow. Blooms should be treated before the water undergoes a noticeable color change. However, a sudden die-off of these algae can deplete oxygen in the water and cause a fish kill.

**<u>Filamentous algae (or moss)</u>** form floating, mat-like growths that usually begin around the edges and bottom of ponds in the early spring. Moss is common in lakes and ponds in the Midwest. Repeated chemical treatments may be needed during the summer for effective control.

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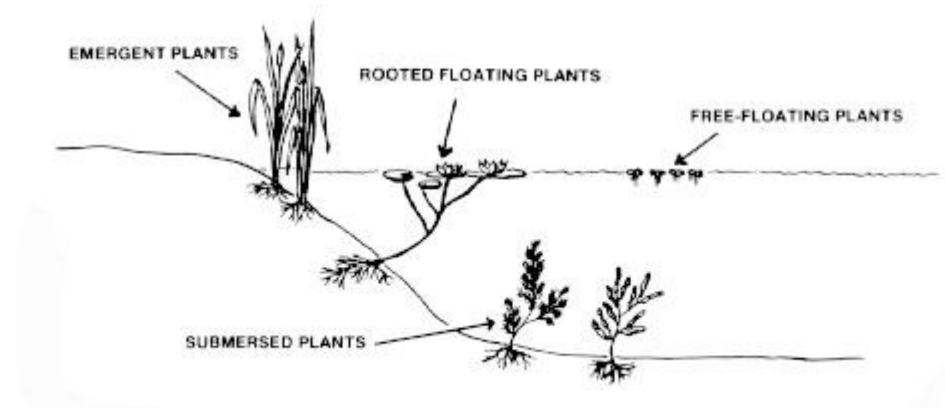
*Jim Rathert, courtesy of Missouri Dept. of Conservation*

***<u>Chara</u>*** **<u>, or stonewort</u>** usually grows in very hard water and is often calcified and brittle. The plant is rooted, and leaves are arranged along the stem in whorls. It grows completely underwater and has a musky smell. Once established, *Chara*, with its heavy coating of calcium carbonate, can be difficult to control. Although this plant resembles some flowering plants, it is an alga.

# Flowering Plants

Flowering plants can be grouped into broad categories according to where they are found in a body of water.




## Emergent Plants

**<u>Emergent (shore or marginal) plants</u>** commonly include cattails, bulrushes, spike rushes, reed canarygrass, and other grass-like perennial plants. Broadleaves include willow trees and creeping water primrose.

*Cattails*
*Ohio State Weed Lab, The Ohio State University, Bugwood.org*

*Reed canarygrass*
*John M. Randall, The Nature Conservancy, Bugwood.org*

*Spike rush*
*Max Lichner, USDA Forest Service*

*Willow*
*Paul Wray, Iowa State University, Bugwood.org*

*Creeping water primrose*
*John Hilty, Illinois Wildflowers*

## Floating Weeds

## Rooted Floating Plants

Rooted floating plants include **water lily, spatterdock, and water lotus**. Spatterdock is very competitive and can completely fill in shallow areas less than 3 to 4 feet deep. New spatterdock plants sprout from massive underground rhizomes. It differs from waterlily in having heart-shaped leaves that come above the surface of the water and a yellow flower. Waterlily has round leaves.

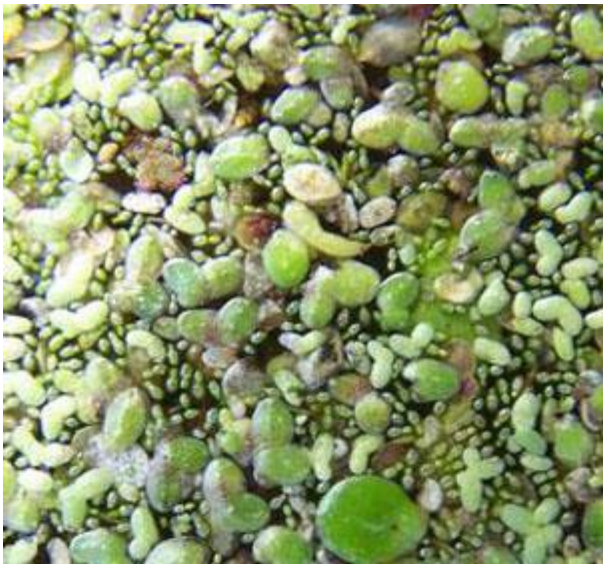
*Spatterdock*
*Rebekah D. Wallace, University of Georgia, Bugwood.org*

*Water lily*
*Becca MacDonald, Sault College, Bugwood.org*

*Water lotus*
*Kelle Sullivan, Florida Fish and Wildlife Conservation Commission, Bugwood.org*

## Free-Floating Plants

Free-floating plants, such as duckweed and watermeal are **extremely small seed-bearing plants that float free on the water's surface.** They **never become rooted** in the soil, and reproduce by sexual and asexual means. They can completely cover the surface of a pond. Both plants are found in nutrient-rich waters so inflow of wastewater from livestock feedlots, septic fields, etc. should be eliminated.



*Duckweed*
*Karan A. Rawlins, University of Georgia, Bugwood.org*

*Watermeal*
*Graves Lovell, Alabama Department of Conservation and Natural Resources, Bugwood.org*

## Submersed Plants

Submersed plants are **rooted in the bottom sediments and grow up through the water**. Flowers or flowering spikes sometimes emerge above the water surface. The main criteria for identification are leaf arrangement and leaf shape.

***Common Underwater Weeds***

*Chris Evans, University of Illinois, Bugwood.org*

The leaves of **Curly-leaf pondweed** are somewhat stiff and crinkled, approximately 1/2-inch wide and 2- to 3-inches long. Small teeth are visible along the edges of the leaves, which are arranged alternately around the stem. Leaves become more dense toward the end of branches. The plant appears reddish-brown in the water but is actually green when pulled out and examined closely. Curly-leaf pondweed grows best in the spring and tends to die in the summer. It is common in ponds, lakes, and ditches.

*John Hilty, Illinois Wildflowers*

**Leafy pondweed** has very narrow leaves with an alternate arrangement. It is more common in ponds than in large lakes

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*Graves Lovell, Alabama Department of Conservation and Natural Resources, Bugwood.org*

**Waterthread pondweed** is a perennial plant usually restricted to shallow water. Its relatively small (1-inch long) floating and submerged leaves with distinctive veins distinguishes it from most other pond weeds.

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*Graves Lovell, Alabama Department of Conservation and Natural Resources, Bugwood.org*

**<u>Coontail</u>** (also called **hornwort**) is a submerged, free-floating aquatic plant that has branched, spined leaves arranged in a whorl like a bottlebrush. This plant lives mostly in still or slow-moving water and is usually found in areas with moderate to high nutrient levels. Coontail floats in dense masses just beneath the water's surface and can also grow near the bottom in channels and other deep areas.

*John Hilty, Illinois Wildflowers*

**Brittle naiad** is a submersed annual aquatic plant that spreads by seeds and plant fragments. Its oppositely arranged leaves are 1 to 2 inches long and are toothed, stiff, and pointed. Brittle naiad resembles coontail but its leaves are in pairs while coontail leaves are in whorls of 4 or 5. It can form dense mats that outcompete native species and can interfere with recreational activities.

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*Alison Fox, University of Florida, Bugwood.org*

**Eurasian watermilfoil** is a feathery, submersed aquatic plant that has become a major aquatic invader across much of North America. Plants are rooted at the bottom of still or slow-moving water (3 to 12 feet deep). They grow rapidly creating dense mats. This serious, rapidly spreading invader is found in lakes and ponds throughout the Midwest.

# Aquatic Weed Control – Weed Management

*Adapted from North Central Regional Extension Publication No. 241, Carole A. Lembi, Aquatic Weed Specialist, Purdue University and Aquatic Pest Control, University of California Leaflet 2961*

## Managing Aquatic Weeds

### Preventative Control

Proper site selection, design, and construction of ponds are important factors in preventive control of aquatic weeds. Shallow water at the margins provides an ideal habitat for emergent plants. **Banks should be sloped steeply so that very little water is less than 2 to 3 feet deep.**

Proper design and construction of ditches and channels makes weed control easier in the future. **If the banks are leveled and smoothed, hard-to-reach places will be eliminated.**Lining canals will help to alleviate water weed problems, too.

### Mechanical Control

Mechanical control may be needed to manage severe waterweed infestations. Aquatic herbicides may not be an option if the water is used for livestock, drinking, or fish. Hand-pulling weeds or dredging the pond may be used, if practical.

**Motor-driven underwater weed cutters** are available and can be used for the control of such plants as water-lilies and watermilfoil. Some mowers simply cut the weeds loose beneath the water surface. **Aquatic weed harvesters** collect weeds for removal.

**Disposal of harvested weeds can be a problem.** Most mechanical control methods fragment weeds. Many weed species can spread and reproduce from these pieces. Mechanical control is usually slower and more expensive than the use of herbicides. Underwater weed cutting must be done continuously during the summer and usually represents a long-term financial investment.

Other types of habitat manipulation include **riprapping shorelines and anchoring screens (e.g., Aquascreen®) or black plastic sheets in the bottom sediments to prevent establishment of rooted plants.**

*Aquashade® (photo: tricountyfs.com)*

Dyes such as Aquashade® **inhibit light penetration.** They can be applied along the shoreline and will mix throughout the body of water within about 24 hours. The dye intercepts light normally used for photosynthesis by underwater plants. A minimum effective concentration must be maintained for effective control.

## Cultural Control and Habitat Alteration

Cultural control and habitat alteration can be effective in controlling aquatic weeds. The **drawdown technique**, lowering the water over the winter, can be very effective. Exposure of the sediments in the shallow areas of a lake or pond to alternate freezing and thawing action will kill the underground rhizomes of many aquatic weeds (the majority of aquatic weeds are perennial and come from rhizomes).

*Photo: J. Lennon*

Drawdown has been quite successful against Eurasian watermilfoil and waterlilies, but the degree of control depends somewhat upon the severity of the winter. There are several advantages to a winter drawdown in addition to weed control. As the sediment dries, it is compacted, thereby increasing the depth of shallow areas.

Many aquatic plants or their seeds are carried into a pond by wind, birds, stocking fish, people, etc. These plants infest a pond only if the water conditions are just right. Their success usually means that nutrients are entering the pond from runoff or stream inflow.

How to help **prevent serious weed infestations**:

- **Do not fertilize ponds.** Most waters in Kentucky are sufficiently rich in plankton and other food organisms.

**Maintain a good sod and grass cover** around your pond. This will help prevent runoff and erosion. Do not fertilize the turf directly around the pond.

Livestock will increase turbidity and fertility and tear down the banks. Limit their access to ponds only to avoid of extreme heat stress. Otherwise, **fence the pond and water animals outside the fence.**

**Check septic tanks for possible leakage** or seepage into the pond. Locate new septic drainage fields so that the nutrient-rich effluent will not reach your pond.

**Do not permit runoff from chicken coops, feedlots, etc.,** to enter your pond. If this kind of runoff is occurring upstream from your pond, you should check with your county Board of Health to see if anything can be done about it.

All of these measures will help prevent weed growth, particularly in new ponds. In older ponds these measures may only aid in reducing infestations of floating plants such as algae and duckweed.

Aeration has been publicized as another method of weed control. Although it is definitely beneficial for fish life and can help prevent fish kills, there is **no evidence that aeration inhibits weed growth**.

## Biological Controls

Biological control is the **reduction or removal of a plant using grass carp or other species.** It became legal to release the sterile triploid form of the grass carp or white amur (*Ctenopharyngodon idella*) in Kentucky in 1986. This fish feeds on aquatic vegetation with little effect on other fish in the pond and cannot reproduce. **The non-triploid form is illegal to use in Kentucky.**

**Grass Carp** *Ctenopharyngodon idella*
adult

*Grass carp (photo: finfarm.com)*

Larger grass carp are less effective at plant control so periodic re-stocking is necessary. These fish can escape ponds through overflows so preventive barriers are needed. They prefer some aquatic plant species but may not effectively control others. Over-stocking may require removal of extra carp after the vegetation is controlled.

The grass carp is the only one of five carp species found in Kentucky that eats aquatic vegetation. **When stocking your pond be sure to use grass carp; the other species will not work and can harm other fish in the pond.** More information on grass carp is available at http://fw.ky.gov/Fish/Pages/Farm-Pond_Management-Biological-Treatment.aspx.

## Chemical Controls

Herbicides can be used to control aquatic weeds. Those used primarily to control algae may be called algicides, even though they also kill other aquatic plants. Used properly, aquatic herbicides can control vegetation without harming fish or other aquatic life.

*Photo: mainelakes.org*

**Aquatic herbicides must be labeled for that use by the Environmental Protection Agency and registered with the Kentucky Department of Agriculture.** They vary in their weed control spectrum, specific application sites, and application methods. After a weed has been correctly identified, read the labels carefully before buying and using any product. Most have restrictions that may prevent their use on particular bodies of water. Also, be sure to include secondary water uses (i.e., swimming, livestock watering and irrigation) when selecting products.

*Ideal water temperature (photo: lochnesswatergardens.com)*

Most aquatic weeds begin growing in early spring when water temperatures reach 55°F to 60°F. **The spring months (March, April, May), when water temperatures are between 70° and 80°F, are an ideal time to apply herbicides to control aquatic weeds.** At this time weeds are small and easier to control than during the summer; in addition, dissolved oxygen levels in the water are usually higher.

Aquatic herbicides are not toxic to fish when applied according to label directions. **Failure to follow label directions can result in fish kills.** Plants killed by the herbicides often decompose rapidly. This process consumes dissolved oxygen, reducing the amount available to fish. Fish kills can occur if the dissolved oxygen concentration drops too low. Observe treated water for 1 week, have emergency aeration equipment available in case oxygen depletion problems occur.

**Treating the pond with herbicides during the hot summer months is risky** because dissolved oxygen concentrations tend to be low and weed biomass tends to be high. Treat only 1/4 to 1/3 of the total surface acreage of a pond at one time to minimize the risk of herbicide-induced dissolved oxygen depletions. However, even partial pond treatments can be risky during the summer in ponds that routinely have low dissolved oxygen levels. In addition, some herbicides are not labeled for partial pond treatments.

Multiple application of products with the same mode of action can result in herbicide-resistant plants. **Rotate among herbicides with different modes of action and use cultural and biological control when possible.**

## Herbicide Formulations

Aquatic herbicides generally are available in sprayable or granular formulations.

## Sprayable Formulations

**Sprayable formulations must be mixed with water and applied so that they disperse evenly**. Examples include:

- AS - aqueous solution – liquid formulation with water as solvent
- SP - soluble powders dissolve and form true solutions in water.
- WP - wettable powders
- DF – dry flowable
- WDG – water dispersible granule
- EC - emulsifiable concentrates form milky white "oil-in-water" emulsions

# Granular Formulations

• G - granular formulations are small clay-based pellets that carry the active ingredient on or in the product. They are usually distributed by some sort of slinger-spreader and sink to the bottom. Slow-release granules or pellets release the pesticide active ingredient over an extended period of time.

**Granules are used primarily to control algae or submersed weeds.** They sink to the bottom and work about the same manner as bottom soil treatments. Application rates for granules are given as amount per unit of surface area or as a concentration in ppm. They must be broadcast evenly over the water surface for best results.

**Advantages to granular formulations** include

- treatment is confined to the bottom are where submersed weeds are
- slow-release formulations can provide extended control
- low concentrations of herbicides can be used
- toxicity to fish may be reduced

# Application

A mechanical sprayer or spreader and boat are needed to adequately treat large areas. Sprayable herbicide formulations can be applied with hand-held or mechanical pressurized sprayers or with a boat bailer. Injecting the chemical near the outboard motor propwash will help to disperse it. Submersed plant treatments from boats often require the use of weighted trailing hoses to distribute the herbicide directly on the target plants.

Hand-operated or mechanical rotary spreaders can be used to apply granular or pelleted formulations. Soluble crystals should be dissolved in water and sprayed over the pond. While not ideal, the required amount can be placed in burlap bags and dragged behind a boat or suspended in the water near an aerator until the herbicide dissolves.

Adding a registered aquatic adjuvant (usually a surfactant) to some foliar applied herbicides (e.g., diquat, glyphosate) will help them wet and penetrate the foliage. Use a registered aquatic adjuvant that is recommended by the manufacturer according to the label directions. Using adjuvants to treat submersed weeds is usually not recommended.

# What You Need to Know Before Using a Chemical

**The most important considerations before buying and applying a herbicide for aquatic weed control are:**

**Identify the weed correctly. The types of weeds controlled can vary greatly among herbicides. Selecting the wrong produce can result in a control failure. Identification help can be obtained from your county Extension Service.**

**Restrictions on water use. Although most aquatic herbicides break down readily and rapidly in water and pose no threat to human or animal health, there are waiting periods on the use of water treated with most herbicides. These restrictions--usually on fishing, swimming, domestic use, livestock watering or irrigation--dictate which herbicides will be appropriate for your pond or lake. Always check the herbicide label for restrictions.**

**Dosage. Most aquatic herbicide labels give dosages on the basis of acre-feet (volume measurement). Acre-feet is calculated by multiplying the surface area by the average depth. For example, a pond with a surface acreage of l/2 acre and an average depth of 4 feet contains (4 feet x 1/2 acre) = 2 acre-feet. Check the herbicide label for the amount to apply per acre-foot.**

**Timing. Late spring is usually the best time to apply aquatic herbicides because the plants are young actively growing. That is when they are most susceptible to herbicides. Do not wait until late summer to treat. By then the vegetation is usually extensive and thick and the water is is warm and still. Killing all vegetation at once under these conditions could seriously deplete the water of its oxygen and cause a fish kill. If you must treat this late in the summer, treat only a portion of the weed growth at a time.**

**Temperature. Aquatic weeds are not affected by herbicides when the water is too cold. The water temperature should be in the 60's °F., preferably the upper 60's (in the area to be treated). Plants are usually actively growing from late April to early June.**

**Retreatment. More than one treatment may be required for adequate control. Retreatment is usually required in succeeding years. Plants can regenerate each spring from seeds, spores, and underground rhizomes. These structures generally are not affected by aquatic herbicides. Also, new plants can sprout from seeds.**

# Dosage Calculations

Aquatic herbicides must be applied at labeled rates which were developed to provide effective, yet safe, weed control. Applying an excessive rate of a herbicide does not provide better weed control but does increase the cost and may harm the environment. Applying less than the recommended rate usually results in poor weed control. Some herbicide treatments, such as those for controlling emergent plants, are applied on the basis of the surface area to be treated. Others, such as those to control certain submersed weeds, are based on the volume of water to be treated. **Read the label instructions carefully because mistakes in calculating treatment rates can be costly and dangerous.**

## Surface Area Treatment (in acres)

Calculate the amount of herbicide needed for a surface acre treatment using the following formula:

$$F = A \times R$$

*where:*

- F = Amount of formulated herbicide product
- A = Area of the water surface in acres - The surface area of a rectangular body of water equals length in feet times width divided by 43,560 (the number of square feet in an acre).
- R = Recommended rate of product per surface acre

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**Example:**

How much product is needed (F) to treat a 500 ft x 100 foot pond (A) at the rate of 3.4 fluid ounces per acre (R).

(500 ft x 100 ft) = 50,000 sq ft/43,560 sq ft/acre = 1.15 acres

1.15 acres x 3.4 fl oz/acre = 3.9 fl oz of product

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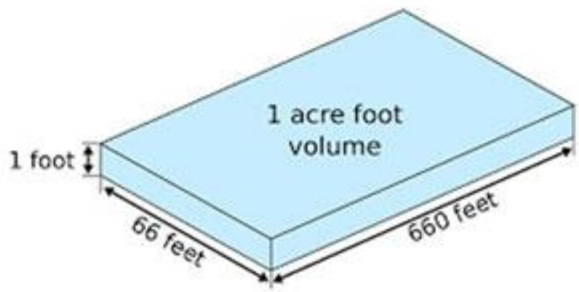
# Acre-foot Treatment




Many aquatic herbicides list their application rates in terms of the amount of product to use per acre-foot of water. An **acre-foot of water is defined as 1 surface acre of water that is 1 foot deep**. The number of acre-feet of water can be found by multiplying the number of surface acres times the average water depth.

The amount of herbicide needed for an acre-foot treatment is determined by the following formula:

$$\mathbf{F = A \times D \times R}$$

*where:*

- F = Amount of formulated herbicide product
- A = Area of the water surface in acres
- D = Average depth of the water in feet
- R = Recommended rate of product per acrefoot

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**Example:**

How much product is needed (F) to treat a 500 ft x 100 foot pond (A) that is 3 feet deep at the rate of 6 fluid ounces per acrefoot (R).

(500 ft x 100 ft) = 50,000 sq ft/43,560 sq ft/acre = 1.15 acres x 4 ft deep = 4.6 acrefeet.

4.6 acrefeet x 6 fl. oz. / acre foot = 27.6 fl oz of product

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## Parts Per Million (or Billion) Weight Treatment

The treatment rate of some aquatic herbicides may be listed as the final concentration of the chemical in the water on a parts per million weight (ppmw) basis.

Determine the amount of herbicide needed for a ppmw treatment by the following formula:

**F = (A × D × CF × ECC) ÷ I**

*where:*

- F = Amount of formulated herbicide product
- A = Area of the water surface in acres
- D = Average depth of the water in feet
- CF = 2.72 pounds per acre-foot (*This is the conversion factor when total water volume is expressed on an acre-foot basis. 2.72 pounds of a herbicide per acre-foot of water is equal to 1 ppmw.*)
- ECC = Effective chemical concentration of the active ingredient of herbicide needed in water to control the weed
- I = Total amount of active ingredient divided by the total amount of active and inert ingredients For liquid products, I = pounds of active ingredient per gallon. For dry products, I = percent active ingredient ÷ 100%.

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**Example:**

How much of an 80% WP herbicide formulation is needed (F) to treat a 500 ft x 100 foot pond (A) that is 3 feet deep at the rate of 2 ppm (R).

(500 ft x 100 ft) = 50,000 sq ft/43,560 sq ft/acre = 1.15 acres x 3 ft deep = 3.45 acrefeet

3.45 acrefeet x 2.72 pounds/acrefoot = 9.38 pounds

9.38 pounds x 2 (ppm) = 18.76 pounds/0.8 (80% WP) = 23.5 lbs

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## Total Water Volume

The whole body of water from the surface to the bottom is treated OR only 1/4 to 1/3 of the water volume (based on surface area) at a time. Calculate the volume of the body of water and add chemical to obtain the required dilution.

The concentration of chemical needed to control aquatic plants is often stated in parts per million (ppm) or parts per billon (ppb). For example, if the toxic concentration for a particular plant is 2 ppm, then the chemical should be applied at the ratio of 2 parts of active ingredient to one million parts of water (2:1,000,000) in the area to be treated.

Calculate the acre-feet of the body of water to be treated. Multiply the surface acres by the average depth in feet.

An acre-foot of water weighs 2.7 million pounds (2,700,000). Multiply 2.7 x the ppm concentration wanted x acre-feet = pounds of active ingredient needed.

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**Example:**

Calculate the number of pounds of active ingredient needed to treat a body of water containing 10 acre-feet at the rate of 0.5 ppm.

2.7 * 0.5 * 10 = 13.5 pounds of active ingredient

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## Application

**Bottom soil surface**

Herbicide applications may be made to the bottom soil of a drained pond, lake, or channel.

**Floating and immersed weeds**

can be killed with direct sprays on the foliage applied from a boat or the shore.

**Submersed weeds and algae**

can be treated using sprays or granular formulations. Sprays are applied as water surface treatments, particularly in shallow water. The herbicide is then dispersed by diffusion, thermal currents, and wave action. Good control depends upon good dispersion of the chemical.

## Weed Control in Large Impoundments

**Herbicides that work well in small bodies of water may perform poorly in large impoundments** because of much greater water movement by thermal currents and wave action. In these cases, weed control may be improved by

- using maximum recommended rates
- treating relatively large areas at one time
- apply when winds are at a minimum
- use bottom treatments in deep water
- select herbicides that are absorbed quickly by the plants

## Weed Control in Limited-Flow Waterways

Flood drainage canals, sloughs, and drains are good examples of limited-flow waterways. **Weed control methods in these systems are very similar to those for static water**. Evaluate the possibility of contamination when planning herbicide use. In some areas, drainage water may flow onto crop land or into drinking water supplies.

# Secondary and Environmental Effects of Aquatic Pesticide Applications

**Incorrect applications of herbicides in water may pose serious hazards to humans, wildlife, fish, and desirable plant life.** Select the correct herbicide and apply it at the proper rate. Follow all restrictions on the label. Water has many uses and herbicides will not always remain where they are applied.

**Improper applications can kill fish directly or deplete the oxygen concentration excessively if the plants die too quickly.** Decomposition of dead fish can contaminate downstream water supplies. Water may be unsuitable for humans, animals, or irrigation.

## In Static Water - Ponds, Lakes, Reservoirs

Weed control may be unsatisfactory if application rates are too low in static water. **Excessive application rates may kill fish, prevent use by livestock, or prohibit use for irrigation for an indefinite period.** However, there should be little downstream effect because little or no outflow normally occurs.

## In Limited-flow Water

Improper application rates could result in **contamination of downstream wate**r used by municipalities or communities for domestic water supplies. The hazardous condition would exist whether limited-flow water sources were treated with an application rate too low to accomplish a desired kill of vegetation or if the rate were excessive. Use of excessive rates might result in a **fish kill** that could affect downstream water supplies through bacteria from decay and decomposition of dead fish.

## In Moving Water

Application of pesticides to moving waters **may lead to at least temporary contamination of downstream domestic water supplies**. In addition, **non-target aquatic organisms may be affected.**

## Limited Area Application

Aquatic weeds may occur in the whole body of water as submersed weeds, or may appear to cover the whole surface of the water as floating weeds. Conversely, the same weeds or other pests may occur only in limited areas within a body of water, whether it is a static, limited-flow, or moving body of water. "Limited area application" implies the advantage o**f improved safety to aquatic species, specifically fish.** If pesticides that are potentially toxic to the fish population are applied to a limited area, the fish population can move to untreated water areas to escape potential toxic effects. Also, a minimal amount of pesticide is applied. This tends to **reduce the potential effect upon downstream environments in the event of spillover** from the treated body of water.

## Faulty Application

There are **two major hazards involved in faulty application of pesticides:**

**(1) damage to non-target organisms**

**(2) unsatisfactory control.**

For example, a granular formulation of an aquatic herbicide might work well in static water or limited-flow situations but it would be useless in fast moving water, All currently registered herbicides employed for aquatic weed control are rated as slightly toxic, or non-toxic to fish, birds, insects, and other aquatic organisms as long as proper application rates and techniques are employed. **Pesticide labels should be carefully observed to ensure that the aquatic environment is not contaminated during pest control efforts.**

## Precautions

Unforeseen or unexpected conditions or circumstances may lead to less than satisfactory results even when best management practices are used. **The applicator is always responsible for the effects of herbicide residues on livestock and crops, as well as problems that could arise from the drift or movement of herbicide from his/her property to that of others.** Always read and follow carefully the instructions on the label.

Due to a federal court ruling, all applications of herbicides into or over waters of the U.S. fall under the Environmental Protection Agency (EPA) National Pollution Discharge Elimination System (NPDES) as of 2011. The regulation reads, "**You are required to obtain a permit if you discharge biological pesticide or chemical pesticide that leaves a residue in water when such applications are made into, over, or near waters of the United States.**"

Contact the Kentucky Energy and Environment Cabinet, Department for Environmental Protection, Division of Water, Surface Water Permits Branch for more information.